8.5 ENVIRONMENTAL MONITORING

8.5.1 Monitoring program

(1) Monitoring parameters for water quality and gas composition

Water quality parameters and gas composition parameters, as well as their analytical method are same as those of Ampang Jajar and shown in **Table 5.2.1** in the **Section 5.2** previously.

(2) Sampling Quantity, Schedule and Locations

The following **Table 8.5.1** summarizes the sampling quantity of monitoring for Ampang Jaya pilot project site.

Table 8.5.1 Sample Number at Ampang Jaya Pilot Project Site

Sample type	Ampang Jaya (Number of locations)
Surface water	2
Leachate	2
Groundwater	2
Gas	2

Sampling schedule and specific consideration is same as that applied for Ampang Jajar site. **Figure 8.5.1** shows the location of monitoring for each sample type.

(3) Geological setting and Installation of monitoring well

The site is undulating hills with the elevation of approximately RL+90m to RL+190m. In general, the north-eastern part of the site is higher and it is sloping towards the western part of the site.

<Geological Background>

Figure 8.5.2 shows a geological map of the site and its surrounding areas. It is reproduced from a geological map published by Geological Survey Department of Malaysia. As shown in the figure, the site is located in the granitic area. Due to tropical climate, weathering generally extends to great depth into the granite body and the top portions are usually weathered into residual soils. The residual soil is composed of silt, clay and sometimes sand, depending on the degree of weathering and composition of parent rocks.

<Soil Stratification>

Based on the results of the exploratory drilling, a soil profile is prepared. The orientation of the soil profile is indicated in **Figure 8.5.3** whereas the profiles are shown in **Figure 8.5.4**. As can be seen in the soil profile, the subsurface ground conditions at the site can be divided into the following 4 major geological units:

a) Miscellaneous Fill
b) Colluvial Deposits
c) Residual Soils of Granite
d) Granite Bedrock

<Miscellaneous Fill>

The miscellaneous fill covers the entire area of the landfill site with the thickness varying from 5.75m in AM-W2 to more than 14.60m in AM-G1. The fill comprises of greyish brown mottled yellowish to yellowish brown sand with presence of decayed woods, construction debris, household materials and fine gravel. Yellowish brown to light grey spotted black, weak to strong boulders were also encountered in the fill layer in AM-W1with confirmed thickness ranges from 0.2m to 1.4m.

<Colluvial Deposits>

Colluvial is debris produced by slope failure on slope erosion. It is considered that the colluvial distribution is random and the variation of its component can be very large. The colluvial deposits is found underlying the fill at AM-W1 and AM-W2. The colluvial deposits are underlain by the residual soils of Granite. The thickness of colluvial deposits varies from 1.05m in AM-W2 to 1.10m in AM-W1 and it comprises of light grey to dark grey, sandy clay and sand with presence of decayed woods and some fine gravel.

<Residual Soils of Granite >

The residual soil of Granite is considered to be distributed at the entire site. The drilling at AM-G1 was terminated before reaching the original ground and thus the residual soil were not confirmed.

The residual soils mainly consist of light grey to yellowish brown mottled white silty sand and sandy silt with some fine to medium grained sand, fine quartz gravels and completely destroyed feldspar.

The residual soil is divided into 4 zones in terms of SPT N-values as follows:

a) Residual Soil I, RS I (N=0 to 30)
b) Residual Soil II, RS II (N= 30 to 50)
c) Residual Soil III, RS III (N>50)

In general, the RS I is underlain by RS II while RS II overlies RS III.

The thickness of the RS I varies from 2.8m in AM-W1 to 4.7m in AM-W2. RS II was encountered only at AM-W1 with the thickness of 1m. The thickness of the RS III is 2.70m in AM-W2. In AM-W1, the thickness of RS III was not confirmed as the drilling was terminated in this zone.

<Granite Bedrock>

The granite bedrock was encountered at AM-W2 at the depth of 13.70m below ground level. The granite bedrock is yellowish brown to light grey, weak to strong and moderately to slightly weathered. The thickness of granite bedrock was not confirmed as the drilling was terminated in this zone.

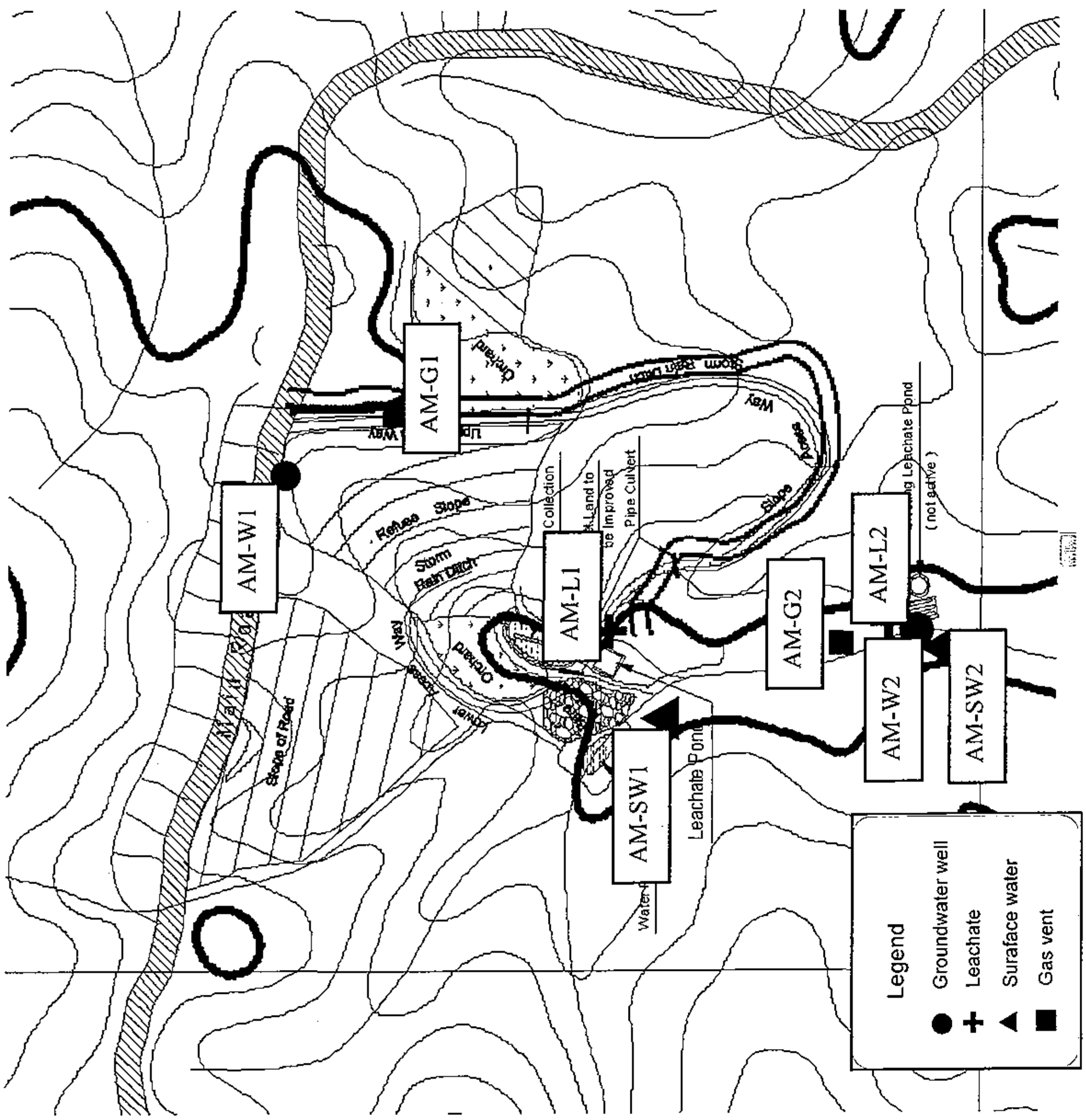
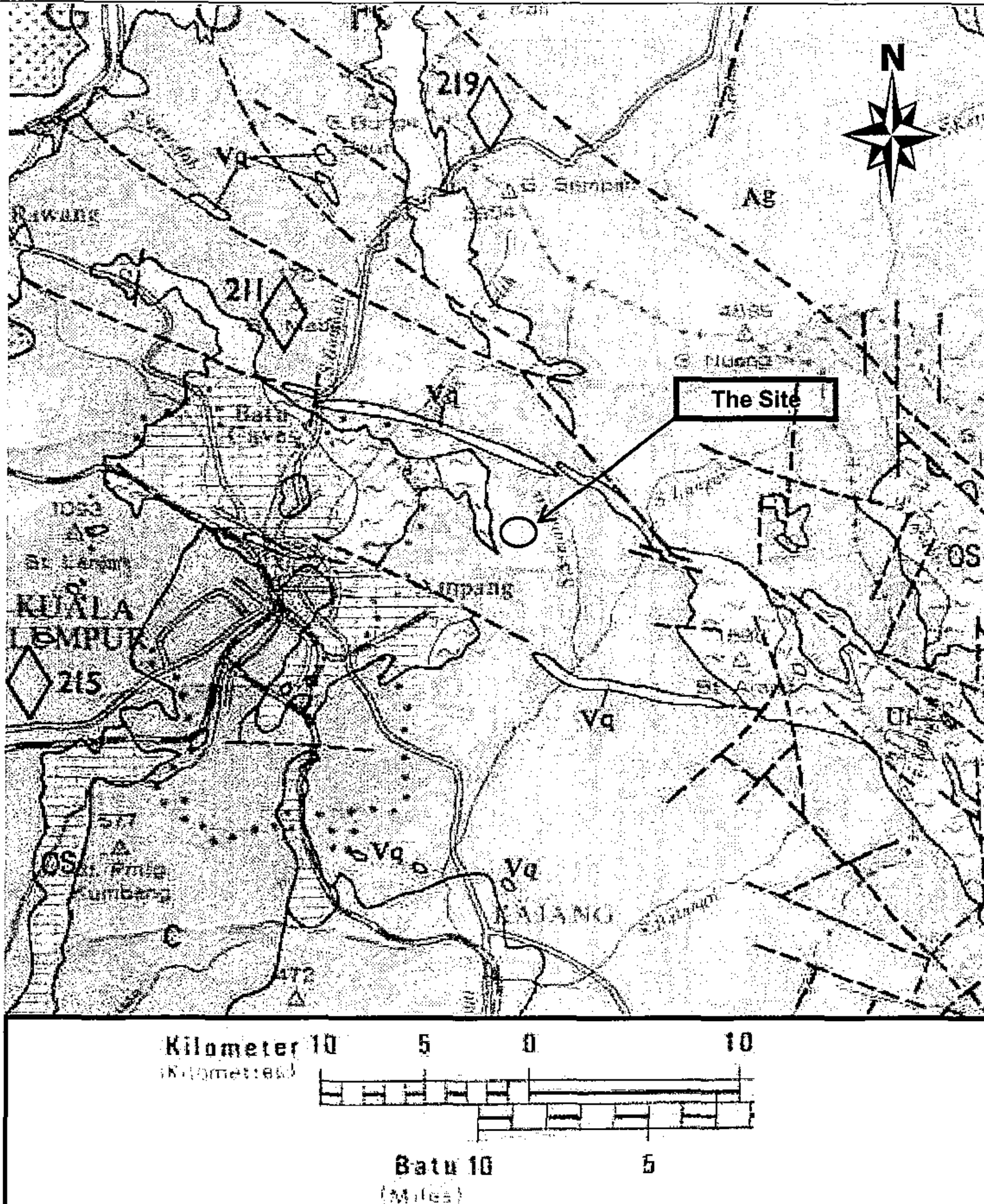


Figure 8.5.1 Map of Sampling Location for Monitoring, Ampang Jaya



C	Carboniferous	Phylite, shale, slate and sandstone; argillaceous rocks are commonly carbonaceous
	Silurian - Ordovician	Phylite, schist and slate
D	Devonian	Phylite, schist and slate; limestone and sandstone locally prominent.
		Acid intrusives (Granite)

Figure 8.5.2 Map of Geological Setting, Ampang Jaya (reproduced from geological map published by Geological Survey Malaysia, 1985)

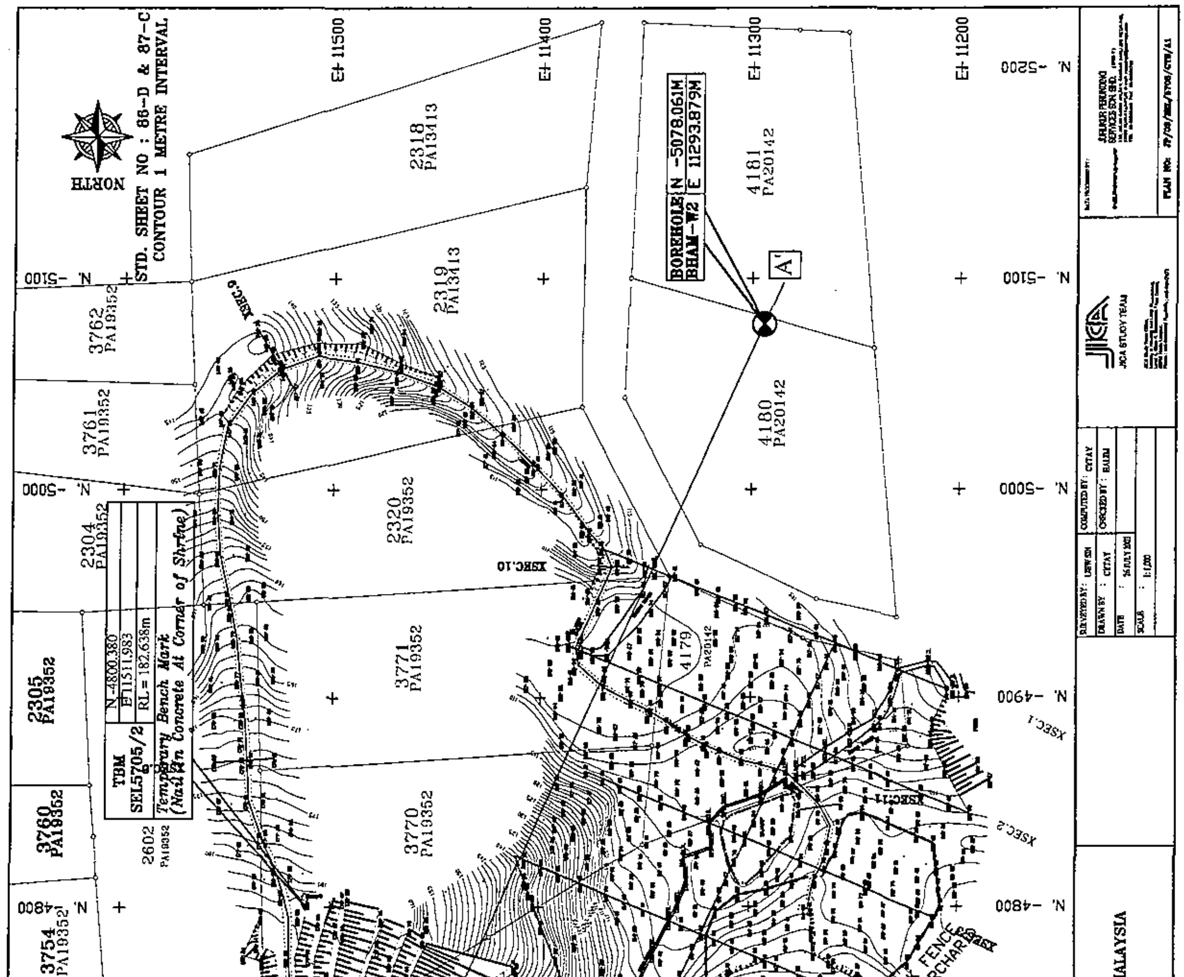


Figure 8.5.3 Map of Cross Section Line, Ampang Jaya

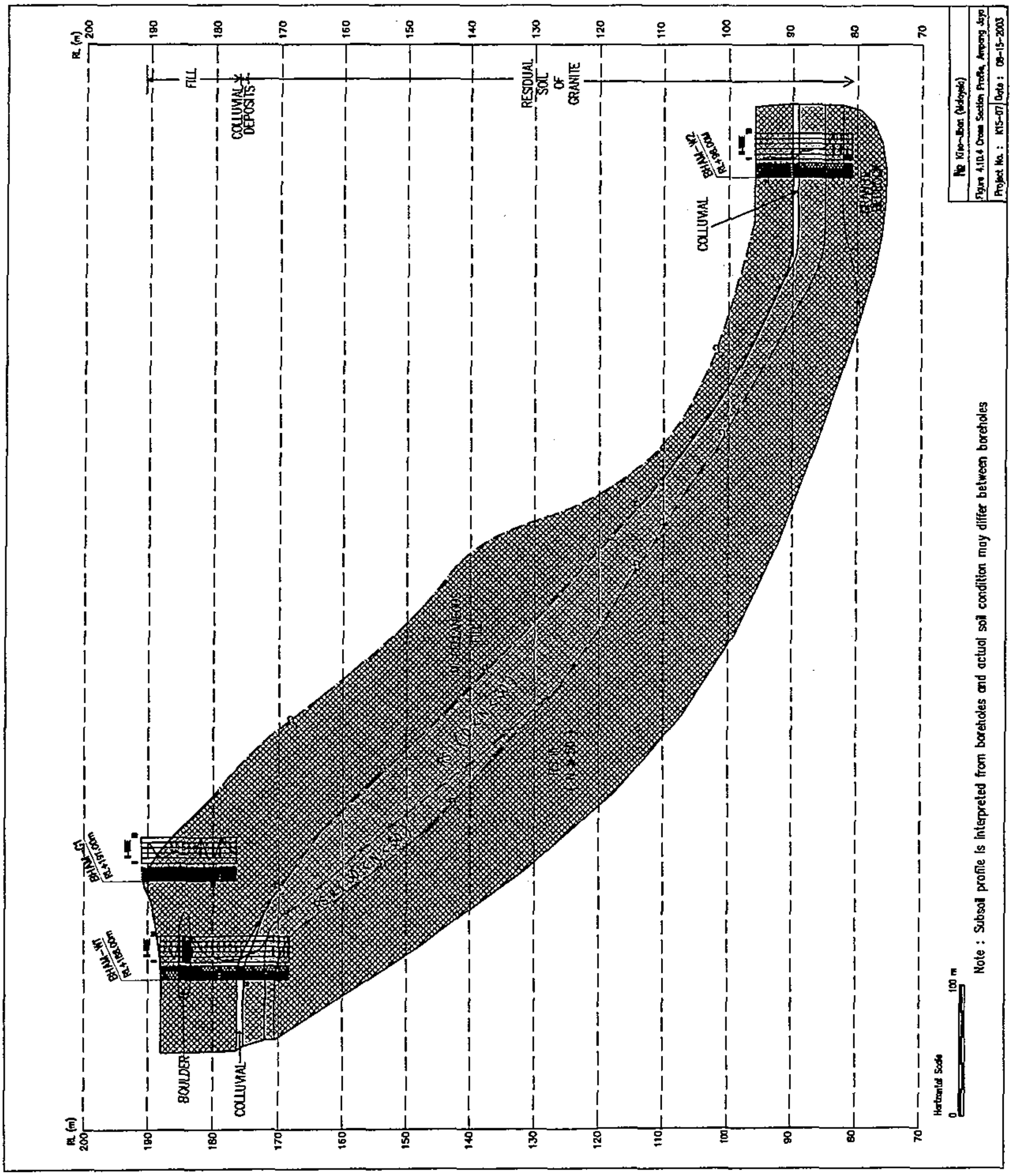


Figure 8.5.4 Cross Section Profile, Ampang Jaya

8.5.2 Field sampling activity

Field sampling and measurement were carried out prior to the commencement of the works at the site for use as the baseline data. A similar set of sampling was also taken after the works. The sampling schedules are shown in **Table 8.5.2** and **Table 8.5.3**.

