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SOLID WASTE MANAGEMENT STUDY FOR PULAU PINANG AND SEBERANG PERAI MUNICIPALITIES

SUPPORTING REPORT

VOLUME V

PRESENT CONDITION SURVEY

AUGUST 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

SSS

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SOLID WASTE MANAGEMENT STUDY
FOR
PULAU PINANG AND SEBERANG PERAI MUNICIPALITIES

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ABBREVIATION

ABC	:	Action Plan for a Beautiful and Clean Malaysia
BSDS	:	Bakau Street Disposal Site
BPTS	:	Balik Pulau Transfer Station
CIF	:	Cost, Insurance and Freight
DBKL	:	City Hall of Kuala Lumpur
DID	:	Drainage and Irrigation Department
DOE	:	Department of Environment
EIA	:	Environmental Impact Assessment
ENSEARCH	:	Environmental Management and Research Association of Malaysia
EPU	:	Economic Planning Unit
FTZIP	:	Free Trade Zone Incineration Plant
FTZTS	:	Free Trade Zone Transfer Station
GDP	:	Gross Domestic Product
IKU	:	Public Health Institute
JICA	:	Japan International Cooperation Agency
JKKK	:	Village Development and Security Committee
JMPDS	:	Jelutong Mole Previous Disposal Site
JMTS	:	Jelutong Mole Transfer Station
JPBD	:	Town and Country Planning Department
KEMAS	:	Community Development, Ministry of National and Rural Development
KMDS	:	Kuala Muda Disposal Site
LWL	:	Low Water Level
LA	:	Local Authority
M	:	Million
MC	:	Municipal Council
MMTS	:	Mak Mandin Transfer Station
MPPP	:	Majlis Perbandaran Pulau Pinang
MPSP	:	Majlis Perbandaran Seberang Perai
MOH	:	Ministry of Health
MHLG	:	Ministry of Housing and Local Government
M/P	:	Master Plan
MSWM	:	Municipal Solid Waste Management
NEB	:	National Electricity Board
NEP	:	New Economic Policy
PADS	:	Pantai Acheh Disposal Site
PBDS	:	Plan Burong Disposal Site
PDC	:	Penang Development Corporation
PERDA	:	Penang Rural Development Authority
PHA	:	Public Health Assistant
PHI	:	Public Health Inspector
PICIP	:	Prai Indusrial Complex Incineration Plant
PSD	:	Public Services Department, Prime Minister's Department
JKR/PWD	:	Public Works Department
PPC	:	Penang Port Commission

PPC	:	Penang Port Commission
S/R	:	Suppoting Report
SWM	:	Solid Waste Management
SWMIS	:	Solid Waster Management Information System
TDC	:	Tourist Development Corporation
UDS	:	Urban Drainage System
USD	:	Urban Service Department
USM	:	University Sains Malaysia

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1 Results of Time and Motion Study for Collection Vehicles

1.1 Objectives of Study

The term of "Time and Motion Study" is used in a broad sense covering not only the study of time and motion of collection crews but also the study of dustbins, routes, road condition, user cooperation etc. to collect relevant information to improve a collection system.
It has two general objectives.

① The first objective is to diagnose the present collection and haulage system.
② The second objective is to obtain data to plan for the improvement of the collection and haulage system.

In Penang, the former was a main object of this study, therefore it was carried out to confirm present system of collection and haulage and to point out improvable items in both MPPP and MPSP.
And also this study was executed to transfer the procedure of study and method of analysis to both municipalities as one of methods of self diagnosis of collection and haulage system.
In carrying out this study, special attention was given to the following items