Table 8.5.2 Sampling Schedule - Before PP, for Baseline Data

Sampling points	Date	Time	Type of monitoring
AM-W1	28 Aug 2003	09:45	Groundwater monitoring
AM-W2	25 Aug 2003	13:15	
AM-G1	25 Aug 2003	12:35	Landfill gas monitoring
AM-G2	25 Aug 2003	15:45	
AM-L1	25 Aug 2003	10:45	Water & leachate monitoring
AM-L2	25 Aug 2003	11:50	
AM-SW1	25 Aug 2003	10:00	
AM-SW2	25 Aug 2003	11:30	

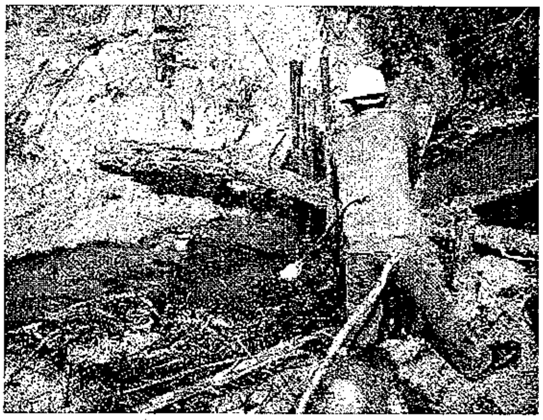
Table 8.5.3 Sampling Schedule - After PP Improvements

Sampling points	Date	Time	Type of monitoring
AM-W1	06 Feb 2004	15:10	Groundwater monitoring
AM-W2	06 Feb 2004	12:55	
AM-G1	06 Feb 2004	14:45	Landfill gas monitoring
AM-G2	06 Feb 2004	13:25	
AM-L1	06 Feb 2004	12:35	Water & leachate monitoring
AM-L2	06 Feb 2004	11:50	
AM-SW1	06 Feb 2004	11:25	
AM-SW2	06 Feb 2004	12:10	
AM-W1	19 May 2004	13:50	Groundwater monitoring
AM-W2	19 May 2004	12:45	
AM-G1	19 May 2004	13:30	Landfill gas monitoring
AM-G2	19 May 2004	13:10	
AM-L1	19 May 2004	11:10	Water & leachate monitoring
AM-L2	19 May 2004	12:10	
AM-SW1	19 May 2004	10:40	
AM-SW2	19 May 2004	12:20	
AM-W1	29 June 2004	-	Groundwater monitoring
AM-W2	29 June 2004	09:40	
AM-G1	29 June 2004	13:05	Landfill gas monitoring
AM-G2	29 June 2004	12:05	
AM-L1	29 June 2004	10:20	Water & leachate monitoring
AM-L2	29 June 2004	11:02	
AM-SW1	29 June 2004	11:07	
AM-SW2	29 June 2004	11:35	

The samples were taken in accordance with the parameters and specific preservation methods as explained previously in **Section 5.2** and **5.3**.

Plate 8.5.1 shows some of the photographs taken during the sampling exercise.

Plate 8.5.1 Sampling Exercise in Ampang Jaya PP



AM-SW1

AM-SW2

AM-L1

AM-L2

AM-G1

8.5.3 Laboratory analysis

Analytical methods as well as QC/QA program are as same as that of Ampang Jajar and Pekan Nenasi.

The results of the laboratory analysis for both the sampling exercises are shown in **Table 8.5.4, 8.5.5**and **8.5.6**

Table 8.5.4 Summary of Results - Physical Parameters

Samples taken on		*25/8/03*					
Test Parameters	Units	W1 09:45hrs	W2 13:15hrs	L1 10:45hrs	L2 11:50hrs	SW1 10:00hrs	SW2 11:30hrs
pH (*in-situ*)	-	7.5	5.9	8.2	6.9	6.0	6.9
Temperature (*in-situ*)	^{0}C	29	29	31	30	27	29
ORP	mV	10	-162	7	-18	66	25
Conductivity	mS/cm	0.25	1.16	5.15	1.89	0.031	0.301
Turbidity	NTU	23.2	200	72.8	58.4	46.9	60.5
DO	mg/l	0.75	2.85	1.92	3.13	4.13	4.17
BOD_5 at 20^{0}C	mg/l	8	18	67	14	1	17

COD	mg/l	28	251	813	130	8	45
Total suspended solid	mg/l	107	26	154	35	19	29
Samples taken on		*06/2/04*					
Test Parameters	Units	W1 15:10hrs	W2 12:55hrs	L1 12:35hrs	L2 11:50hrs	SW1 11:25hrs	SW2 12:10hrs
pH (*in-situ*)	-	7.1	6.7	8.5	8.1	6.9	6.8
Temperature (*in-situ*)	^0C	29	30	29	29	28	30
ORP	mV	-56	-44	77	-33	326	57
Conductivity	mS/cm	0.349	1.05	4.87	2.62	0.034	0.320
Turbidity	NTU	17.8	24.7	27.2	80.2	14.3	20.5
DO	mg/l	0.78	0.91	0.55	1.52	3.21	2.87
BOD_5 at 20^0C	mg/l	9	12	113	12	2	8
COD	mg/l	20	26	294	191	3	24
Suspended solid	mg/l	21	11	52	33	7	11
Samples taken on		*19/5/04*					
Test Parameters	Units	W1 13:50hrs	W2 12:45hrs	L1 11:10hrs	L2 12:10hrs	SW1 10:40hrs	SW2 12:20hrs
pH (*in-situ*)	-	7.4	6.0	8.3	6.9	6.4	6.9
Temperature (*in-situ*)	^0C	30	31	29	31	30	30
ORP	mV	-110	-82	0.44	-102	112	53
Conductivity	mS/cm	0.39	1.86	4.51	2.79	0.34	0.91
Turbidity	NTU	83.4	23.1	17.1	43.7	32.8	27.4
DO	mg/l	2.72	1.27	1.50	2.14	2.14	4.38
BOD_5 at 20^0C	mg/l	5	32	92	78	11	15
COD	mg/l	11	66	755	142	14	46
Suspended solid	mg/l	50	32	28	22	16	6
Samples taken on		*29/6/04*					
Test Parameters	Units	W1 -	W2 09:40hrs	L1 10:20hrs	L2 11:02hrs	SW1 11:07hrs	SW2 11:35hrs
pH (*in-situ*)	-	-	6.1	8.0	6.6	6.2	6.6
Temperature (*in-situ*)	^0C		31	30	29	30	31
ORP	mV		-89	75	-220	126	-126
Conductivity	mS/cm		1.69	4.62	0.48	0.06	2.03
Turbidity	NTU		2.83	71	60.4	34.4	143
DO	mg/l		2.62	7.45	8.11	2.16	4.43
BOD_5 at 20^0C	mg/l		10	81	10	1	14
COD	mg/l		110	830	39	3	180
Suspended solid	mg/l		56	128	9	12	22

Table 8.5.5 Summary of Results - Metals and Other Test

Samples taken on		*25/8/03*					
Test Parameters	Units	W1 09:45hrs	W2 13:15hrs	L1 10:45hrs	L2 11:50hrs	SW1 10:00hrs	SW2 11:30hrs
Arsenic	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	mg/l	<0.2	<0.2	1.4	0.4	<0.2	<0.2
Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent Chrome	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Trivalent Chromium	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	mg/l	28.4	74.7	2.04	5.04	0.29	0.61
Lead	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Manganese	mg/l	1.46	3.09	0.02	0.22	0.11	0.30
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/l	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
Tin	mg/l	<0.1	<0.1	0.2	<0.1	<0.1	<0.1
Zinc	mg/l	0.11	0.08	0.06	0.07	0.18	0.07
Cyanide	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphide	mg/l	<0.01	0.02	<0.01	0.04	0.02	<0.01
Chloride ion	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenol	mg/l	<0.02	0.04	0.14	0.12	<0.02	0.47
Oil & Grease	mg/l	<1	<1	<1	<1	<1	<1
Total Nitrogen	mg/l	10	38	373	197	<1	29
Ammonia Nitrogen	mg/l	9.37	34.1	334	197	<0.01	27.5
Nitrate Nitrogen	mg/l	0.13	<0.01	15.5	0.21	0.20	0.88
Nitrite Nitrogen	mg/l	<0.01	<0.01	20.6	0.06	<0.01	0.33
Samples taken on		*06/2/04*					
Test Parameters	Units	W1 15:10hrs	W2 12:55hrs	L1 12:35hrs	L2 11:50hrs	SW1 11:25hrs	SW2 12:10hrs
Arsenic	mg/l	< 0.05	< 0.05	0.08	0.06	< 0.05	< 0.05
Boron	mg/l	< 0.2	< 0.2	1.5	0.5	< 0.2	< 0.2
Cadmium	mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Chromium, hexavalent	mg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chromium, trivalent	mg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	mg/l	0.07	0.08	0.12	0.08	0.06	0.07
Iron	mg/l	0.34	0.07	4.25	18.3	0.45	0.57
Lead	mg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Manganese	mg/l	0.31	0.04	0.03	0.33	0.12	0.4
Mercury	mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Nickel	mg/l	< 0.01	< 0.01	0.03	< 0.01	< 0.01	< 0.01
Tin	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Zinc	mg/l	0.04	0.13	0.05	0.05	0.06	0.08
Cyanide	mg/l	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sulphide	mg/l	< 0.01	0.01	0.02	0.03	< 0.01	< 0.01
Chloride ion	mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenol	mg/l	< 0.001	0.03	< 0.001	< 0.001	< 0.001	< 0.001
Oil & Grease	mg/l	<1	<1	<1	<1	<1	<1
Total Nitrogen	mg/l	13	1	271	143	1	15
Ammonium-nitrogen	mg/l	6.0	0.20	258	135	0.12	9
Nitrate-nitrogen	mg/l	1.02	0.25	< 0.01	0.01	0.15	0.8
Nitrite-nitrogen	mg/l	0.34	< 0.01	0.04	0.04	< 0.01	0.28

Samples taken on		*19/5/04*					
Test Parameters	Units	W1 -	W2 09:40hrs	L1 10:20hrs	L2 11:02hrs	SW1 11:07hrs	SW2 11:35hrs
Arsenic	mg/l	<0.05	<0.05	0.08	<0.05	<0.05	<0.05
Boron	mg/l	<0.2	<0.2	1.4	0.4	<0.2	<0.2
Cadmium	mg/l	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Chromium, hexavalent	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium, trivalent	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	mg/l	0.08	0.01	0.28	<0.01	<0.01	<0.01
Iron	mg/l	41.2	40.4	4.54	12.7	2.03	3.94
Lead	mg/l	0.09	<0.05	<0.05	<0.05	<0.05	<0.05
Manganese	mg/l	1.51	1.87	0.09	1.30	0.15	0.51
Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/l	0.02	<0.01	0.03	<0.01	<0.01	<0.01
Tin	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	mg/l	0.17	0.11	0.15	0.11	0.08	0.03
Cyanide	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sulphide	mg/l	<0.01	0.01	<0.01	0.01	<0.01	<0.01
Chloride ion	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenol	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Oil & Grease	mg/l	<1	<1	<1	<1	<1	<1
Total Nitrogen	mg/l	10	55	225	144	10	39
Ammonium-nitrogen	mg/l	0.56	45.0	181	126	0.70	33.0
Nitrate-nitrogen	mg/l	0.05	0.08	0.05	0.01	0.16	0.98
Nitrite-nitrogen	mg/l	<0.01	<0.01	1.73	0.05	<0.01	0.21
Samples taken on		*29/6/04*					
Test Parameters	Units	W1 15:10hrs	W2 12:55hrs	L1 12:35hrs	L2 11:50hrs	SW1 11:25hrs	SW2 12:10hrs
Arsenic	mg/l	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Boron	mg/l	-	0.2	1.6	< 0.2	< 0.2	0.3
Cadmium	mg/l	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Chromium, hexavalent	mg/l	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chromium, trivalent	mg/l	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Copper	mg/l	-	<0.01	0.14	0.11	< 0.01	0.18
Iron	mg/l	-	87.2	4.75	0.44	0.67	23
Lead	mg/l	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Manganese	mg/l	-	1.72	0.04	0.42	0.09	1.52
Mercury	mg/l	-	< 0.001	< 0.001	< 0.001	< 0.001	0.003
Nickel	mg/l	-	< 0.01	0.03	< 0.01	< 0.01	< 0.01
Tin	mg/l	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Zinc	mg/l	-	0.09	0.05	0.06	0.03	0.08
Cyanide	mg/l	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sulphide	mg/l	-	< 0.01	0.11	0.01	< 0.01	0.01
Chloride ion	mg/l	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenol	mg/l	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Oil & Grease	mg/l	-	< 1	< 1	< 1	< 1	< 1
Total Nitrogen	mg/l	-	55	313	29	1	128
Ammonium-nitrogen	mg/l	-	50.2	295	23.6	0.29	122
Nitrate-nitrogen	mg/l	-	0.37	0.13	1.85	0.11	0.62
Nitrite-nitrogen	mg/l	-	< 0.01	1.75	0.46	< 0.01	0.04

Table 8.5.6 Summary of Results - Landfill Gases

Samples taken on		*25/8/03*	
Test Parameters	Units	AM-G1 15:45hrs	AM-G2 12:35hrs
Methane (CH_4)	%	37.1	36.6
Carbon Dioxide (CO_2)	%	30.8	30.8
Oxygen (O_2)	%	Not Detectable	Not Detectable
Nitrogen (N_2)	%	32.6	32.9
Hydrogen Sulphide (H_2S)	ppm	3	3
Carbon Monoxide (CO)	ppm	12	14
Samples taken on		*06/2/04*	
Test Parameters	Units	AM-G1 14:45hrs	AM-G2 13:25hrs
Methane (CH_4)	%	25.9	28.6
Carbon Dioxide (CO_2)	%	26.9	28.7
Oxygen (O_2)	%	2.5	1.2
Nitrogen (N_2)	%	44.7	41.7
Hydrogen Sulphide (H_2S)	ppm	18	3.7
Carbon Monoxide (CO)	ppm	21.7	16
Samples taken on		*19/5/04*	
Test Parameters	Units	AM-G1 13:30hrs	AM-G2 13:10hrs
Methane (CH_4)	%	29.0	38.6
Carbon Dioxide (CO_2)	%	25.7	32.7
Oxygen (O_2)	%	4.0	0.4
Nitrogen (N_2)	%	41.7	27.7
Hydrogen Sulphide (H_2S)	ppm	8.2	10.7
Carbon Monoxide (CO)	ppm	12.7	18.3
Samples taken on		*29/6/04*	
Test Parameters	Units	AM-G1 13:05hrs	AM-G2 12:05hrs
Methane (CH_4)	%	27.1	35.4
Carbon Dioxide (CO_2)	%	24.1	31.6
Oxygen (O_2)	%	4.2	0.5
Nitrogen (N_2)	%	44.5	32.5
Hydrogen Sulphide (H_2S)	ppm	6	3
Carbon Monoxide (CO)	ppm	20.0	15.0

8.5.4 Considerations

(1) Considerations - Baseline

The monitoring data for August 2003 represents the baseline data.

1) Groundwater Quality

The monitoring well AM-W1 was installed at the top of the ridge and AM-W 2 is at the bottom of the valley. Since AM-W1 is at the top, the groundwater contamination will be lesser than that for AM-W2. The results indicated that the iron ad manganese values exceeded the permitted benchmarked limits. As explained in Chapter 7, for the Pekan Nenasi PP, the high levels of iron and manganese are readily found in the soil and not influenced by the landfill contaminants. The results showed relatively high levels or ammonia, electric conductivity and COD for AM-W2, thus indicating contamination.

2) Groundwater Flow

The groundwater levels measured during the sampling exercise are shown in **Table 8.5.7**.

Table 8.5.7 Groundwater Levels at Ampang Jaya PP Site

Monitoring Well	Elevation (MSL m)	Groundwater level from the top of the well (m)	Groundwater level (MSL m)
AM-W1	188.0	16.05	171.95
AM-W2	96.0	1.65	94.35
AM-G1	191.0	13.85	177.15

With the groundwater levels, the contour map for groundwater was generated and shown in **Figure 8.5.5**. The direction of groundwater flow is deduced to flow from the north to the south.

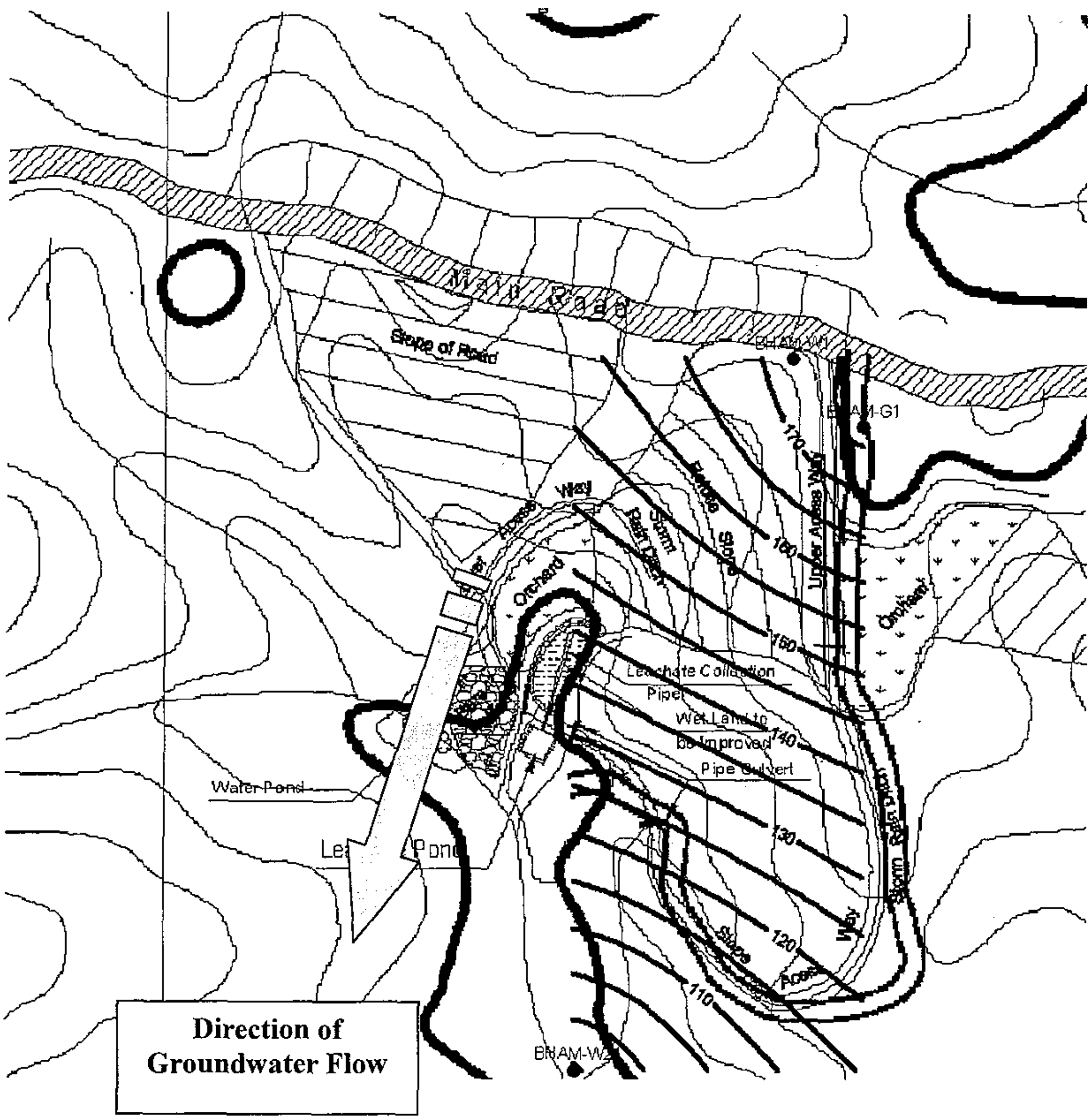


Figure 8.5.5 Groundwater Level Contour Map, Ampang Jaya PP

3) Leachate and Surface water quality

The Ampang Jaya closed landfill site is situated upstream of the water intake point, about 8km away. The EQA effluent standard A must be applied. The results for the water quality parameters are shown in **Table 8.5.8**.

Table 8.5.8 Leachate and Water Quality

	Standard A	L1	L2	SW1	SW2
BOD_5 at 20° C (mg/l)	20	***67***	14	1	17
COD (mg/l)	50	***813***	***130***	8	45
Boron (mg/l)	1.0	***1.4***	0.4	<0.2	<0.2
Iron (mg/l)	1.0	***2.04***	***5.04***	0.29	0.61
Manganese (mg/l)	0.2	0.02	***0.22***	0.11	***0.30***

From the above table, the results for AM-L1 exceeded almost all the parameters. The results of the other parameters were within the standard A. The results for surface water analysis showed that for SW1, that is upstream of the river, was not influenced much by the leachate. But for SW2, which is down stream, was heavily influenced by the leachate. Only Manganese exceeded the standard A for SW2.

The relationship between the quality of leachate, surface water and groundwater can be expressed by total nitrogen and electric conductivity as shown in **Figure 8.5.6**. As expected, leachate and water qualities are dependent on the location of the sample rather than the types of samples. The results for W1 and SW1 which are located at the upstream showed much better quality than W2 and SW2 which are at the down stream

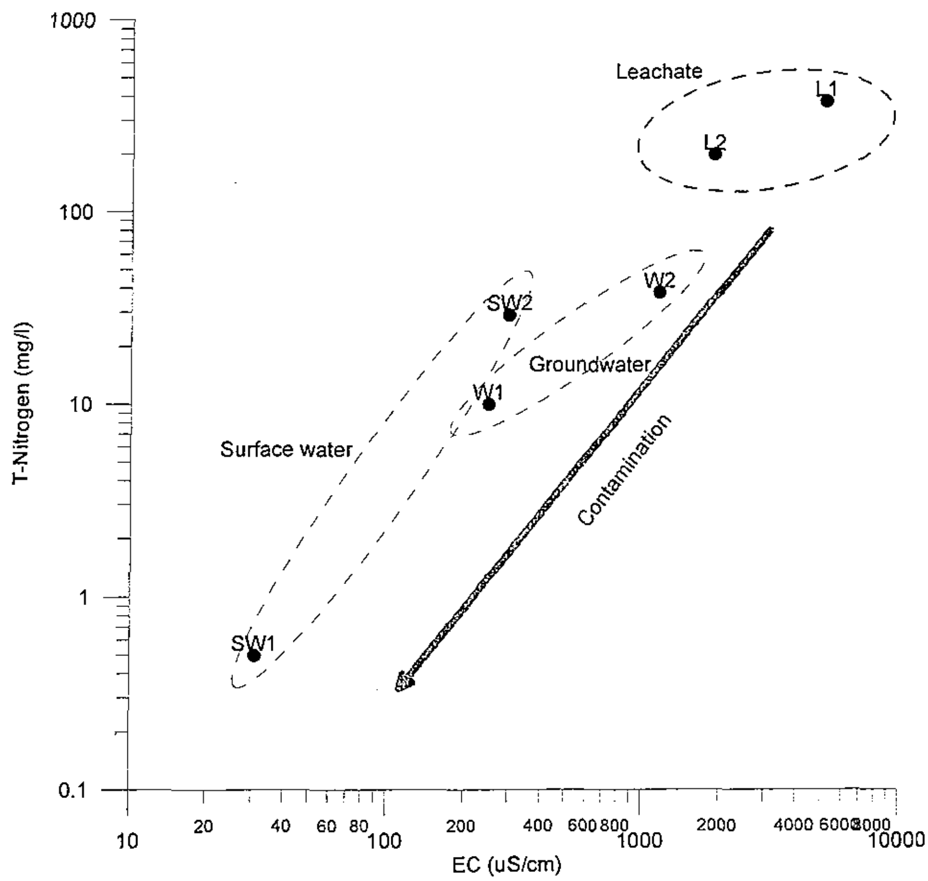


Figure 8.5.6 Water Quality Relationship - Ampang Jaya PP

4) Landfill gas

The results for landfill gas at AM-G1 and AM-G2 showed similar gas composition with 37% of methane and 31% of carbon dioxide.

(2) Considerations - after the PP improvements

The evaluation of the PP improvement will be discussed in **Volume 4, Chapter 9**. The brief results of the environmental monitoring will be discussed for three aspects, i.e., environmental impact, safety and stabilization process.

1) Environmental impact

For surface water and leachate, their water quality was compared with effluent standard A. As noted in **Table 8.5.8**, for the 5 parameters, i.e., BOD_5, COD, Boron, Iron and Manganese, it shows that the results already exceeded the limits in some points during baseline sampling, before the PP improvement. **Table 8.5.9** summarised the results of monitoring for those parameters exceeding the effluent standard A. While leachate constantly exceeded in BOD_5, COD, Iron and Manganese, surface water also exceeded Iron and Manganese. L1 sample also slightly exceeded in Boron and Arsenic.

In accordance with the EQA, the leachate from the site, which exceeds the prescribed standards in the various parameters, should not be discharged without treatment. Since there is a water intake point downstream of the site, water treatment facility is urgently required.

Table 8.5.9 Results of Monitoring Before and After the PP

	Sampling point	BOD_5 (mg/l)	COD (mg/l)	Boron (mg/l)	Iron (mg/l)	Manganese (mg/l)	Arsenic (mg/l)
Effluent standard A		20	50	1.0	1.0	0.2	0.05
Feb/04	L1	***113***	***294***	***1.5***	***4.25***	0.03	***0.08***
	L2	12	***191***	0.5	***18.3***	***0.33***	***0.06***
	SW1	2	3	<0.2	0.45	0.12	<0.05
	SW2	8	24	<0.2	0.57	***0.4***	<0.05
May/04	L1	***92***	***755***	***1.4***	***4.54***	0.09	***0.08***
	L2	***78***	***142***	0.4	***12.7***	***1.3***	<0.05
	SW1	11	14	<0.2	***2.03***	0.15	<0.05
	SW2	15	46	<0.2	***3.94***	***0.51***	<0.05
June/04	L1	***81***	***830***	***1.6***	***4.75***	0.04	<0.05
	L2	10	39	<0.2	0.44	***0.42***	<0.05
	SW1	1	3	<0.2	0.67	0.09	<0.05
	SW2	14	***180***	0.3	***23***	***1.52***	<0.05

The groundwater quality of the monitored samples also exceeded the benchmark values for Iron and Manganese. From the hydrogeological viewpoint, the groundwater from the site will eventually mix with the surface water downstream. Therefore, separate environmental impact consideration is not required.

2) Safety

For the landfill gas, methane has been detected at over 50% concentration at the wells. In order to prevent gas explosions or fire, no burning should be permitted within these areas

The risk of slope collapse and landslides are major problems at the site. Any work at the top, middle and bottom of the slope should be prohibited to prevent any accidents.

3) Stabilisation process

The leachate and landfill gas composition indicated that there is active aerobic and anaerobic degradation of organic matter inside the waste layers. Land subsidence measurement at the settlement plates installed at site showed substantial signs of continued subsidence at the top of the slope (measured to be about 59mm over the 8 months period). It is estimated that the final stabilisation of the site will require a longer period of time.

8.6 CONTINUOUS OPERATIONS & MAINTENANCE AND MONITORING

8.6.1 Operation and maintenance of landfill facilities

All the facilities provided and installed at the landfill site, such as the soil cover, leachate collection pipes, gas ventilation systems, surface drainage etc, should be operated and maintained properly, up until the closed landfill site has stabilised.

It is highly recommended that the Local Authority or the operator of the site should carry out the regular inspection and maintenance work at the site, and to ensure that the facilities are in good working conditions. The types of work required are as follows;

a. Leachate collection and treatment facilities

Although only the leachate collection pipes and the leachate pond have been provided, such facilities should be maintained and inspected regularly.

However, due to restraints of the Pilot Project and the lack of support from the Local Authority concerned, it was not possible to provide the essential leachate treatment facilities such as the aerators, recirculation systems and filtration system. It is strongly recommended that, since the Ampang Jaya site is situated up stream of the water intake point, it is essential that MHLG or the Local Authority should continue with the rehabilitation upgrading work by providing the necessary leachate treatment systems. Such work should include the provision of power supply to bottom valley of the site.

b. Gas ventilation pipes

The gas ventilation pipes act as the gas vents and also air supply pipes to supply oxygen to the waste layers and accelerate the waste degradation process. The gas ventilation pipes should be maintained over the long term and new ventilation pipes be installed where necessary.

c. Surface drainage

The surface drainage system should be inspected and maintained regularly, and cleared of any debris and blockages. Drains may also be damages as a result of uneven ground settlements. In such cases, all damaged section should be maintained or replaced. Since the PP works included the provision of stormwater drains along the access road, it is crucial that these drains are also maintained and inspected regularly.

d. Other supporting facilities

Other supporting facilities like the access road and the vegetation growth on the top/slopes should be maintained where necessary for a long period of time. For the PP, a large portion of the works involved the repair and upgrading of the access road. This access road is the only access to the site and should be maintained properly. Furthermore, since the gradient of the access road is rather steep, and prone to erosion and wash out by heavy rain water, it is crucial that the road surface is constantly repaired and protected.

The typical example of the maintenance items of the landfill facilities, method and scale/frequency are shown in **Table 8.6.1**.

Table 8.6.1 Summary of Maintenance Items

Facilities	Items	Methods	Scale/ Frequency
Top cover & dykes	Cracks, pools and soil erosion on the surface, State of plants	Periodic visual inspections	The entire site, weekly
Surface drainage on the top cover	Clogging by soil/leaves, Damage by sedimentation	Periodical visual inspections	The entire site, weekly (more frequent during the rain season)
Cut-off drainage around the site	Clogging by soil/leaves, Damage by traffic	Periodical visual inspections	The entire site, weekly (more frequent during the rain season)
Gas ventilation pipes	Clogging, damage to pipes, corrosion	Periodical visual inspections	all pipes, weekly
Leachate collection pipes	Clogging, damage to pipes, corrosion	Periodical inspections & comparison of the effluent quantity data	daily
Leachate treatment facility	Quality of treated effluent	Daily inspections (colour of effluent) Periodical effluent analysis	daily monitoring frequency
Monitoring facility	Conditions of the monitoring wells	Periodical inspections	all wells, weekly

8.6.2 Monitoring of environment and landfill stabilisation

In accordance with the Guideline, for the Post Closure Management for Ampang Jaya, the following monitoring programme has been recommended, as shown in **Table 8.6.2**.

Table 8.6.2 Monitoring Programme

Monitoring media/parameters	Item and parameters	Frequency	Location
Leachate	• pH • BOD • COD • Nitrogen (Ammonia, Nitrate, Nitrite) • ORP • EC • TOC	4 times / year	1 point/ leachate pond
Landfill gas	• Oxygen (O_2) • Nitrogen (N_2) • Methane (CH_4) • Carbon Dioxide (CO_2) • Hydrogen Sulfide • Temperature	2 times/ year	2 points/ site
Land subsidence	Topographic height of the top of the landfill	Once a year	1 point/ landfill block
Groundwater	Groundwater benchmark parameters	Once a year	3 points/ site
Surface water	Effluent standard parameters	Once a year	2 points/ stream

The site specific recommendations are as follows.

(1) Leachate

Leachate should be monitored according to the guideline. In view of the existing water intake downstream of the site, strict monitoring programme should be observed.

(2) Landfill gas

Continued monitoring of the gas composition is recommended.

(3) Land subsidence

The rate of land subsidence can provide a good measure of the stabilization of the site. The settlement plates that were provided under the Pilot Project should be measured once a year as a good indicator of stabilisation process.

(4) Groundwater

Although groundwater is contaminated, it will ultimately outflow to the surface water sources. Continuous monitoring at the current wells is recommended but no additional well is required.

(5) Surface water

Surface water should be monitored regularly in accordance with the guideline. In view of the existing water intake point downstream of the site, strict monitoring programme should be observed.

CHAPTER 9 PILOT PROJECTS EVALUATION

9.1 TECHNICAL EVALUATION

9.1.1 General

The Pilot Project sites were selected to reflect the 3 different types of site conditions, i.e.;

- A landfill site operated under improved conditions and closed recently (Ampang Jajar)
- A site located in wetland area and currently still under operations (Pekan Nenasi), and
- A site closed for a number of years ago and which was poorly located and operated (Ampang Jaya).

From the implementation of the 3 pilot projects, the experience gained are summarised as follows;

- A budget should be allocated for the design (including topographical surveys and soil investigations), construction, operations and monitoring of the safe closure plan.
- The operator and/or owner (in PP case; Local Authorities) should prepare the concept plans for the closure.
- If in-house expertise is not available, local engineering consultants should be engaged to carry out the works, including the detailed designs and operation plans.
- Local contractors should also be engaged to carry out the construction works.
- The Local Authorities should develop the post closure operation and maintenance system through identification of the stakeholders and demarcation of responsibilities for funding and the actual operations under control of State Government.

The evaluation of the 3 Pilot Projects should take into consideration not only on the technical issues and outcome of the Pilot Project works but also on the performance of the stakeholders, local counterparts, consultants, and others. Such evaluation criteria includes the degree of technology transfer, confirmation of the technical capabilities of the Malaysian consultants and contractors, and enhancing the understanding of Local Authorities on safe closure.

The summary of the evaluation items is shown in **Table 9.1.1**.

Table 9.1.1 Evaluation of Pilot Projects

Item	A*	B*	C*	Comment
1. Malaysian technical capability				
(1) Detailed design	O			Detailed design was prepared by Local consultants appropriately based on the instruction of the JICA Study Team.
(2) Construction	O			Contractors implemented the construction woks well.
2. Construction Implementation				
(1) Construction period	O	O		Ampang Jaya PP completed on time, but Ampang Jajar and Pekan Nenasi PP faced some delays due to rainy season.
(2) Budget maintenance	O			All PPs completed within the budgets.
(3) Equipment and materials		O		All the equipment and materials for the works procured in Malaysia.
(4) Workmanship		O		Contractors implemented the construction woks as it was designed.
3. Applicability of Guidelines				
(1) Ampang Jajar PP	O			Re-formation of slope and application of C3 level (leachate collection, drainage system, gas vents, etc).
(2) Pekan Nenasi PP	O			Application of C3 level (semi-aerobic landfill system including leachate re-circulation system).
(3) Ampang Jaya PP		O		Installation of leachate collection and drainage system.
4. Deepening understanding of safe closure				
(1) MHLG		O		Arrangement of C/P personnel for each pilot site for supervise works. Implementation of training workshops.
(2) Local Authorities	O		O	Active participation of Las in Ampang Jajar and Pekan Nenasi PP. Inadequate participation in the case of Ampang Jaya PP.
(3) Site operators	O			Understanding and Cooperation of landfill operators during implementation. Adjacent cell was developed by LA's initiative in Pekan Nenasi.
(4) Public	O			Based on the public hearing to Ampang Jajar residents (about 200 attendees), PP was totally accepted by the public.
(5) 1st Training Workshop	O			Topic: Evaluation of landfill sites and planning of pilot projects. Attendees: federal/state government and local authorities.
(6) 2nd Training Workshop	O			Topic: Detail design, construction work and monitoring of PP. Attendees: Federal/state government, LAs, and concessionaires.
5. Environmental improvement				
(1) Ampang Jajar	O			Surface water & Leachate improved. Landscaping improved.
(2) Pekan Nenasi		O		Leachete improved. Continuous monitoring is required.
(3) Ampang Jaya		O	O	Leachate can be controlled. Leachate treatment is urgently required.

Note: * Key: A = Excellent, B = Satisfactory, C = Inadequate

9.1.2 Achievement of Pilot Projects

The technical achievement of the Pilot Projects were evaluated based on 2 main criteria, i.e. whether the projects were carried out in accordance with the design and Pilot Project Plan, and whether the works were carried out satisfactory.

The scope of works, i.e. the facilities that were installed and the works completed are summarised below.

(1) Ampang Jajar Pilot Project

No.	Installed Facilities	Achievements and Remarks
1	Slope Re-formation and Final Cover	
	Re-formation of the 1st Step Slope and final cover *Improvement of the lowest slope to 1:2, and supply and compaction of impermeable clayey soil on the slope. Height of the step varies from 3.2 to 7.1m.*	The cut and fill works were carried out as specified. The amount of cut and fill material were about 700m^3 and 1,580m^3 respectively. The slopes are now more gradual and well compacted. The new slopes are less likely to slip and slide.
	Application of cover soil on the upper layer of the 2nd Step Slope (t = 300mm) *Supply and compaction of clayey soil on the slope and steps with a thickness of 300mm to improve the existing slope. Number of steps above the first step range from 2 to 5 steps.*	The cover application works were completed as specified. However, some areas exhibited soil settlements and were most likely due to poor soil compaction during construction and also the due to rain water soil erosion.
	Vegetation cover (t = 150mm) *Application of rich organic field soil.*	Topsoil were used and laid on the surface of the slopes and steps.
	Turfing (slope protection) *Spot turfing for protection of the slope.*	Turfings (local cow grass) were planted on the slopes and steps. It was observed that the grass at certain areas at the top of the slopes did not grow as fast and as healthy as those at the bottom of the slopes. This could be due to lack of irrigation and nutrients. Nevertheless, more time should be allowed for the grass to mature.
	Planting (1 tree/25m^2) *Selected tree type should be able to grow under the landfill conditions*	Small trees that were selected by MPSP were planted at the steps as specified. It is not possible to judge the suitability of the tree selection, as time is required for the tree to mature.
2	Leachate collection system (Main Pipe)	
	Blind (buried) leachate collection pipe (dia. 450mm) *Supply and installation of perforated spun concrete pipe class H, of nominal diameter 450mm including placing of gravel around the pipe, partial excavation and laying with crusher-run of 200mm thickness, on wooden sleeper/wedge.*	The pipes were installed as per the specification. The pipes achieved their purpose as leachate has been observed flowing from the pipes.

No.	Installed Facilities	Achievements and Remarks
3	Gas venting system	
	Vertical gas venting pipes (150mm) *Supply and installation of vertical gas venting perforated HDPE pipe, of diameter 150mm in pits surrounded by gravel (50 to 150mm), to a depth of 3.5m penetrating the solid waste. Connecting pipes should be installed at about 1.5m above ground*	6 units of HDPE vertical gas pipes were installed with U-bends fitted at the discharge end as specified. The pipes achieved their purpose as the odour from gas can be smelled around the pipe discharge area.
	Gas pipes at the slopes (HDPE, 150mm) *Supply and installation of inclined vents (perforated 150mm HDPE) to vent the gas and collect leachate. Pipes are located at four (4) sections along the slope and connect with vertical and horizontal pipes for leachate and gas. Pipes are laid below ground in trenches of 50 x 50cm and surrounded by gravel.*	Constructed as specified.
	Horizontal gas and leachate collection branch pipes (150mm) *Supply and installation of horizontal gas venting perforated HDPE pipe, diameter 150mm buried in trenches of 500mm x 500mm and surrounded by gravel of size 25mm. These pipes are laid along the upper two steps.*	About 600m of the HDPE pipes were provided and laid as specified.
4	Improvement of existing perimeter roads	
	Crusher-run pavement (t = 200mm) *Supply, level and compaction of the crusher-run for pavement of width 3.5m and thickness of t=200mm, including bed grading, along the road running adjacent to the foot of the slope.*	The road level was raised with the laying of the crusher run, and compacted. The road is now wider and easier to access.
5	Slope storm water drainage	
	Drainage at steps *Supply and place RC pre-cast type drainage ducts of dimensions 300 x 300mm along the steps.*	All the surface drainage and culverts were provide and constructed as specified. However, it was noticed that the open drains were filled with debris and soil, and thus restricting the rainwater flow. The drains must be inspected and cleared regularly, especially during the raining season.
	Drainage at slope (sloping part) *Supply and placement of RC pre-cast type cascading drainage ducts of dimensions 600 x 600 mm, at 5 locations along the slope.*	
	Drainage pipes at step crossings and under perimeter road (dia. 300mm) *Supply and installation of pipe culvers of spun concrete, diameter 300mm under the steps and the perimeter road.*	
	Earth drain (300 & 900 wide) *Earth drain of 300 x 300mm shall also be laid along the top of the slope.*	The earth drain was constructed at the top of the slope and well compacted. Nevertheless, the earth drain should be inspected regularly and repaired when necessary.

No.	Installed Facilities	Achievements and Remarks
	Drainage pits at steps and perimeter road. *Square brick drainage pits of base dimensions S1=750x750mm and S2=900x900mm are installed at the intersections of leachate main and branch pipes and at the intersections of horizontal and cascading drains and the main drainage pipe.*	The drain pits and rip raps were constructed as specified. However, weeds and shrubs were observed overgrown into the facilities and require clearing. Regular inspection, clearing and maintenance of the drainage pits etc are required.
	Rip Rap (3000mm x 2500mm x 900mm depth) with cement mortar *Riprap is installed at the 5 locations where the concrete drainage pipe connects with the wide earth drain to drain the collected storm water to the existing earth drain.*	
	Drainage at toe (600 x 450 pieces U Drain) *RC pre-cast drains of dimensions 600 x 450mm are laid along the foot of the slope to receive.*	

(2) Pekan Nenasi Pilot Project

No.	Installed Facilities	Achievements and Remarks
1	Leachate Collection System	
	Excavation of solid waste *Excavation of the solid waste in the existing operation area in order to install the leachate collection system.*	Since the waste layers were rather shallow, the excavation work was carried out without any problems. The excavated waste was placed in the adjacent active cell.
	Main leachate collection pipe (dia. = 450mm) installed in two lines *Non-perforated spun concrete pipe, Class H, of nominal diameter 450mm laid under the berm and road, with a length of 12m x 2 lines. Perforated spun concrete pipe, Class H of nominal diameter 450mm including placing of gravel around the pipe and preparation of pipe bed with crusher-run of 200mm, over wooden sleeper/wedge of length 30m x 2 lines.*	The pipes were installed as per the specification. The pipes achieved their purpose as leachate has been observed flowing from the pipes at the discharge end to the leachate pond.
	Branch leachate collection pipe (dia. = 225mm) installed in 4 lines *Supply and install perforated spun concrete pipe of nominal diameter 225mm with minimum slope of 1:200 and total length of 290m.Pipes laid on compacted crusher run and surrounded by gravel.*	Constructed as specified.