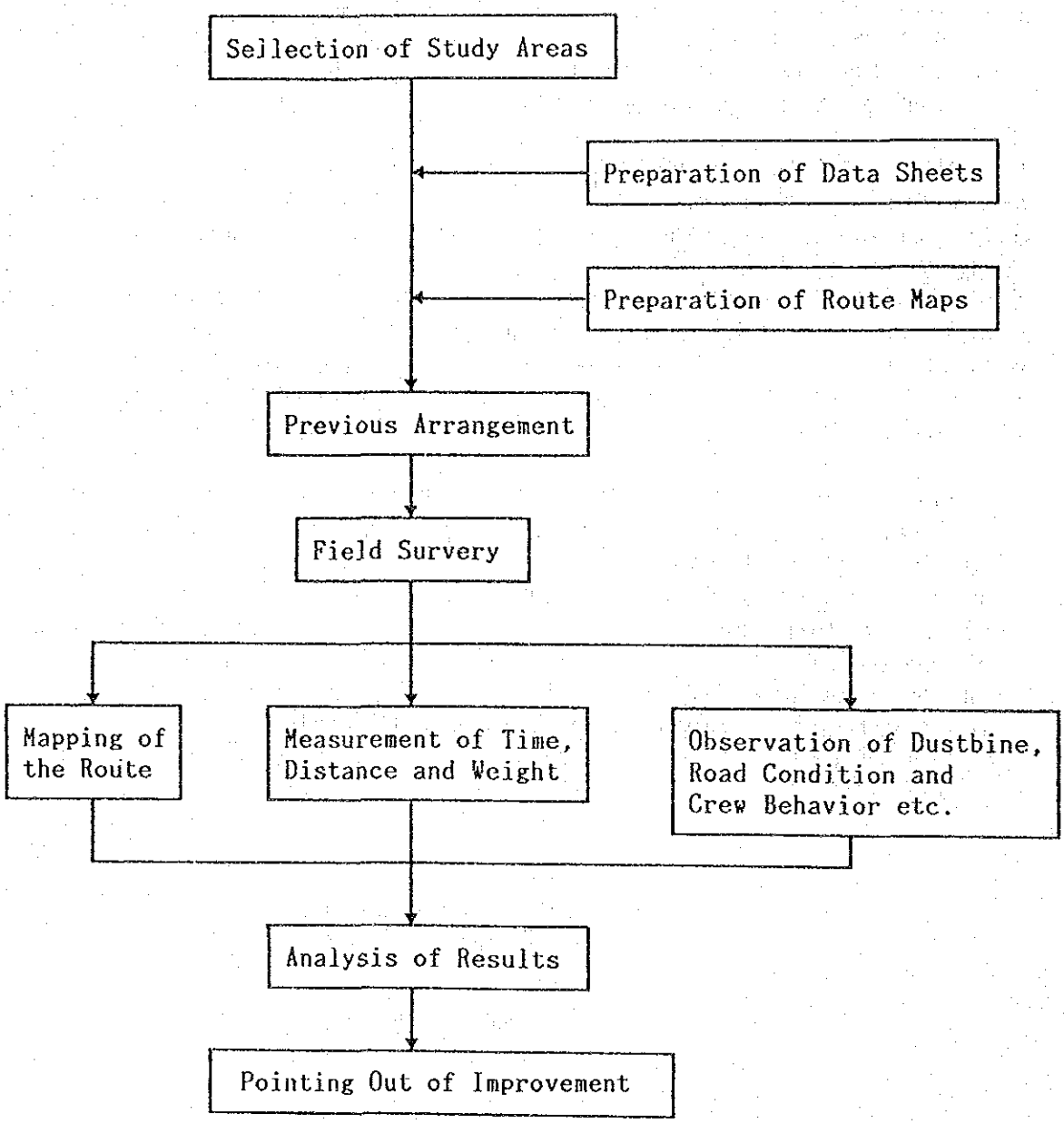
① Relation to time, distance and weight on collection and transportation
② Type of dustbins
③ Working efficiency of collection workers
④ Collection route
⑤ Level of user cooperation with collection work
⑥ Service level
⑦ Maintenance condition of collection vehicles

1.2 Procedure and Method of Study

(1) Procedure

The study was carried out according to following procedure.

Fig. 1.2-1 Procedure of Study



(2) Selection of Study Areas

Each 5 area for Time and Motion Study were selected from MPPP and MPSP according to type of collection vehicles and collection waste . Consequently, following areas were selected.

Fig. 1.2-2 Selection of Study Areas (MPPP)