No.	Installed Facilities	Achievements and Remarks
2	Gas venting system	
	Vertical gas venting pipe *Supply and install 4 gas collection pipes, uPVC class D, diameter 160mm with a height of 2.5m. Installation at square pits of brick walls of outer dimensions of 1.65 x 1.65m and clear height of 0.9m.*	Installed as specified and oil drums were used and placed over the manhole chambers, i.e. at the connection points for the main and branch pipes. Since the PP area is rather shallow, at present not much gas has been detected.
3	Leachate pond	
	Excavation for leachate pond *Leachate pond dimensions are 100m length x 10m bottom width x 2m depth and the pond is to be excavated at the location of the present pond so only part of the required excavation volume of 2,600m^3 is required.*	The pond was excavated and the sides were compacted. The depth is about 2m.
	Earth berm along the leachate pond (h = 1.0m, L = 145m) *Supply impermeable clayey soil to form 1m high berm from the existing ground level, with slope of 1:2 and 1m width at the top. Top level of the berm is 3.20m from the ground level.*	The bern was constructed as specified. The nearby existing clay soil was used and compacted.
	Access road embankment (t = 200mm) between dike and leachate pond *Levelling, subgrade and fill the soil material with average thickness of 200mm crusher run. Access road constructed on existing berm with a minimum width of 3m.*	The access road was constructed to allow easy access to the pump shelter for installation and maintenance purposes, and was constructed as specified. This road should not be used by heavy vehicles or by the waste disposal trucks.
	Crusher-run pavement for access road *Supply, level and compact the crusher run with a thickness of 300mm.*	
	Aerator (7.5 kw) *Supply and installation of low speed surface aerator, vertically mounted geared motor, with electrical accessories and wiring of 300m extensions. Aerator installed at approximately centre point of the pond length.*	The surface aerator complete with electrical control panel was installed. MD Pekan provided the main power supply cables and poles.
	Re-circulation pump (5 kw) *Supply and installation of suction pump with discharge outlet of diameter 80mm including all accessories and wiring of 300m extensions.*	The pump was installed in the pump shelter constructed on the side of the access road nearer to the pond. Flexible hoses were connected from the pump discharge to the 4 sprinklers installed at the top of each gas vent.

(3) Ampang Jaya Pilot Project

No.	Installed Facilities	Achievements and Remarks
1	Access way through the site Improvement of existing access road which extends to the valley bed, descending from an elevation of 187.980 at the site entrance (Station 1) to an elevation of 105.800 at the pipe culvert crossing. Road section to be improved extends to a length of 1,032m.	
	Excavation and fill work *Cut and fill works to form subgrade.*	Excavation and fill work were carried to widen and improve the access road to the bottom of the valley.
	Access way construction (w = 7.0m) *Level the sub grade.*	The access way was widen to 7m and compacted.
	Crusher-run pavement (t = 200mm) *Supply, level and compact crusher run of thickness 200mm.*	The 3.5m wide road was provided with 150mm thick crusher run layer and sprayed with asphalted tack coat.
	Surface storm water plastered drains (width 450 to 600mm) at the higher road elevation section *Install plaster drain along the inner access road edge to a length of approximately 400m.*	Plastered drains (cast-in-situ cement drain) were provided initially but due to the rains, and ease of construction, these were later replaced with 600mm pre-cast V type concrete drains.
	Surface storm water drainage (w = 600 to 900mm) installed at the lower road section as it descends into the valley *Supply and install precast RC drains off size 600 x 600mm and 900 x 900mm to a length of about 500m along the inner edge of the access road.*	The drains were installed as per the specifications. However, it was observed that the back filling at the sides was not sufficient and was prone to erosion. These areas must be monitored and inspected regularly. The drains should also be cleared of sand and debris regularly.
	Pipe culvert at crossings (dia. = 1m) *Supply and installation of concrete pipe culvert of diameter 1.00m, spun pipe, Class H below the road to channel the water in the existing earth drain below the road.*	Installed as per specifications.
2	Leachate collection	
	Main leachate collection pipes (dia. = 450mm) *Supply and install perforated spun concrete pipe, Class H, of nominal diameter 450mm, including placing of gravel around the pipe, with partial excavation and preparation of pipe bed with crusher run of 200mm and over wooden sleeper/wedge with a length of about 130m. RC pipe is installed in 5 sections with inclinations of 1:26, 1:13, 1:8 and 1:4 in ascending order. Elevations are RL 110 at the swamp and increasing to RL 125 at the foot of the waste slope.*	The specified concrete pipes were replaced with similar diameter HDPE pipes, with the approval of the Study Team. During the construction period, the access to the PP site was bad and hence the lighter HDPE pipes were used as it was easier to transfer to the site. The installation work was also easier as it required less use of heavy machinery. The pipes achieved their purpose as leachate has been observed flowing from the pipes to the pond.

No.	Installed Facilities	Achievements and Remarks
3	Gas venting system and branch leachate pipes	
	Vertical gas venting pipe (dia. = 150mm) *Supply and install vertical gas ventilation perforated pipe, HDPE, of diameter150mm and heights of approximately 1.5m.*	The pipes were installed as specified.
	Horizontal leachate and gas venting pipe (dia. = 100mm) *Supply and install horizontal gas ventilation perforated HDPE pipe, of diameter 100mm, in trenches of size 500m x 350m, surrounded by gravel of size 25mm.*	Horizontal branch pipes were installed at 13 points. The last sections at the end of the branches were turned upwards to form vertical gas vents. The branch pipes act as both leachate collection pipes and also as gas ventilation pipes.
4	Surrounding wetland areas	
	Site clearing *Clearing the site, trees and shrubs in order to implement the construction of the storm water drainage and leachate retention pond.*	The site clearing was completed as specified without cutting down of the large trees. Cover soil were laid on area where waste has been exposed.
	Storm water drainage (w = 600) *Supply and install RC pre-cast drains of 600 x 600mm surrounding the swamp (pond) and channelled to the earth drain in order to divert rain water from the pond.*	U-shaped 600mm RC pre-cast drains were installed around the PP area and the pond as specified. The surface water is now collected from the surface, bypassing the waste filled area and discharged to the stream.
	Excavation of the swampy area *Deepening the swamp area to receive the collected leachate for retention before discharge into the water channel.*	The existing pond was excavated, widen and deepen to provide a new earth leachate pond.
5	Storm water drainage in the downstream area	
	Storm water drainage (w = 1,000 mm) *Supply and install three RC pipes under the access road to channel storm water from the storm water drainage system and leachate from the retention pond to the earth drain.*	The original design requested for pipe culverts to be provided at 3 locations, however, during construction period, the design was modified to allow for only 2 locations, with the approval of the Study Team. The modification allows better drainage of the drain water and leachate to the stream.

9.1.3 Achievement of Safe Closure Requirements – Pilot Projects

The PP Plans for the 3 PPs were set up in order to determine the suitability and sustainability of implementing safe closure for the landfill sites in Malaysia. The results of the PPs, the achievements and experiences gained will be used to establish and review the Guideline for Safe Closure in Malaysia.

As with all projects, the actual implementation of the PPs will differ slightly from the original concept designs due to changes necessary to accommodate the variations at the site and also due to circumstances that were faced with during the construction period.

However, in all cases, the initial objectives of the PP should be preserved. The achievements and the degree of satisfaction have been identified and evaluated, and the shortcomings and remarks are as follows;

(1) Suitability of the Guideline on landfills under different conditions

From the results and experiences gained from the PPs, it was concluded that the guidelines presented in the Draft Guideline were generally sufficient and were adopted satisfactory for the 3 PPs. However, there are certain areas that may require on-site considerations, i.e. the technical details on local materials selection, local compaction methods and testing could be addressed.

(2) Construction methods and materials

The local construction methods employed in the PPs were general satisfactory and were in accordance with normal practices. However, it was noted that the skills necessary to compact the waste on the slopes were lacking and can be improved. Care must be taken during excavation of the old waste as noxious fumes and gases will be released, and are hazardous to the workers.

The selection of local construction material were also satisfactory and all the required materials were available locally and readily available. However, since the PP only required small quantities of the perforated concrete pipes, these were more difficult to attain and had to be modified at the site, i.e. the perforations were drilled at site.

(3) Constructions costs

The estimates for the construction cost were initially prepared by the Study Team and subsequently tenders were called for the actual works. The actual PP implementation cost was within the estimated budget.

(4) Construction period

The actual construction period differed for the 3 PPs, nevertheless all construction works were completed within the 3 months period, i.e. from September to December 2003. The Ampang Jajar PP experienced some delay towards the end of the construction period due to the heavy rainfalls, but eventually was completed in time. The Pekan Nenasi PP construction work actually completed in time but the equipment installations, i.e. the pump and aerator, were slightly delayed. The power supply cables were provided in time and were provided and coordinated by MD Pekan. The Ampang Jaya PP actually completed ahead of schedule due to the contractor's desire to complete the work before the anticipated rainy season.

(5) Local technical capabilities in design, construction and maintenance

For the PP, only the conceptual designs and specifications were prepared by the Study Team. The detailed designs and the works were prepared and provided by the local consultants and contractors. Based on the outcome of the detailed design work and overall construction performance, the capabilities of the local consultants and contractors were considered good and satisfactory.

The topographical surveys and soil investigations were all completed without major difficulties. The construction works were also completed satisfactorily without major technical difficulties except for the rain falls that delayed the progress of the works.

(6) The effect of safe closure and rehabilitation of landfills

All the 3 PPs have contributed to the improvement of the sites based on both the environmental standpoints and also the aesthetic viewpoints.

For Ampang Jajar, the PP works have improved the eastern slopes and put in leachate collection facilities. The aesthetics also improved tremendously and are now more acceptable by the public, both at the park side and view from the highway. However, recent observations showed that the grass at the top of the slopes did not fair as well as those at the bottom. The vegetation growth at the site should be monitored regularly and looked after. All dead patches of grass should be replaced and all over grown areas should be cut and maintained.

For Pekan Nenasi, this site is still in operations and hence the PP effect may not be as obvious in a short period of PP. Nevertheless, with the installation of the leachate collection system, this will improve conditions of the site and will accelerate the decomposition process. All these will reduce the negative environmental effects during the life span of the site and will more the task of safe closure must easier in the future. However, proper operations and maintenance of the facilities are required. The aerator and recirculation pump must be operated continuously thorough the life span of the site.

For Ampang Jaya, this site has been abandoned but nevertheless the improvement works will ensure that the leachate are now being collected in the pond and retained before discharge to the stream. It is strongly urged that MHLG or the Local Authority should implement additional improvement works by installing better mechanical treatment systems such as aerators and recirculation pumps. This will improve the quality of the leachate further. It must be reiterated that the Hulu Langat water intake point is situated downstream of the site and thus is it essential that the untreated leachate from this site should not contaminate the river source.

9.1.4 Proposal for Continuous Operation and Maintenance

The sustainability and continuous improvement of the PP sites can only be achieved with proper care in the operations and maintenance of the installed facilities. As such the following have been proposed.

(1) Ampang Jajar Pilot Project

The Local Authority will have to arrange for the necessary the manpower and budget to operate and maintain the Pilot Project area, and to continue with the improvements to the remaining area in order to implement safe closure for the entire site. The following activities have been proposed:

1. To carry out monthly inspections and maintenance of the open drains, and manholes to ensure that they are clear of debris and the passage not restricted.

2. To carry out monthly inspections and maintenance of the gas vents to ensure that the pipes are straight and the passages not restricted.

3. To carry out monthly inspections and maintenance of the main leachate pipe outlets that are discharging into the leachate pond to ensure the passages are not restricted.

4. To carry out monthly inspections of the leachate pond, the aerators, and the re-circulation system to ensure that all the facilities are functioning properly.

5. To carry out inspections on the plants and turfing growth, and to replace any damaged plants.

6. To carry out monthly inspections of the slopes and to look out for areas with soil erosions or failures , and to carry out all necessary maintenance and repair works by adding more soil and proper compaction.

7. To prepare the budget for the design and construction of the remaining sections to continue with the safe closure works.

(2) Pekan Nenasi Pilot Project

The Pekan Nenasi landfill site is still an operating site and the operator, Alam Flora Sdn Bhd, has already taken steps to introduce similar improvement scheme to the adjacent cell. The following activities have been proposed for the operator to implement.

1. To carry out regular monitoring of the leachate level in the leachate pond to ensure that the level should be below the leachate collection pipe discharge outlet.

2. To carry out monthly inspections and maintenance of the gas vents to ensure that the pipes are straight the passages not restricted.

3. To ensure the aerator is operated daily for around 5 to 8 hours.

4. To operate the leachate re-circulation system during the dry season continuously and as required during the wet season to maintain the leachate level in the leachate retention pond.

5. For the adjacent cell already being developed by Alam Flora Sdn Bhd, it is necessary to construct the new leachate pond and install an aerator and re-circulation system.

(3) Ampang Jaya Pilot Project

The Ampang Jaya Landfill was initially operated by the Ampang Jaya Municipal Council (MPAJ) and was subsequently transferred to the Kajang Municipal Council (MPKj) after its abrupt closure. MPKj has expressed their reluctance to undertake or be involved in the safe closure works for the site. The Study Team propose that MHLG should take responsibility for the site and be involved in the PP activities, including the long term post closure management activities.

1. To carry out monthly inspections and maintenance of the gas vents to ensure that the pipes are straight and the passages are not restricted.

2. To carry out monthly inspections of the leachate pond and the leachate drainage pipe to ensure that the passages are not restricted.

3. To carry out monthly inspections of the leachate collection pipes to ensure that the piping network is in proper condition, and to remove any debris or weeds that may be restricting the passages.

4. To carry out monthly inspections of the stormwater drains to ensure that they are in proper conditions, and to remove any debris and weeds that may be restricting the passages.

5. To develop a plan to provide and install an aerator in the leachate pond and introduction of re-circulation system for treatment of the leachate prior to discharging into the stream.

9.1.5 Degree of Satisfaction of the Local Authorities where PP are located

The 3 Pilot Projects sites are under the management and stewardship of the Seberang Perai Municipal Council (MPSP), the Pekan District Council (MDP) and the Kajang Municipal Council (MPKj). As explained earlier, the MPKj did not participate in the Pilot Project, nevertheless, all the 3 Local Authorities were regularly informed of the status of the PP.

Information of the works were disseminated through presentations at the technical working group levels, reports submitted by the team, meetings with the respective design consultants and contractors and videos showing the phases of implementation.

i. Majlis Perbandaran Seberang Perai (MPSP) – Ampang Jajar PP

MPSP showed great enthusiasts for the Pilot Project and is now preparing their own development plan for the remaining area not covered under the PP. One concern raised by MPSP was the delay in handing over and the lack of clarity of responsibility for maintenance of the already damaged works.

ii. Majlis Daerah Pekan (MDP) – Pekan Nenasi PP

MDP are satisfied with the Pilot Project and have carried out with their site operator, Alam Flora Sdn Bhd, the development of the adjacent cell on the same principle as the pilot project. However they have requested more explanation by the Study Team on the operation system of the pilot project (aerator and re-circulation system operation).

iii. Majlis Perbandaran Kajang (MPKj) – Ampang Jaya PP

Since MPKj did not participate in the PP works, the overall supervisory management of the works were handled by the Counterpart members of MHLG. The Counterpart members expressed their satisfaction with the PP works and the site has since be used as the "exhibition" site for others to visit and to appreciate the PP works.

9.2 ENVIRONMENTAL EVALUATION

9.2.1 Evaluation of Ampang Jajar Pilot Project

Since the PP works were only limited to the southeastern slopes of the site, the monitoring points around the area are important for the environmental evaluation. The sampling points are;

AJ-L1	Leachate monitoring at south section
AJ-SW2	Surface water monitoring at northeastern section
AJ-W3	Groundwater monitoring at south section
AJ-G1	Landfill gas monitoring at north section
AJ-G2	Landfill gas monitoring at south section

(1) Leachate and surface water

Figure 9.2.1 shows the results of monitoring for BOD_5, COD, total-nitrogen (T-N) and electric conductivity of AJ-L1. These parameters are considered as basic water quality indicators used to observe the changes in the water quality.

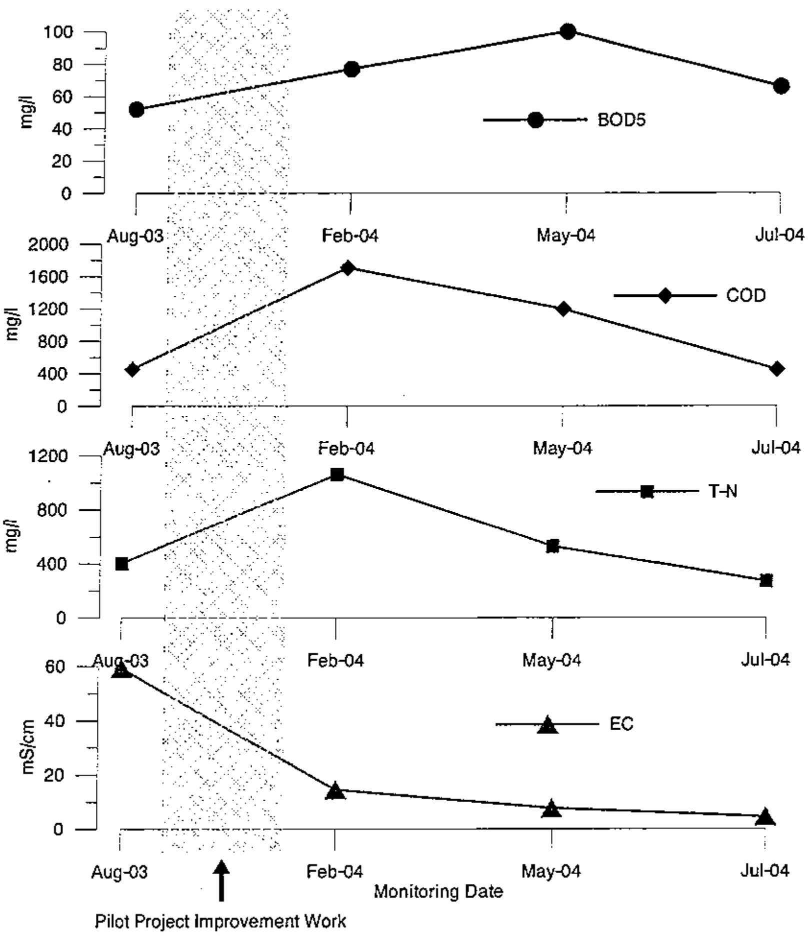


Figure 9.2.1 Ampang Jajar Leachate (L1) Monitoring Results

After the PP works, the BOD_5, COD and total-nitrogen (T-N) increased in concentration during the February, 2004 monitoring. These could be due to the effects of improved rainwater drainage system provided by the PP works. Since lesser surface water got into the waste layers, the leachate concentration temporally increased. However, the COD, total-nitrogen (T-N) decreased for both the May and July, 2004 monitoring. These may indicate the long-term effects of the PP works. The segregation of the rainwater could have increased and promoted the organic degradation inside the landfill layers. Continuous monitoring of these parameters is necessary in order to reach the conclusions the assumption. The BOD_5 results did not show such clear trends of improvement. This may be due to the fact that this section of the landfill site is already quite old and the biodegradable organic are already in low concentration range. The electric conductivity showed consistent improvements.

Figure 9.2.2 shows the results of monitoring for BOD_5, COD, total-nitrogen (T-N) and electric conductivity of AJ-SW2. It should be noted that SW2 is small a canal water located downstream of the improved area and of AJ-L1. As expected, the monitoring results of AJ-SW2 were more or less similar to those of AJ-L1, but at the lower (diluted) concentration range. The COD, total-nitrogen (T-N) and electric conductivity value started to decrease from the baseline values immediately after the PP works. This was considered reasonable as lesser surface water seeping into the landfill layers caused the initial increase in the concentration of the leachate, and also resulted in fewer overflow of the leachate into the surface water system.

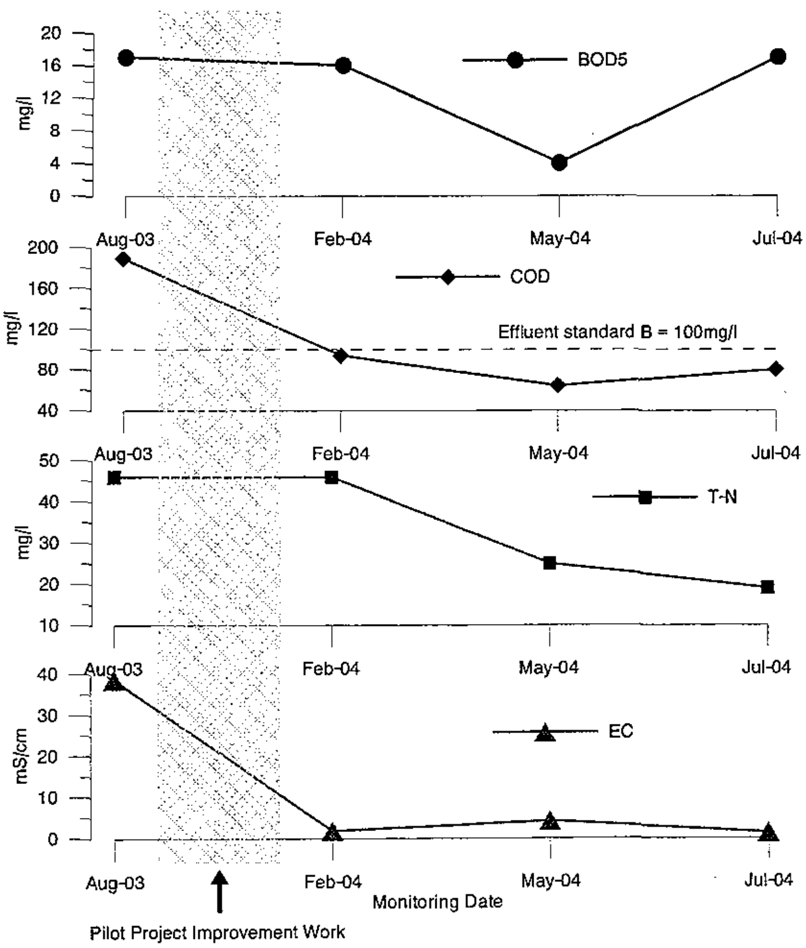


Figure 9.2.2 Ampang Jajar Surface Water (SW2) Monitoring Results

The COD in AJ-SW2 exceeded the Effluent Standard B limits during the baseline survey in August 2003. After the PP works, the COD results have been constantly lower than the effluent standard B as shown in **Figure 9.2.2**.

The Boron and Iron values for AJ-L1 and SW2 were plotted in **Figure 9.2.3**. These values also exceeded the Effluent Standard B limits during the baseline survey in August 2003. After the PP works, the results for the Boron and Iron tended to decrease and at the recent monitoring in July, 2004, their values were all below the Standard B limits.

These are considered as positive effects of the PP improvement works.

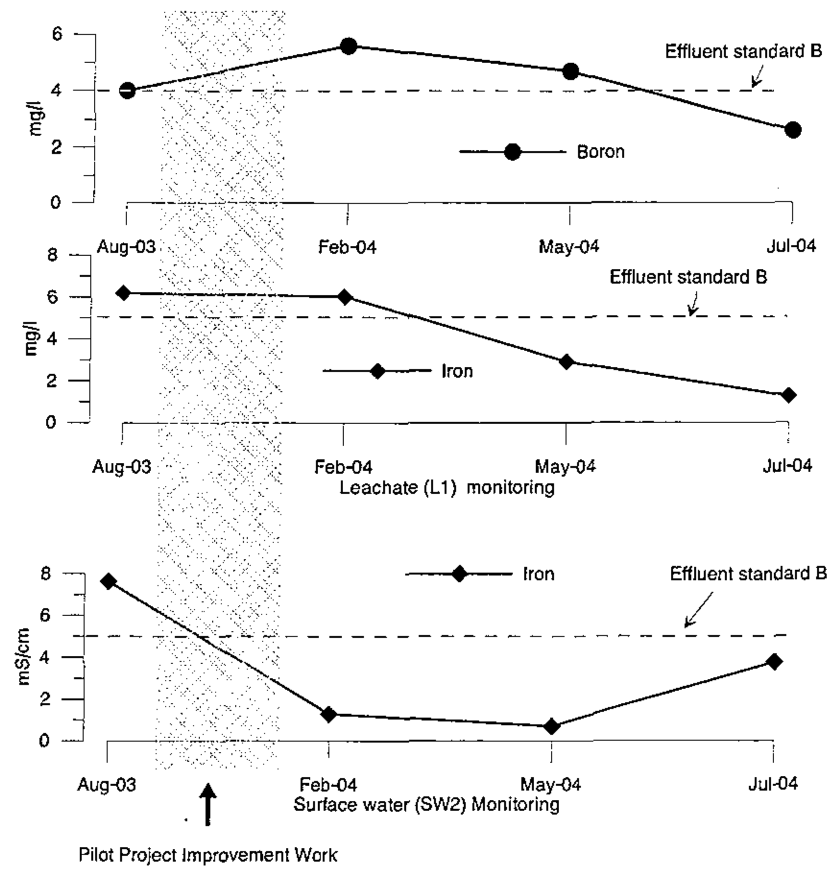


Figure 9.2.3 Ampang Jajar Leachate (L1) and Surface Water (SW2) Monitoring : Boron and Iron Data

(2) Groundwater

Figure 9.2.4 shows the results of the monitoring for BOD_5, COD, total-nitrogen (T-N) and electric conductivity of AJ-W3. It should be noted that W3 is a groundwater well south (downstream direction of groundwater flow) of the PP improved area. As previously discussed in Chapter 6, the groundwater flow of the area is expected to be about 2.0-20 m/year. Obviously, any changes in the water quality at the landfill area will take years before it reaches and affects the water quality at AJ-W3. In this view, the results as appeared in **Figure 9.2.4** seemed to be reasonable.

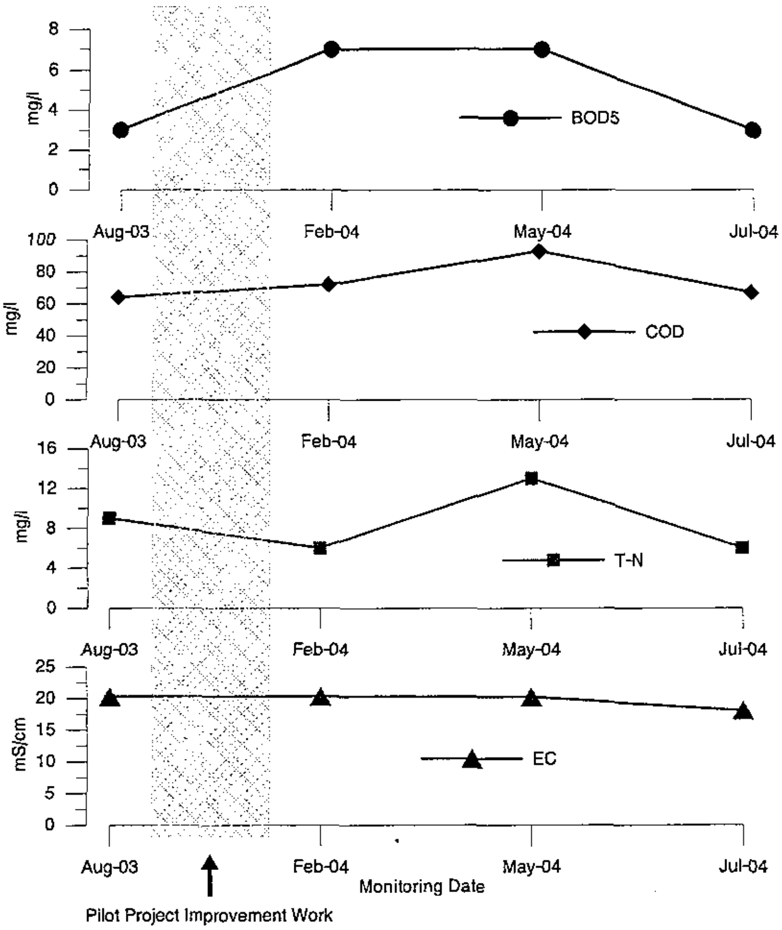


Figure 9.2.4 Ampang Jajar Groundwater (W3) Monitoring Results

(3) Landfill gas

Figure 9.2.5 shows the results of the monitoring for CH_4, CO_2, O_2 and N_2 of AJ-G1 and AJ-G2. It was found that the measurements taken in July, 2004 were not entirely correct due to some measurement error and therefore new measurements were taken in August, 2004.

The results for AJ-G1 showed fluctuated data for all the parameters. It seemed that the landfill gas generated by the organic decay, namely CH_4 and CO_2 tend to decrease after the PP works. The results for AJ-G2 also showed similar trends. It is premature at this early stage to conclude about the long-term effects of the PP improvement from the limited current data.

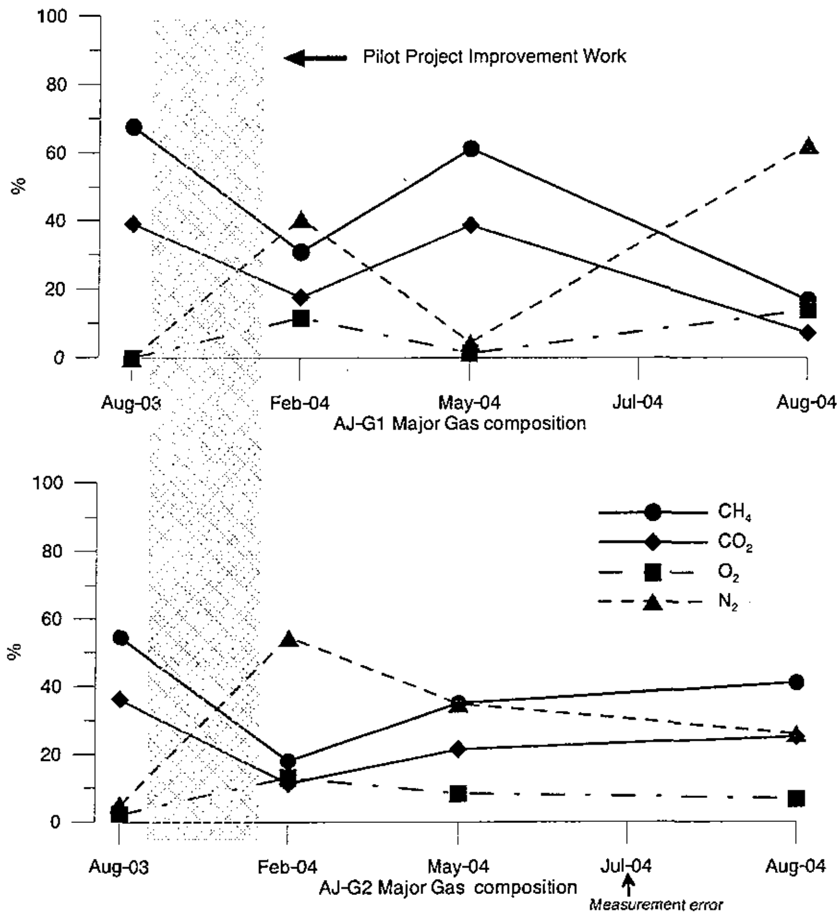


Figure 9.2.5 Ampang Jajar Landfill Gas Monitoring Results

9.2.2 Evaluation of Pekan Nenasi Pilot Project

At the Pekan Nenasi site, the monitoring points listed below are important for the environmental evaluation. The sampling points are;

PN-L1	Leachate monitoring at improved landfill cell
PN-SW2	Surface water monitoring at eastern section
PN-W2	Groundwater monitoring at south section

(1) Leachate and surface water

Figure 9.2.6 shows the results of the monitoring for BOD_5, COD, total-nitrogen (T-N) and electric conductivity of PN-L1. The COD, T-N and electric conductivity showed decreasing tendency after the PP works. The results for BOD_5 seemed they were not changed by the PP works.

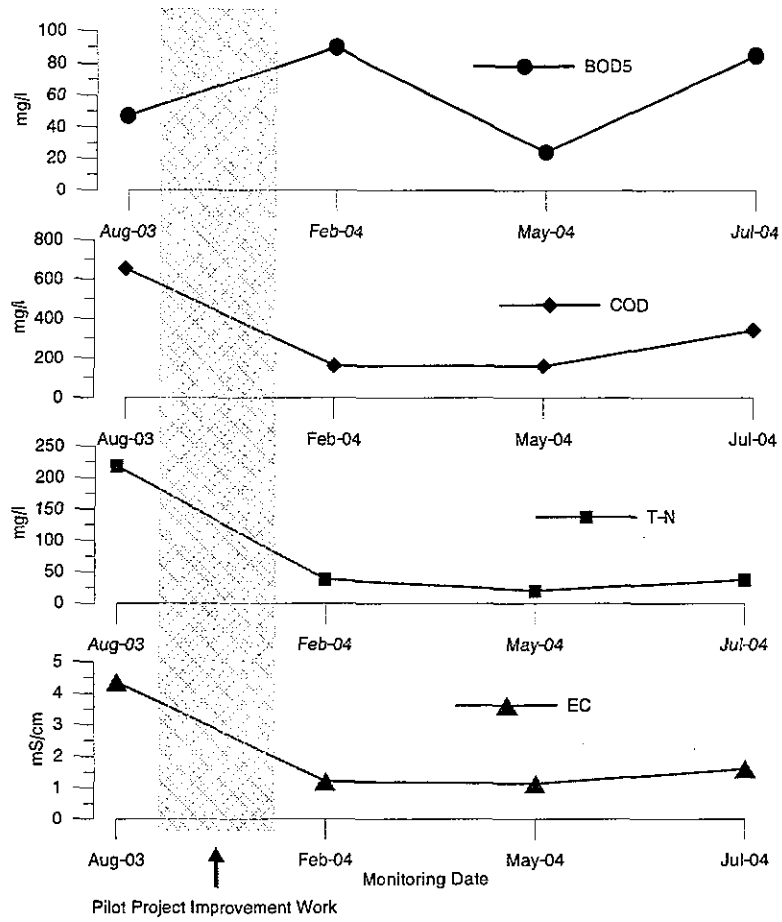


Figure 9.2.6 Pekan Nenasi Leachate (L1) Monitoring Results

Figure 9.2.7 shows the results of the monitoring for BOD_5, COD, total-nitrogen (T-N) and electric conductivity of PN-SW2. In general, the surface water around the site was stagnated. The concentrations of the above same parameters at SW2 were all at very low levels. It seemed that SW2 was not contaminated by the leachate from the site.

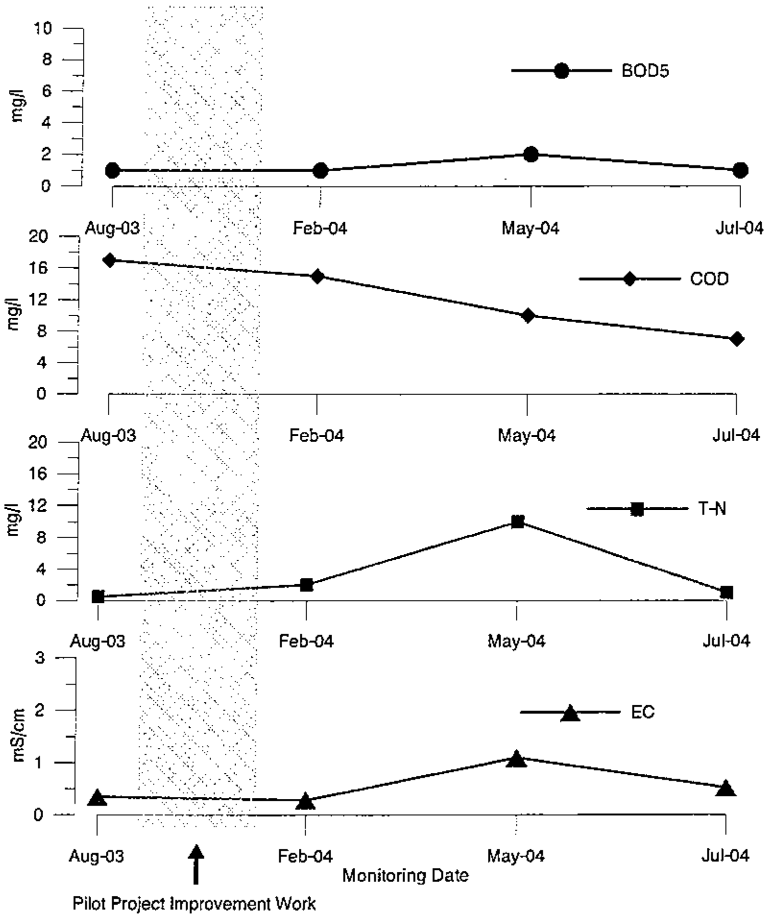


Figure 9.2.7 Pekan Nenasi Surface Water (SW2) Monitoring Results

(2) Groundwater

Figure 9.2.8 shows the results of the monitoring for BOD_5, COD, total-nitrogen (T-N) and electric conductivity of PN-W2. The W2 is a groundwater well at the middle of the site and just southeast of the PP improved area. There was no clear tendency of change in the water quality parameters. This was considered reasonable considering the slow groundwater flow and the presence of the sewage sludge disposal area adjacent to the site.

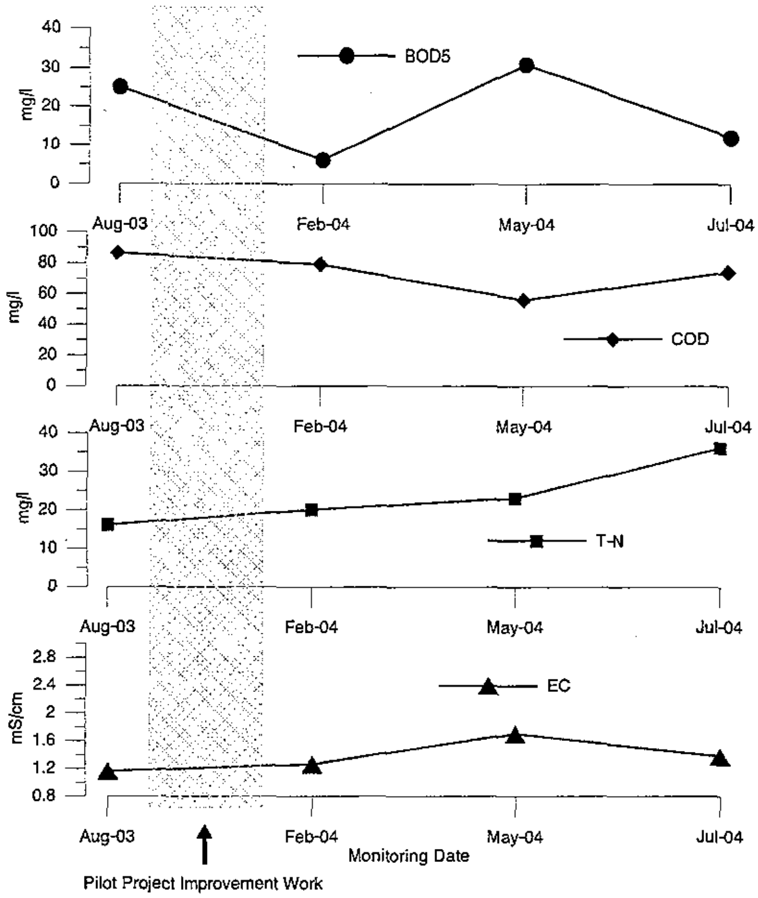


Figure 9.2.8 Pekan Nenasi Groundwater (W2) Monitoring Results

9.2.3 Evaluation of Ampang Jaya Pilot Project

At the Ampang Jaya site, the monitoring points listed below are important for the environmental evaluation. The sampling points are;

AM-L1	Leachate monitoring at discharge of leachate pond
AM-L2	Leachate monitoring at south of leachate pond
AM-SW2	Surface water monitoring at downstream
AM-W2	Groundwater monitoring at downstream area
AM-G1, G2	Landfill gas monitoring

(1) Leachate and surface water

Figure 9.2.9 and **Figure 9.2.10** show the results of the monitorings for BOD_5, COD, total-nitrogen (T-N) and electric conductivity of AM-L1 and AM-L2, respectively. The PP works at the site included the leachate collection system but without the leachate circulation or leachate treatment. Therefore, the leachate quality was not expected to improve much. **Figure 9.2.9** shows almost constant leachate quality for the AM-L1 samples taken at the discharge of the leachate pond. The AM-L2 samples, as shown in **Figure 9.2.10**, indicated improving quality for the COD, T-N and electric conductivity after February, 2004. The PP works resulted in the leachate being collected and thus minimise the penetration of the leachate into the ground and discharge to the waterways downstream. The monitoring of AM-L2 was taken here. Also as the result of the PP works, the leachate is now discharged straight to the surface water drains from the pond, which also reduce the leachate quantity at the AM-L2 location.