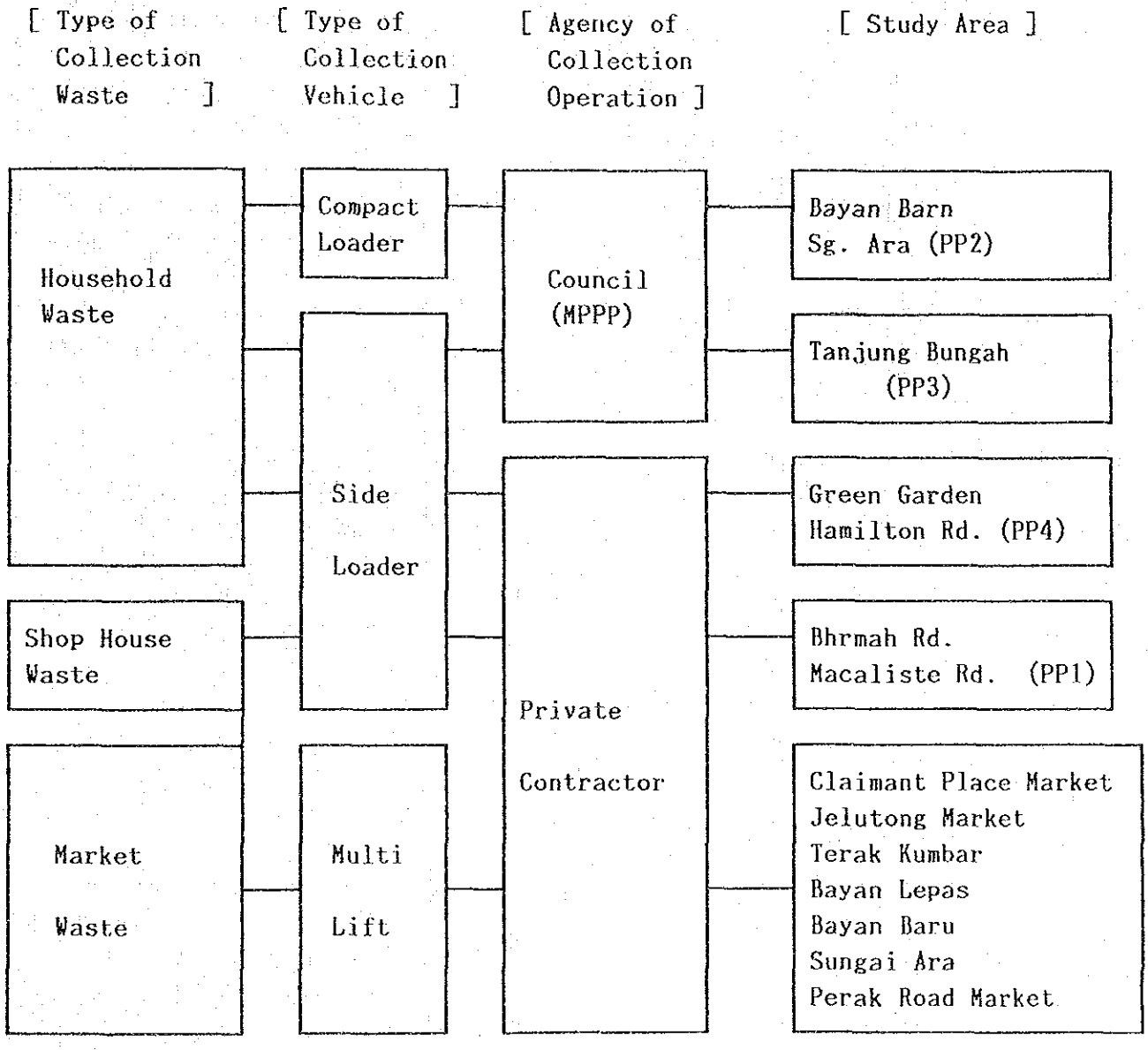


Fig. 1.2-3 Selection of Study Areas (MPSP)