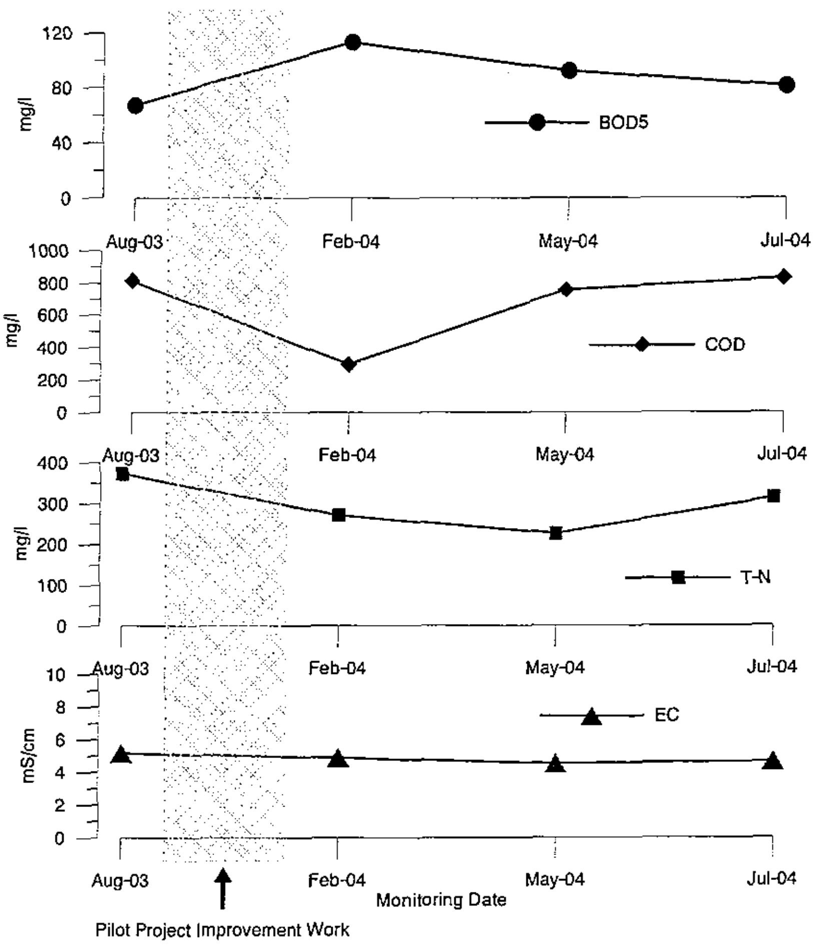


Figure 9.2.9 Ampang Jaya Leachate (L1) Monitoring Results

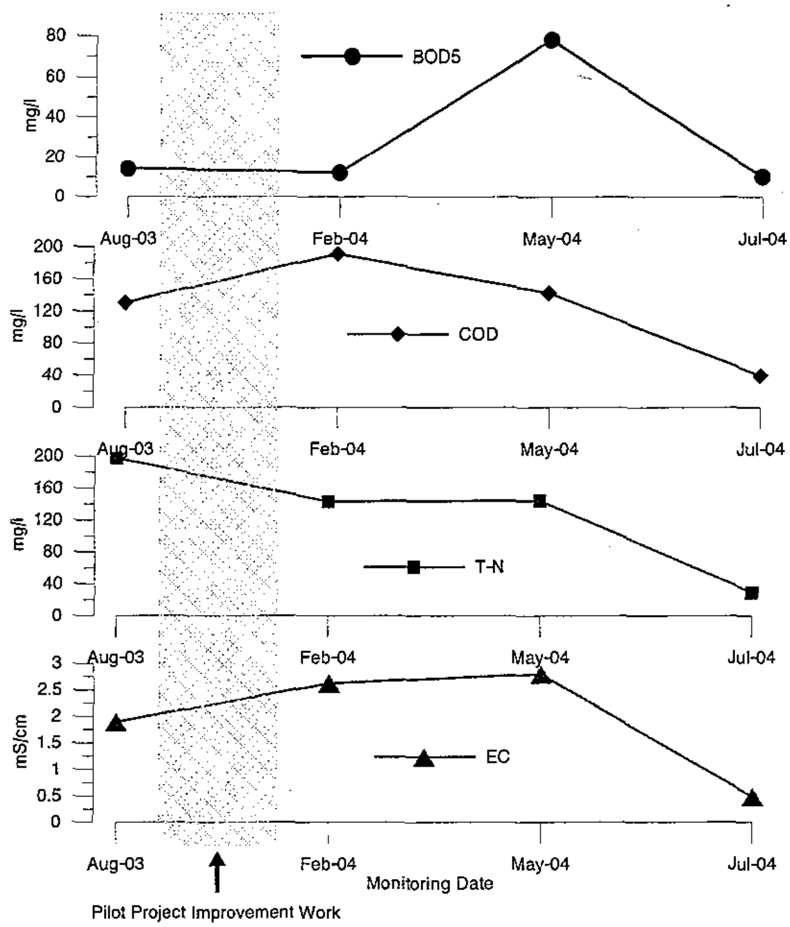


Figure 9.2.10 Ampang Jaya Leachate (L2) Monitoring Results

Figure 9.2.11 shows the results of AM-SW2. The COD, T-N and electric conductivity showed increased tendency after the PP works. This was considered reasonable as more leachate were collected by collection system and directly discharged to the waterway. It was noted that the COD values exceeded the Effluent Standard A limits.

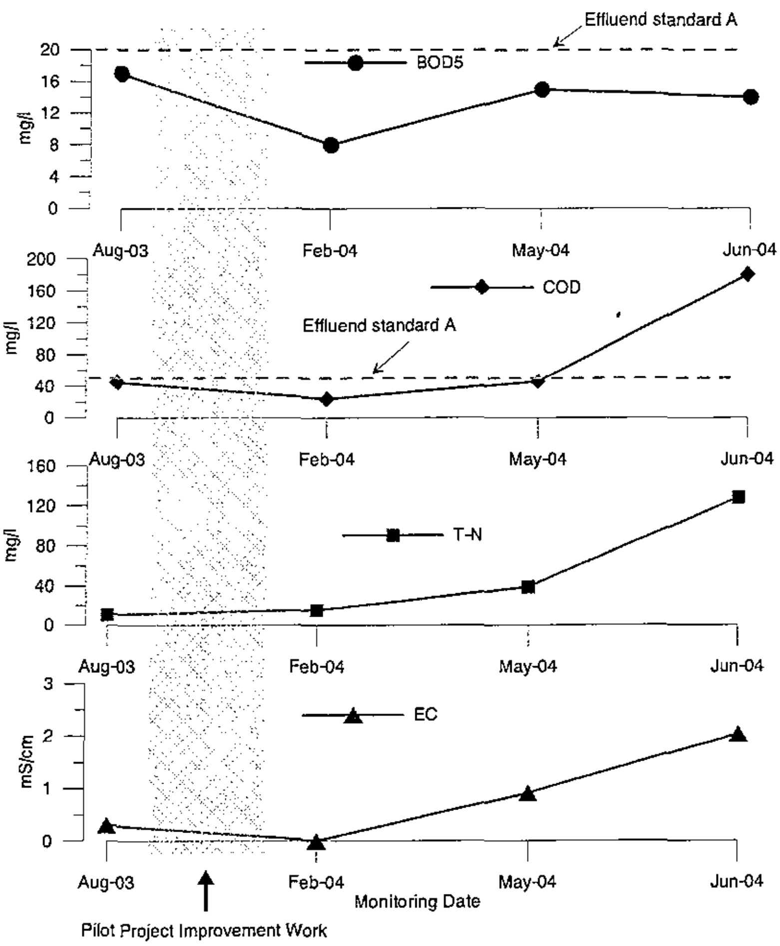


Figure 9.2.11 Ampang Jaya Surface Water (SW2) Monitoring Results

It was observed during the baseline survey that concentrations of Boron, Iron and Manganese were high in the leachate. **Figure 9.2.12** was prepared to confirm the condition of the 3 parameters at AM-SW2. The Boron in well below the Effluent Standard A, but Iron and Manganese have exceeded the limits. They also exhibited the tendency to increase upwards.

It is strongly recommended that the leachate treatment system should be provided, as there is a water intake point downstream of the site.

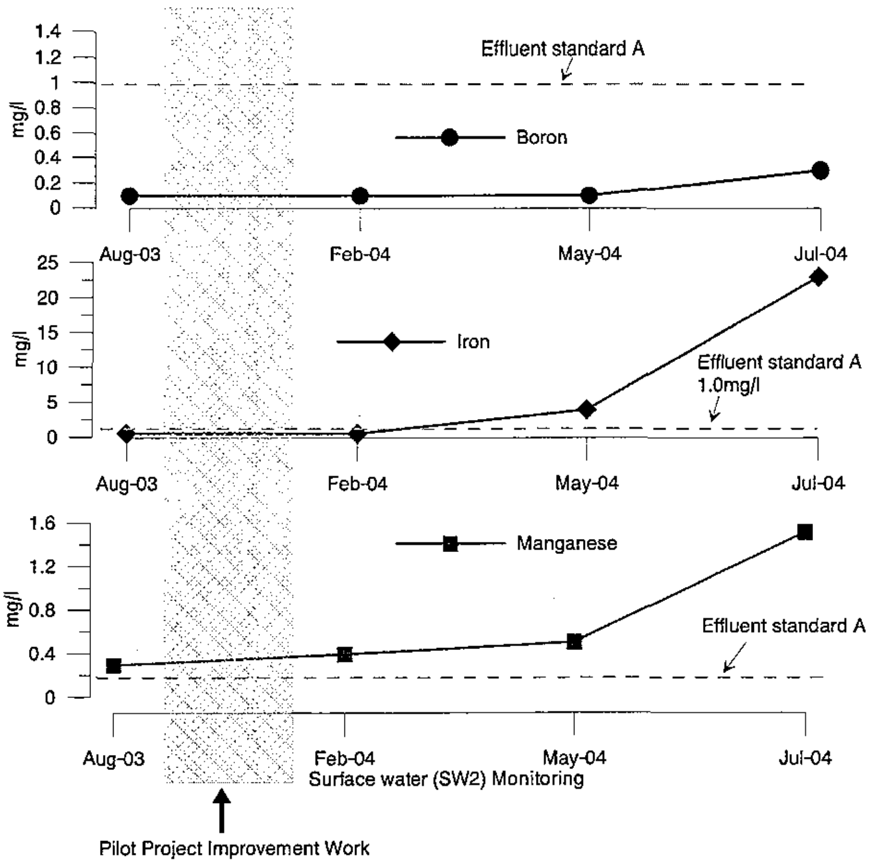


Figure 9.2.12 Ampang Jaya Surface Water (SW2) Monitoring: Boron, Iron and Manganese Data

(2) Groundwater

Figure 9.2.13 shows the monitoring results of AM-W2. Since the PP works provided the better leachate collection to reduce the ground penetration, the groundwater quality should improve in the long-term. However within the present monitoring period of the pilot project, the changes cannot be observed.

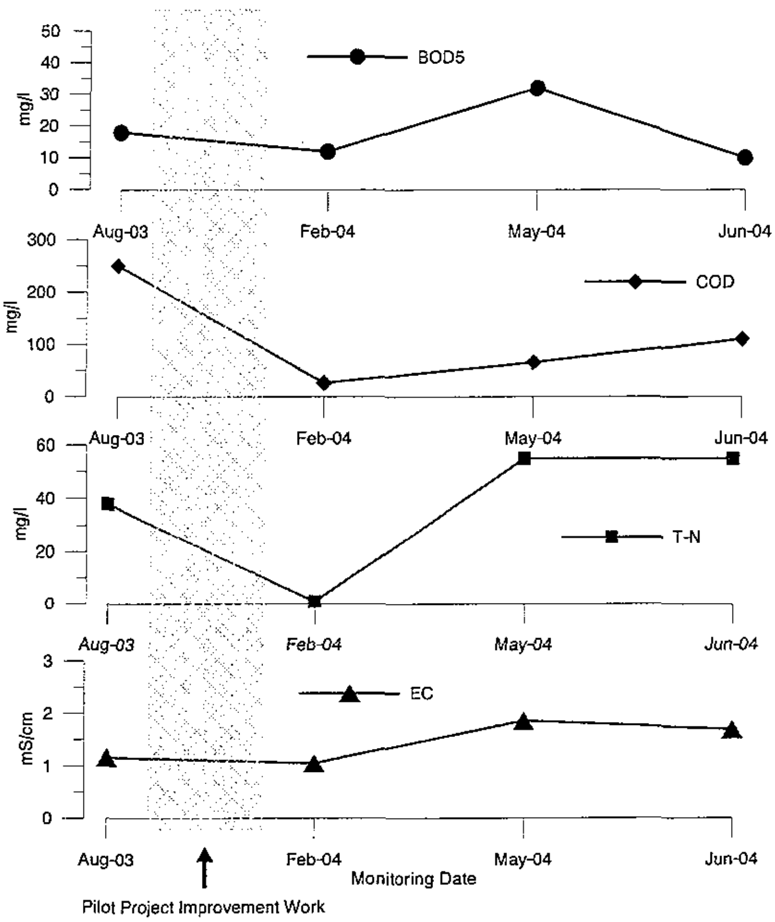


Figure 9.2.13 Ampang Jaya Groundwater (W2) Monitoring Results

(3) Landfill gas

Figure 9.2.14 shows the monitoring results of the landfill gas at AM-G1 and AM-G2. AM-G1 showed slight decrease in CH_4 and CO_2 and increase in N_2. This may indicate better air circulation into the waste layers. On the other hand, AM-G2 showed the opposite tendency with slight increase in CH_4 and CO_2 and decrease in N_2. In both points, the changes were not so significant and cannot be related definitely to the PP improvement works.

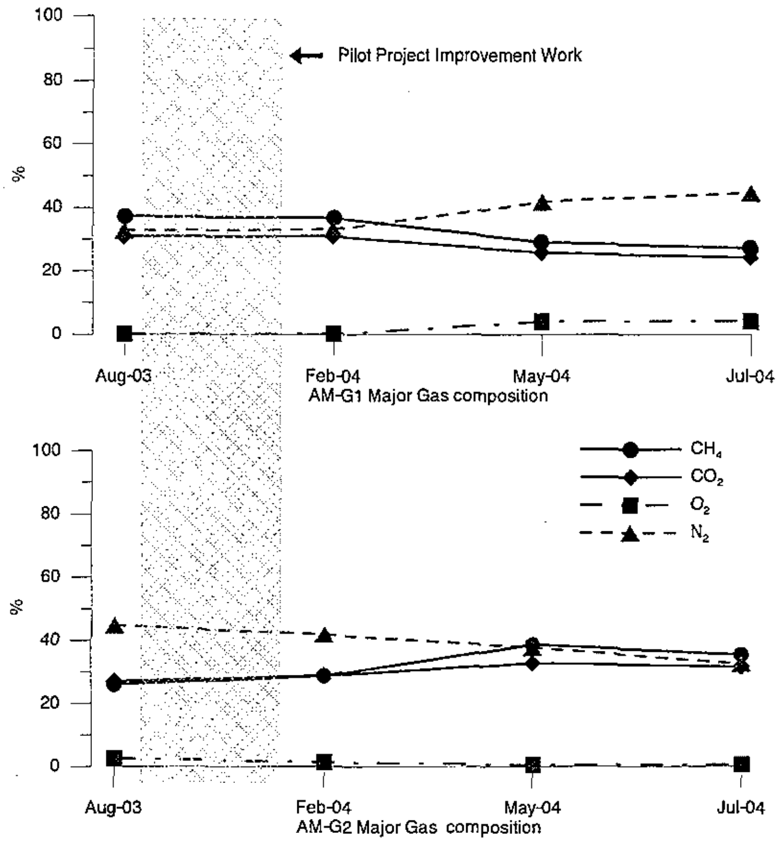


Figure 9.2.14 Ampang Jaya Landfill Gas Monitoring Results

9.2.4 Summary and conclusions

The PP works have provided positive effects in certain points whilst the other points did not show any changes or negative effects. The evaluation of the PP improvement from the environmental points of view are summarised in **Table 9.2.1**.

Table 9.2.1 Summary of Environmental Evaluation

	Ampang Jajar PP	Pekan Nenasi PP	Ampang Jaya PP
Leachate	**Positive effect** Quality deteriorated after PP due to lesser dilution, but started to improve later.	**Positive effect** Quality generally improved.	No change in quality but now in better controlled with leachate collection system.
Surface water	**Positive effect** Quality very well improved.	No change. No significant influence of leachate.	Negative effect. As leachate is directly discharge.
Groundwater	No change. Flow is slow.	No change. Flow is slow.	No change. Flow in slow.
Landfill gas	Fluctuating data. Require continuous monitoring.	No change. No landfill gas.	Slight change. Require continuous monitoring.
Note			Urgently requires leachate treatment system.

9.3 THE EVALUATION BY THE PUBLIC FOR THE IMPROVEMENT OF AMPANG JAJAR LANDFILL SITE

9.3.1 Background

Ampang Jajar landfill at MPSP (Majlis Perbandaran Seberang Perai: Seberang Perai Municipal Council) was chosen by the JICA Study team as one of the landfill sites for the implementation of the improvement works. Evaluation of the site was done through monitoring. However, the evaluation on the comprehensive effects and the feasibility of improvement is difficult at this time since post monitoring of the improvement is carried out in a very short period of time. Due to the constraint, the Study Team decided to implement the survey on public opinion for the improvement in line with a contingent valuation method (CVM), in which widely used to estimate economic values for all kinds of environmental services, in order to take into account aspect of the willingness to pay for the project. With the cooperation from MPSP, the survey was carried out on August 14, 2004 during the "Health Awareness Campaign" workshop, which was organised by MPSP with cooperation of the local community association.

9.3.2 Methodology

(1) Procedures

Two types of questionnaires was prepared by the Study Team and forwarded to MPSP in July, 2004. MPSP has made sufficient copies of the questionnaires and distributed them during the workshop. The actual procedures of the survey at the workshop are as follows:

(i) The questionnaires were given to every participant during the registration.
(ii) A local Study Team member made a presentation the overview of the project
(iii) The presenter later explained every questions and how to answer them.
(iv) The questionnaires were collected by the staff of MPSP after the presentation
(v) The completed questionnaires were handed to the Study Team
(vi) The delivered questionnaires were analysed by the Study Team

(2) Questionnaires

The questionnaires are designed to gather the public opinion on the pilot project, especially the cost sharing aspect for the improvement of landfill site. The period for post-closure management (PCM) for the Ampang Jajar landfill site may need a period of at least 10 years. In the questionnaire, the question on the willingness to pay for the project was asked in Q1. If the public are willing to pay, then he or she should answer Q2 by writing the annual amount they are willing to pay for a period of 10 years for every household. However, if the public are willing to pay but have no idea about the amount, they are guided in Q3 where they can select the amount ranging from RM2.00 to RM20.00/household/year with an increment of RM2.00. They are required to choose any of the amount stated. On the other hand, if the public are not willing to pay, they should proceed to Q4 where they are required to state the reason for their decision on why they are not willing to pay. For those who cannot make any decision or have no idea at all, they should proceed to Q5 to state their reasons or comments.

The contents of questionnaires are as follows:

Q1. Willingness to pay for the project

Q2. How much will you pay for the project in the next 10 years?

Q3. Willingness to pay 2-20RM/household/year for 10 years

50 percent of the number of copies of the questionnaires are made in such a way that the amount is written in ascending order, i.e. from RM2.00 to RM20.00 in RM2.00 increment while another 50 percent of the number of copies of the questionnaires show the amount is written in descending order; i.e. from RM20.00 to RM2.00 with the same RM2.00 interval. Hereinafter, the former questionnaire is expressed as "**Q2-20**" and the latter is as "**Q20-2**".

Q4. Reason why the respondents are not willing to pay in relation to Q1

Q5. Reason why the respondents have not decided to pay in relation to Q1

9.3.3 Result of the survey

(1) Basic description of the attendees and the completed questionnaires

The number of the attendees at the workshop and the questionnaires collected are shown at **Table 9.3.1**. According to MPSP, most of the attendees are the community leaders or their representatives.

Table 9.3.1 The Numbers of Attendees and Questionnaires Submission

The number of attendees (A)	216
The number of "*Q2-20*" (B) (RM2.00-RM20.00:ascending)	43
The number of "*Q20-2*" (C) (RM20.00-RM2.00: descending)	36
The number of questionnaires collected (D = B + C)	79
Cover ratio: (D/A) x 100 (%)	37%

Note: The collected questionnaires with no response are excluded

(2) Analysis of the questionnaires

a. Willingness to pay (Q1)

The number of the attendees who expressed their willingness to pay as per Q1 is shown in **Table 9.3.2**.

Table 9.3.2 Willingness to Pay for the Project

	Q2-20	Q20-2	Total
The number of questionnaires collected (A)	43	36	79
Attendees expressing the willingness to pay (B)	25	24	49
Attendees not willing to pay (C)	9	12	21

Attendees showed "No Idea" (D)	9	0	9
Attendees showed any opinions (E = B + C)	34	36	70
Ratio of attendees showed the willingness to pay (F = B/E x 100)	74%	67%	70%

Note: The number of attendees who marked "No Idea" in the questionnaire with no written reasons is not counted

The analysis showed that more than half of the attendees (70%) are willing to pay for the project. Although majority of them expressed their willingness to pay for the project, some refused to pay. The reasons of their reluctance to pay are given in Q4 of the questionnaire. Five attendees who answered "**Q2-20**" mentioned that "MPSP should finance the project since they are already paying tax to the council". Similar reason was put forward by 4 attendees who answered "**Q20-2**". Although these nine attendees refuse to share the cost of financing the project, they support the improvement works and appreciate the importance. Taking this into consideration, the total attendees that support the project are 58 i.e. 30 attendees who answered questionnaire type "**Q2-20**" and 28 attendees who answered questionnaire type "**Q20-2**". The ratio of support for the project is shown in **Table 9.3.3** which is about 80% in total.

Table 9.3.3 Attendees Showed the Support for the Project

	Q2-20	Q20-2	Total
Attendees expressed opinions (A)	34	36	70
Attendees who are willing to pay (B)	25	24	49
Attendees who are not willing to pay in Q1 but support in Q4 (C)	5	4	21
Attendees support the project (D= B + C)	30	28	58
Ratio of attendees showed their support for the project (F = D/A x 100)	88%	78%	83%

b. The amount that is willing to pay based on Q2: Attendees input

From the feedback on Q2, some of the attendees who indicated their willingness to pay for the project, stated the amount they are willing to pay. The amount is shown in **Table 9.3.4**. The table shows that more than 60% of the attendees have expressed their willingness to pay and provide the actual amount that they are willing to pay. This answer is the reflection of those who are really determined to pay for the project. But the feedback indicates clearly that values of "**Q2-20**" are lower than those of "**Q20-2**" (See **Figure 9.3.1**). There are two peaks of RM2.00 and RM12.00 in **Figure 9.3.1 (1)**, but there is no significant relationship observed. **Figure 9.3.1 (2)** does not show any relationship too. Therefore, it is to be concluded that the characteristic of attendees response cannot be described in any special probability function.

There is supposed to be an influence of the figures on the list in Q3. The list of questionnaire type "**Q2-20**" starts from RM2.00 but that of "**Q20-2**" is RM20.00. The total average will be applied for the evaluation, in order to wipe the influence away.

Table 9.3.4 Amount to be Paid for the Project

	Q2-20	Q20-2	Total
Attendees expressing their willingness to pay in Q1(A)	25	24	49
Attendees who has given actual amount they are willing to finance in Q2 (B)	17	16	33
B/A x 100 %	68%	67%	67%
Maximum value (RM)	*20*	*50*	*50*
Minimum value (RM)	*1*	*2*	*1*
Arithmetic mean (RM)	*7.2*	*14.8*	*10.9*
Geometric mean (RM)	*4.1*	*9.8*	***6.3***

Table 9.3.4 shows that those who have expressed their willingness to pay for the project and had also provide the average annual amount that they are willing to pay is RM6.3/household for 10 years. Two distributions of answers are shown in **Figure 9.3.1.**

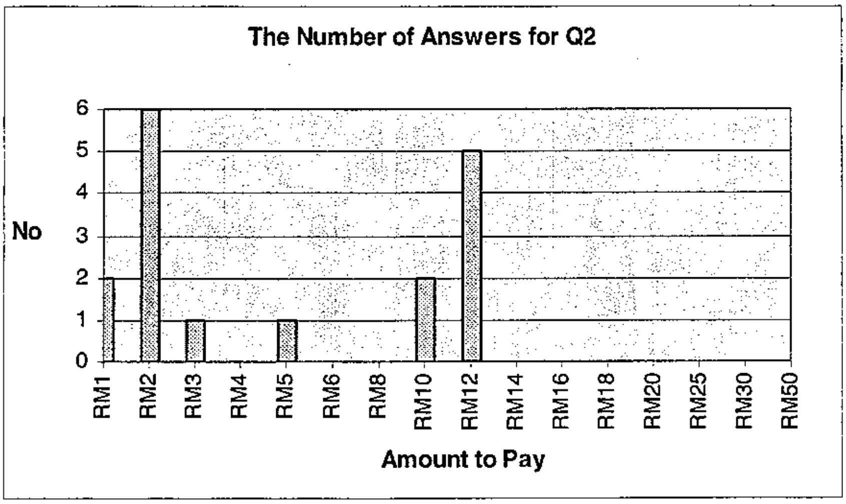


Figure 9.3.1 (1) Distribution of Answers of Q2 for "Q2-20"

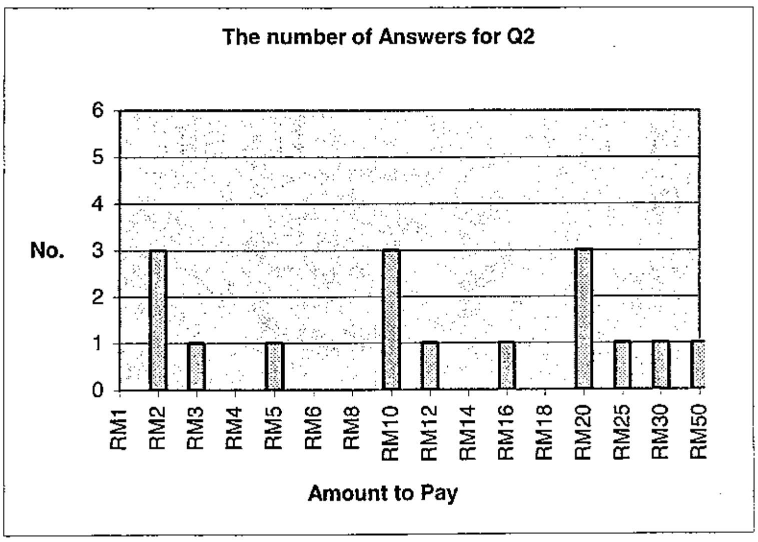


Figure 9.3.1 (2) Distribution of Answers of Q2 for "Q20-2"

c. The amount to pay (Q3): Selection from RM2.00 to RM20.00

Although some of the attendees indicated their willingness to pay, they did not provide the actual amount to be paid. In order to guide them, certain amount is proposed value ranging from RM2.00 and RM20.00 with every an increase of RM2.00 interval and this is shown as 10 sub questions of Q3. The result is summarised in **Table 9.3.5**. Although only a few answers are received, it clearly shows that the amount stated for "**Q2-20**" are lower than those for "**Q20-2**". Similar to Q2, it does not also indicate any specific relationship. The arithmetic means for "**Q2-20**" and "**Q20-2**" is RM6.8/household/year and RM16.8/household/year respectively. The value is lower than Q2 for questionnaire "**Q2-20**" and higher than Q2 for "**Q20-2**". However, the differences were not very significant. Therefore, the answer for Q2 and Q3 seemed to indicate that the group that replied to Q3 is the same sample group that replied to Q2.

Table 9.3.5 Answers Selected fromRM2.00 to RM20.00

Amount to pay	Numbers of answer		Total
	Q2-20	Q20-2	
RM2.00	2	0	2
RM4.00	0	0	0
RM6.00	0	0	0
RM8.00	0	0	0
RM10.00	3	0	3
RM12.00	0	2	2
RM14.00	0	0	0
RM16.00	0	0	0
RM18.00	0	0	0
RM20.00	0	3	3
Total number of answers	5	5	10
Maximum value (RM)	*10*	*20*	*20*
Minimum value (RM)	*2*	*12*	*2*
Arithmetic mean (RM)	*6.8*	*16.8*	*11.8*

d. Complete answers available for cost sharing

Even though there are several ironical answers for Q3, those data seems to be reliable because they explained the reason in Q4 and provide the actual amount in Q3. Therefore these data can also be summed up into one group.

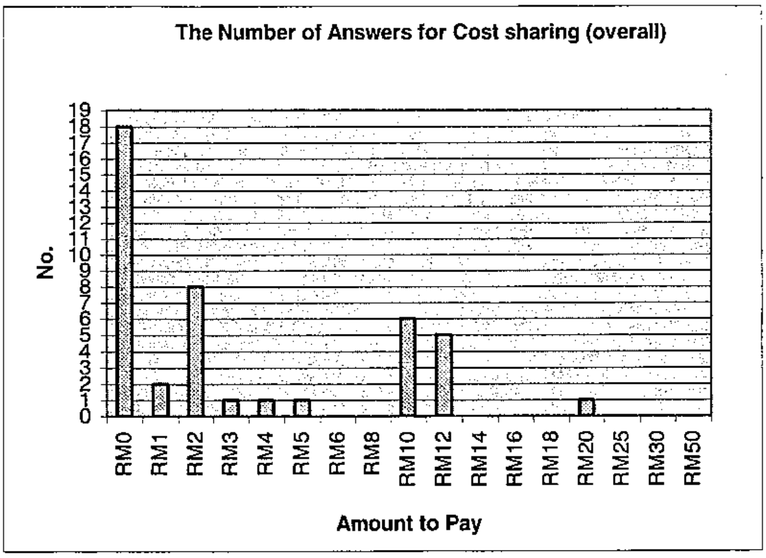


Figure 9.3.2 (1) Distribution of Amount to Pay for "Q2-20"

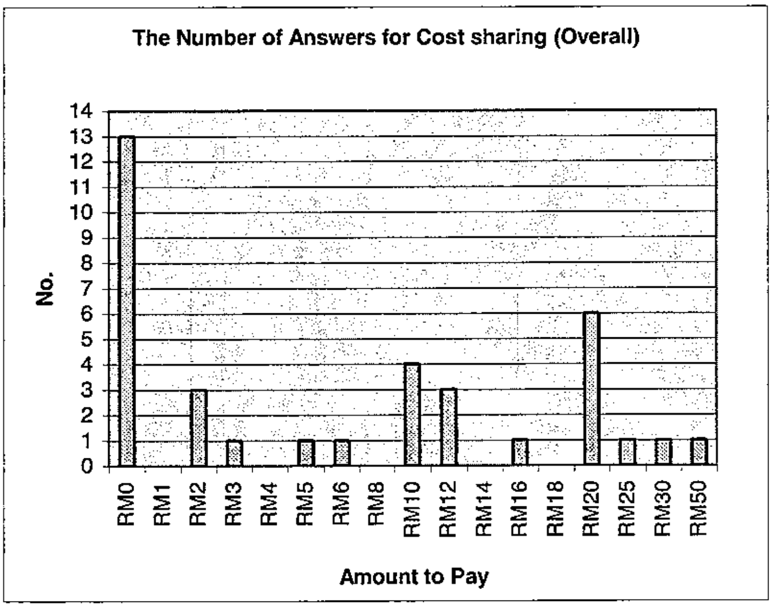


Figure 9.3.2 (2) Distribution of Amount to Pay for "Q20-2"

e. Total answers on amount that is willing to be paid

In order to balance the effect of orders of the values shown in Q3, the answers for both questionnaires can be summed up and treated as one group, because the total number of answers is not so different and neither both groups show any specific distribution functions.

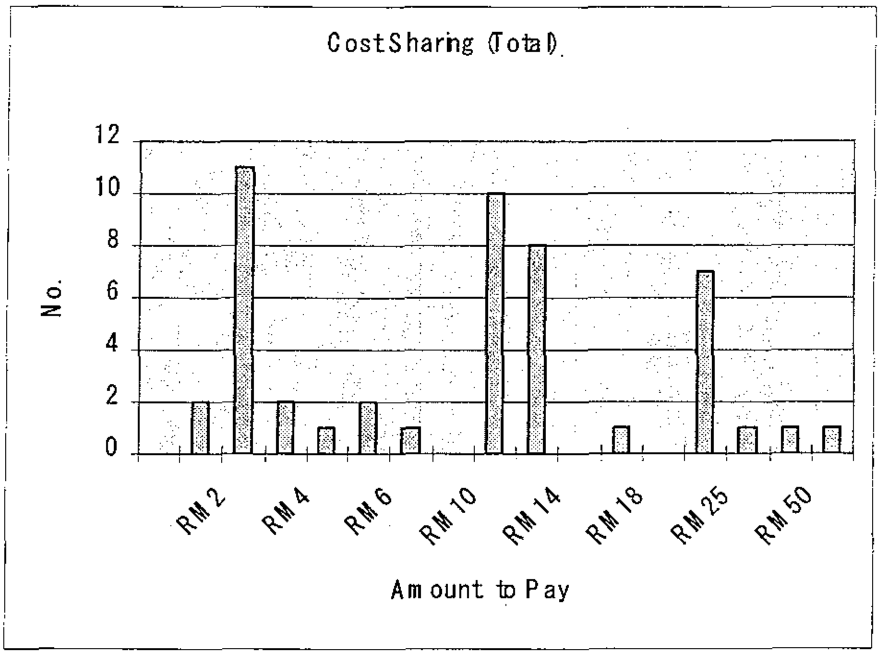


Figure 9.3.3 Distribution of Cost Sharing for "Q2-20" and "Q20-2"

The arithmetic mean for the data shown in **Figure 9.3.3** is 11.0. This mean is not so much different from that of **Table 9.3.4**. Therefore, the amount that the public are willing to finance the cost of the project is estimated as 11RM/household/year based on the public of MPSP who attended the workshop.

f. Evaluation of project cost

In order to evaluate the value for the improvement of the Ampang Jajar landfill site as one of pilot projects, the study team apply the figure from the survey and calculate the value of willingness to pay. The JICA Study Team is standing at pessimistic position, the lower values of the figure are applied for calculation. Based on the survey, the public opinion on the improvement project in Ampang Jajar landfill site are summarized into as follows:

(i) 70% of households are in favour of the project and are willing to pay. (*See Table 9.3.2.*)

(ii) The amount they are willing to pay for the project is estimated to be RM6.30/household/year. (See *Table 9.3.4.*)

Basic conditions for the project in Ampang Jajar landfill site are as follows:

(a) The number of the households in MPSP is 166,266 in the year of 2003

(b) In the workshop, it is explained that the project covered 20% of whole area of the site. Therefore, the attendees at the workshop recognized a scale of the project and evaluate the cost based on this scale.

(c) In the workshop and questionnaires, it is explained that period of 10 years is required to finance the project. But a few of the attendees possibly might not realise the period and expressed the willingness to pay for 1 year period.

Based on above conditions, value of willingness to pay for the project implementation can be estimated as follows:

70% x *166,266* households x RM*6.30*/household/year x *100/20* x *10* years = RM*36,662,000*

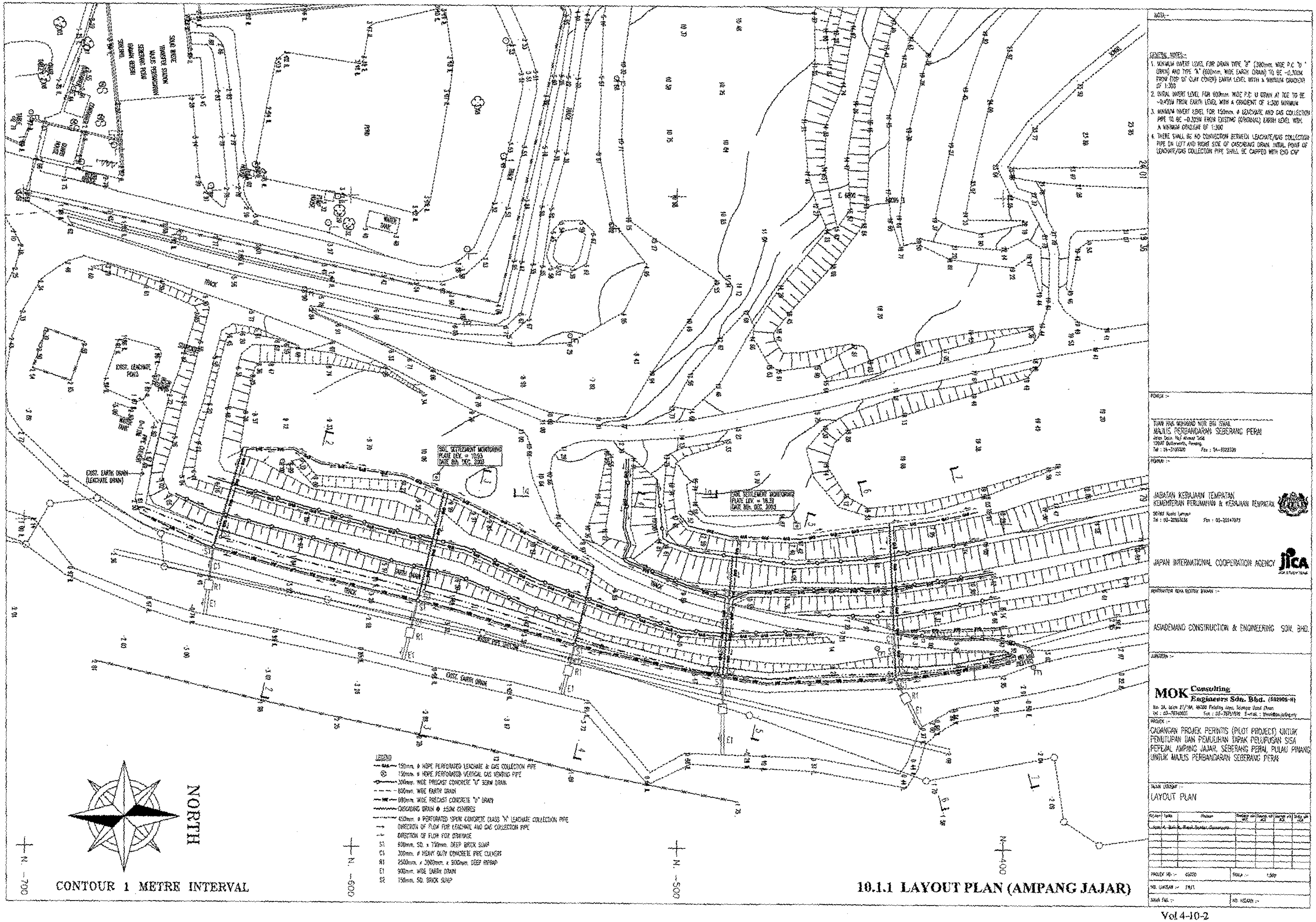
Meanwhile, in accordance with the pilot project cost and O/M cost estimation by the JICA study, project cost can be estimated as follows.

RM*669,805* x *100/20* + RM*241,699* x *10* years = RM*5,766,000*

Compare with above two values, it can be assumed that the project cost can be covered by the value of willingness to pay.

CHAPTER 10 DRAWINGS OF PILOT PROJECTS

10.1 AMPANG JAJAR LANDFILL SITE

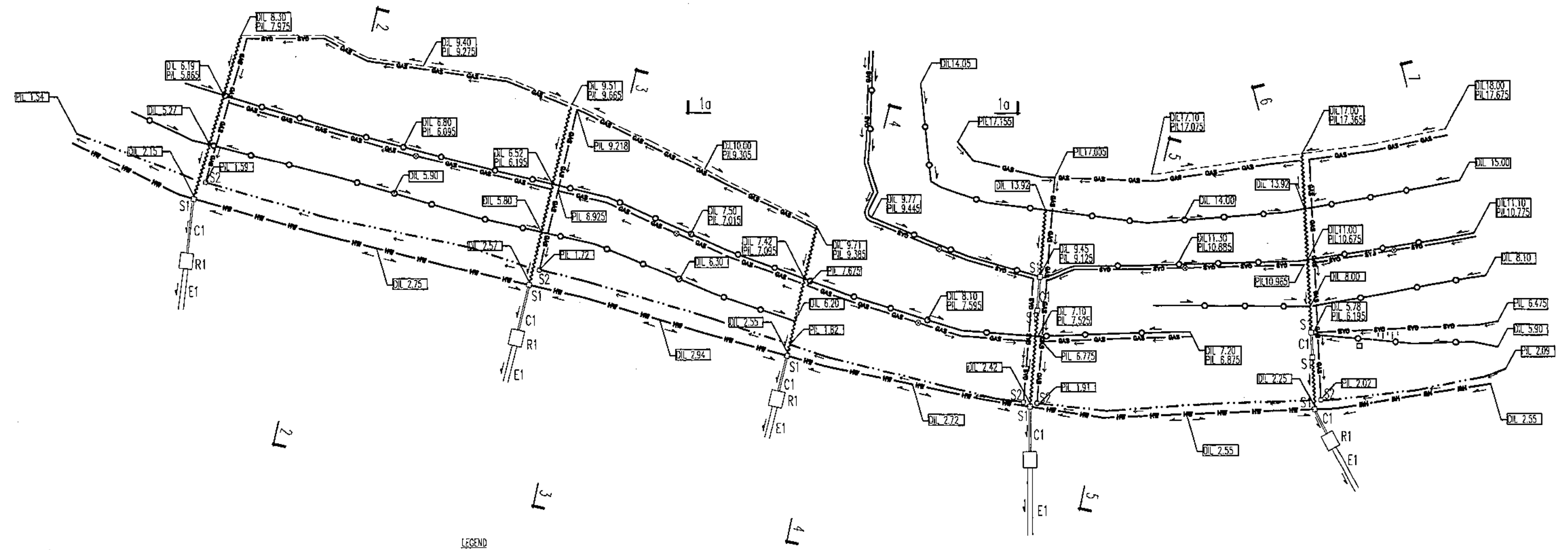


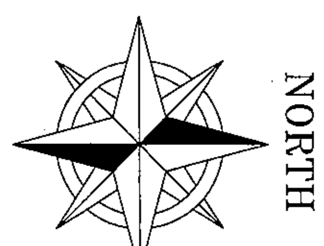
10.1.1 LAYOUT PLAN (AMPANG JAJAR)

NOTA:-

GENERAL NOTES:-

1. MINIMUM INVERT LEVEL FOR DRAIN TYPE "B" (300mm. WIDE P.C "U " DRAIN) AND TYPE "A" (600mm. WIDE EARTH DRAIN) TO BE −0.300M FROM (TOP OF CLAY COVER) EARTH LEVEL WITH A MINIMUM GRADIENT 1:300
2. INITIAL INVERT LEVEL FOR 600mm. WIDE P.C U DRAIN AT TOE TO BE −0.450M FROM EARTH LEVEL WITH A GRADIENT OF 1:300 MINIMUM
3. MINIMUM INVERT LEVEL FOR 150mm. ø LEACHATE AND GAS COLLECTION PIPE TO BE −0.325M FROM EXISTING (ORIGINAL) EARTH LEVEL WITH A MINIMUM GRADIENT OF 1:300
4. THERE SHALL BE NO CONNECTION BETWEEN LEACHATE/GAS COLLECTION PIPE ON LEFT AND RIGHT SIDE OF CASCADING DRAIN. INITIAL POINT OF LEACHATE/GAS COLLECTION PIPE SHALL BE CAPPED WITH END CAP





N. −700

N. −600

N. −500

N. −400

CONTOUR 1 METRE INTERVAL

LEGEND

- 150mm. ø HDPE PERFORATED LEACHATE & GAS COLLECTION PIPE
- 150mm. ø HDPE PERFORATED VERTICAL GAS VENTING PIPE
- 300mm. WIDE PRECAST CONCRETE "U" BERM DRAIN
- 600mm. WIDE EARTH DRAIN
- 600mm. WIDE PRECAST CONCRETE "U" DRAIN
- CASCADING DRAIN @ ±50M CENTRES
- 450mm. ø PERFORATED SPUN CONCRETE CLASS "H" LEACHATE COLLECTION PIPE
- DIRECTION OF FLOW FOR LEACHATE AND GAS COLLECTION PIPE
- DIRECTION OF FLOW FOR DRAINAGE

S1	900mm. SQ. x 750mm. DEEP BRICK SUMP
C1	300mm. ø HEAVY DUTY CONCRETE PIPE CULVERT
R1	2500mm. x 3000mm. x 900mm. DEEP RIPRAP
E1	900mm. WIDE EARTH DRAIN
S2	750mm. SQ. BRICK SUMP
DIL	PROPOSED DRAIN INVERT LEVEL
PIL	PROPOSED LEACHATE AND GAS COLLECTION PIPE INVERT LEVEL

ALL INVERT LEVELS FOR PIPES AND DRAINS SHOWN ARE TO BE ASCERTAINED ON SITE BEFORE COMMENCEMENT OF WORKS

10.1.2 LAYOUT PLAN - SHOWING INVERT LEVEL (AMPANG JAJAR)

PEMILIK :-

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PROJEK :-

CADANGAN PROJEK PERINTIS (PILOT PROJECT) UNTUK PENUTUPAN DAN PEMULIHAN TAPAK PELUPUSAN SISA PEPEJAL AMPANG JAJAR, SEBERANG PERAI, PULAU PINANG UNTUK MAJLIS PERBANDARAN SEBERANG PERAI

TAJUK LUKISAN :-

LAYOUT PLAN – SHOWING INVERT LEVEL

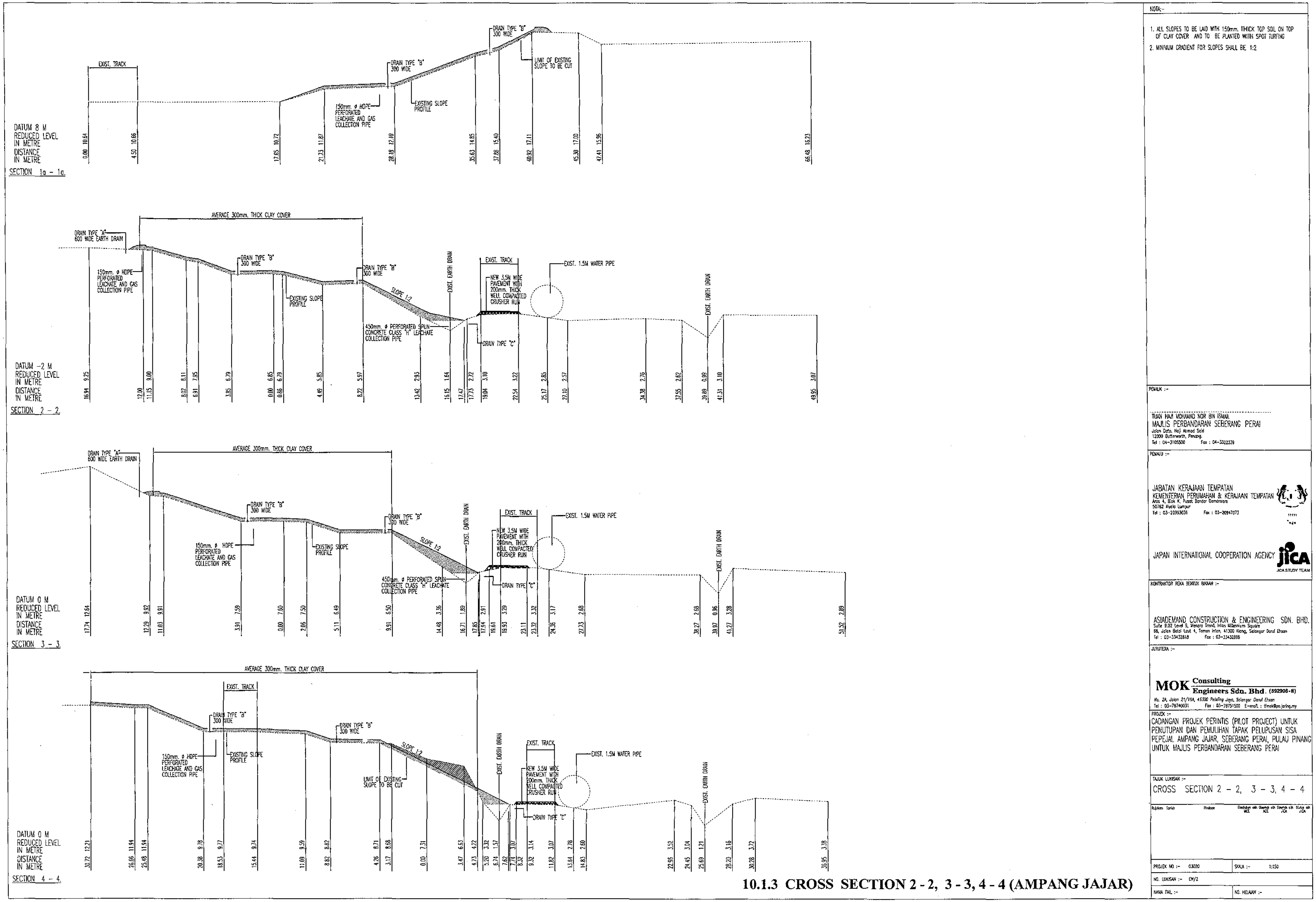
Rujukan	Tarikh	Pindaan	Disediakan oleh MCE	Disemak oleh ACE	Disemak oleh JICA	Dilulus oleh JICA

PROJEK NO :- 03020 SKALA :- 1:500

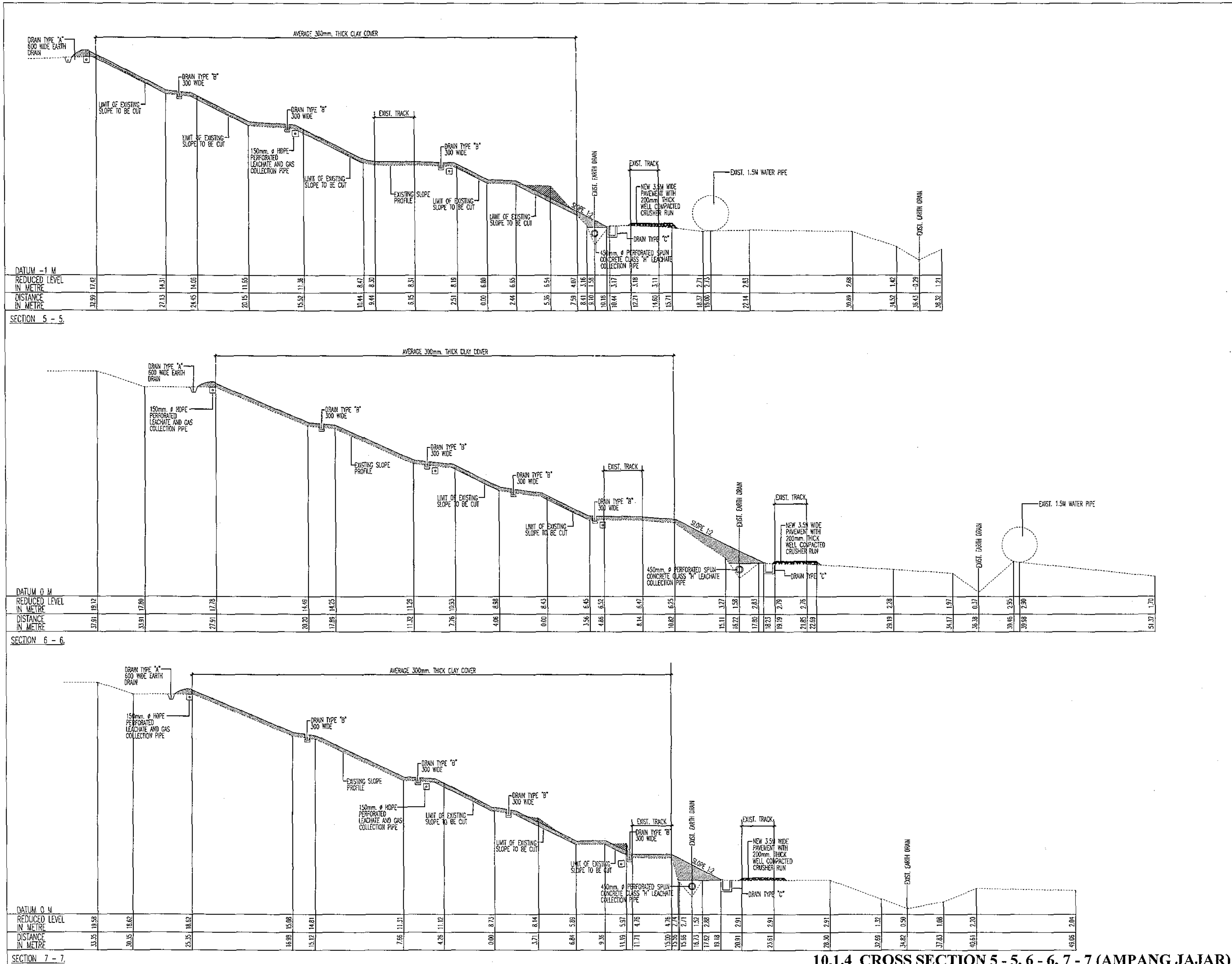
NO. LUKISAN :- EW/6

NAMA FAIL :- NO. HELAIAN :-

JICA STUDY TEAM



10.1.3 CROSS SECTION 2 - 2, 3 - 3, 4 - 4 (AMPANG JAJAR)



10.1.4 CROSS SECTION 5 - 5, 6 - 6, 7 - 7 (AMPANG JAJAR)

NOTA:-

1. ALL SLOPES TO BE LAID WITH 150mm. THICK TOP SOIL ON TOP OF CLAY COVER AND TO BE PLANTED WITH SPOT TURFING
2. MINIMUM GRADIENT FOR SLOPES SHALL BE 1:2

PEMILIK :-

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PROJEK :-

CADANGAN PROJEK PERINTIS (PILOT PROJECT) UNTUK PENUTUPAN DAN PEMULIHAN TAPAK PELUPUSAN SISA PEPEJAL AMPANG JAJAR, SEBERANG PERAI, PULAU PINANG UNTUK MAJLIS PERBANDARAN SEBERANG PERAI

TAJUK LUKISAN :-

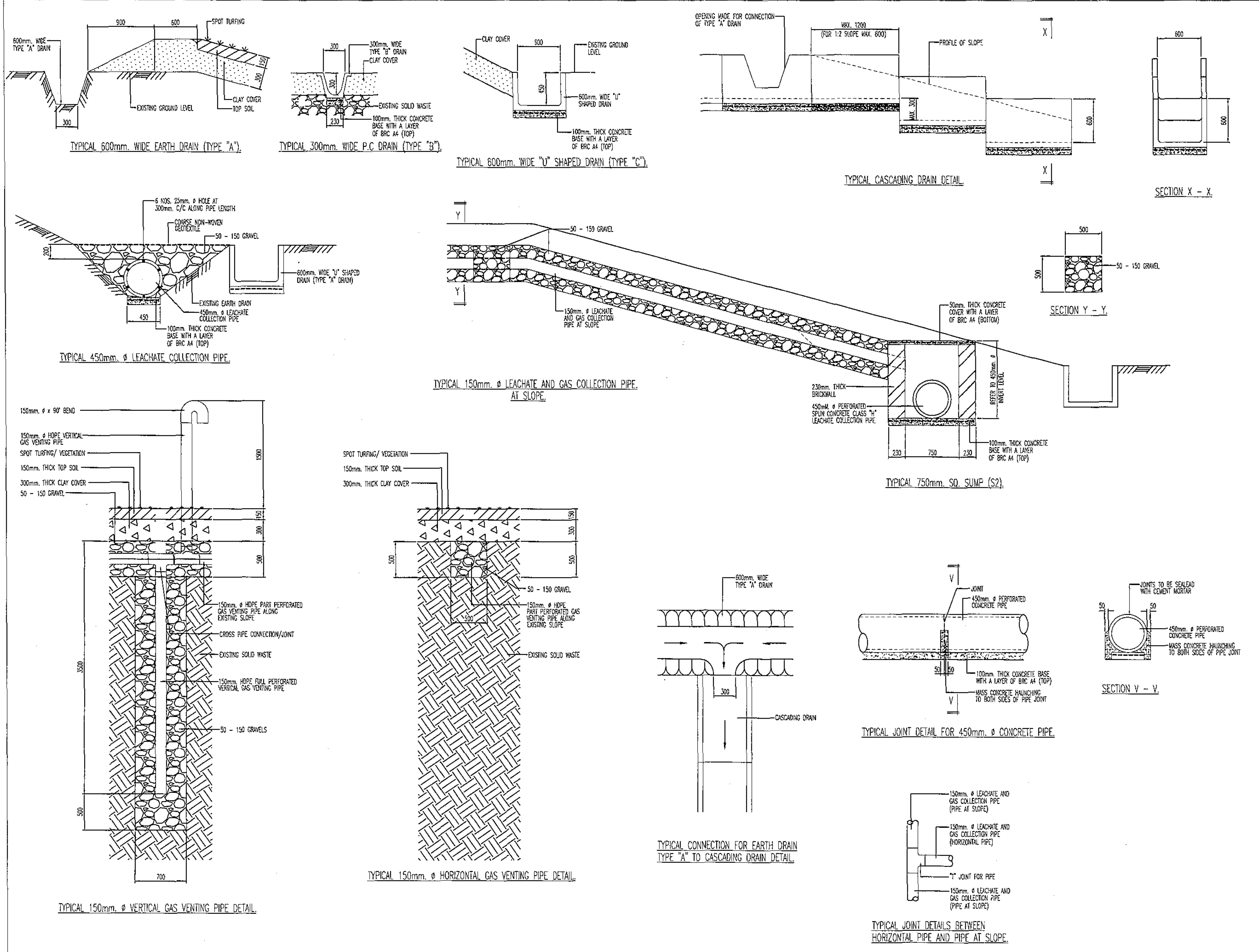
CROSS SECTION 5 - 5, 6 - 6, 7 - 7

Rujukan	Tarikh	Pindaan	[illegible] UCE	[illegible] ACE	[illegible] JICA	[illegible] JICA

PROJEK NO :- 03020 SKALA :- 1:150

NO. LUKISAN :- EW/3

NAMA FAIL :- NO. HELAIAN :-



NOTA:-

1. ALL SLOPES TO BE LAID WITH 150mm. THICK TOP SOIL ON TOP OF CLAY COVER AND TO BE PLANTED WITH SPOT TURFING
2. MINIMUM GRADIENT FOR SLOPES SHALL BE 1:2
3. CONCRETE BASE FOR DRAIN/SUMP SHALL BE OF MINIMUM GRADE 20

PEMILIK :-
TUAN HAJI MOHAMAD NOR BIN ISMAIL
MAJLIS PERBANDARAN SEBERANG PERAI

PEMAJU :-
JABATAN KERAJAAN TEMPATAN
KEMENTERIAN PERUMAHAN & KERAJAAN TEMPATAN

JAPAN INTERNATIONAL COOPERATION AGENCY

KONTRAKTOR REKA BENTUK BINAAN :-
ASIADEMAND CONSTRUCTION & ENGINEERING SDN. BHD.

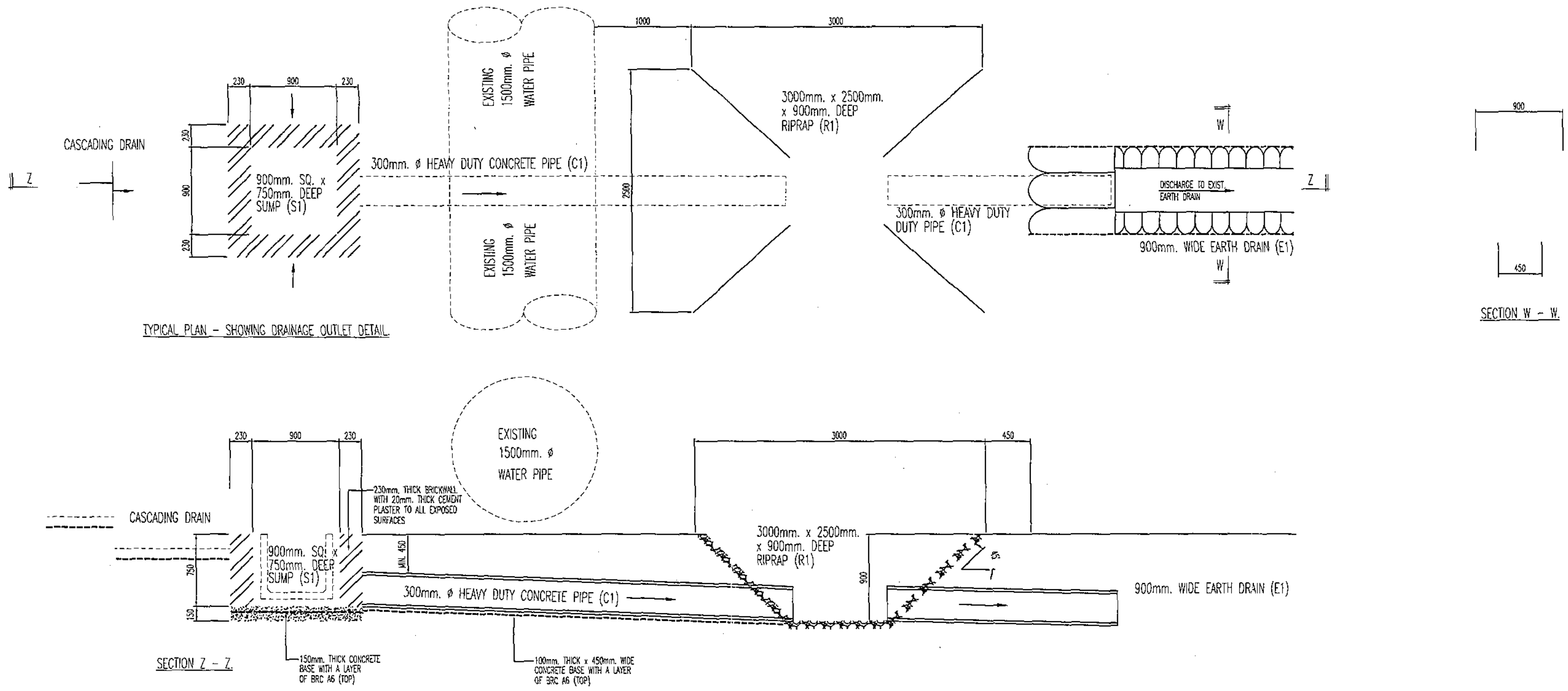
JURUTERA :-
MOK Consulting Engineers Sdn. Bhd. (592908-H)

PROJEK :-
CADANGAN PROJEK PERINTIS (PILOT PROJECT) UNTUK PENUTUPAN DAN PEMULIHAN TAPAK PELUPUSAN SISA PEPEJAL AMPANG JAJAR, SEBERANG PERAI, PULAU PINANG UNTUK MAJLIS PERBANDARAN SEBERANG PERAI

TAJUK LUKISAN :-
TYPICAL DRAINS AND GAS PIPIES DETAIL

PROJEK NO :- 03020 SKALA :- 1:25
NO. LUKISAN :- EW/4
NAMA FAIL :- NO. HELAIAN :-

10.1.5 TYPICAL DRAINS AND GAS PIPIES DETAIL (AMPANG JAJAR)



NOTA:-

1. ALL SLOPES TO BE LAID WITH 150mm. THICK TOP SOIL ON TOP OF CLAY COVER AND TO BE PLANTED WITH SPOT TURFING
2. MINIMUM GRADIENT FOR SLOPES SHALL BE 1:2
3. CONCRETE BASE FOR DRAIN/SUMP SHALL BE OF MINIMUM GRADE 20

PEMILIK :-

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JURUTERA :-

MOK Consulting Engineers Sdn. Bhd. (592906-H)

PROJEK :-

CADANGAN PROJEK PERINTIS (PILOT PROJECT) UNTUK PENUTUPAN DAN PEMULIHAN TAPAK PELUPUSAN SISA PEPEJAL AMPANG JAJAR, SEBERANG PERAI, PULAU PINANG UNTUK MAJLIS PERBANDARAN SEBERANG PERAI

TAJUK LUKISAN :-

TYPICAL DRAINS DETAIL

PROJEK NO :- 03020	SKALA :- 1:25
NO. LUKISAN :- EM/5	
NAMA FAIL :-	NO. KELUAN :-

10.1.6 TYPICAL DRAINS DETAIL (AMPANG JAJAR)