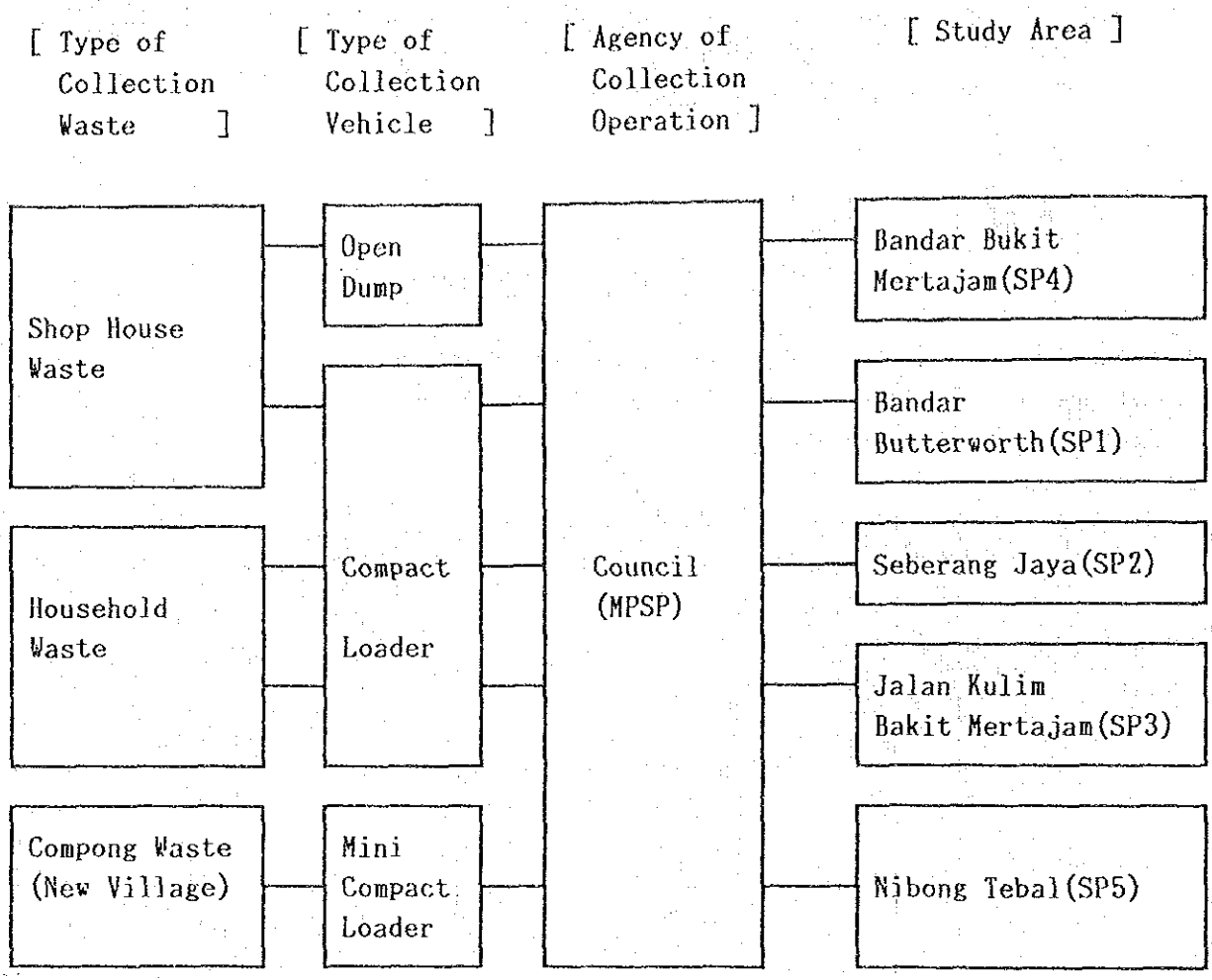


Table. 1. 2-1 Study Area (MPPP)

Date	Study Area (Code)	Type of Collection Waste	Typf of Collection Vehicle	Vehicle Depot	Notes
15.3.88 (TUE)	Bhrmah Rd. Macaliste Rd. (PP-1)	Shophouses Waste	Side Loader *1 (Contractor)	Depot Sg.Nibong	
16.3.88 (WED)	Bayan Barn Sg. Ara (PP-2)	Household Waste	Compact Loader (MPPP)	Workshop Engineer -ing Dept.	
17.3.88 (THE)	Tanjung Bungah (PP-3)	Household Waste	Side Loader (MPPP)	Workshop Engineer -ing Dept.	
18.3.88 (FRI)	Green Garden Hamilton Rd. (PP-4)	Household Waste	Side Loader *2 (Contractor)	Depot Chemor Lane	
19.3.88 (SAT)	Claimant Place Market I Claimant Place Market II Jelutong Market Teluk Kumbar Bayan Lepas Bayan Baru Sungai Ara Perak Road Marke (PP-5)	Market Waste	Multi-Lift *3 (Contractor)	Mobile Service Station Kelawei Rd	

Contractor:

*1 —— Syarikat Hashin SDN.BHD.
*2 —— Waste Disposal SDN. BHD.
*3 —— A.W.S. Jaya SDN. BHD.

Table. 1. 2-2 Study Area (MPSP)

Date	Study Area (Code)	Type of Collection Waste	Type of Collection Vehicle	Vehicle Depot	Notes
8.3.88 (TUE)	· Bandar Butterworth (SP-1)	Shop houses Waste	Compact Loader	Batterworth (workshop)	
9.3.88 (WED)	· Seberang Jaya (SP-2)	Household Waste	Compact Loader	Bukit Mertajam (workshop)	
10.3.88 (THU)	· Jalan Kulim · Bukit Mertajam (SP-3)	Household Waste	Compact Loader	Bukit Mertajam (workshop)	
11.3.88 (FRI)	· Bandar Bukit · Mertajam (SP-4)	Shop houses Waste	Open Dump	Bukit Mertajam (workshop)	
12.3.88 (SAT)	· Nibong Tebal (SP-5)	New Village Waste	Mini Compact Loader	Pejabat Jawi	

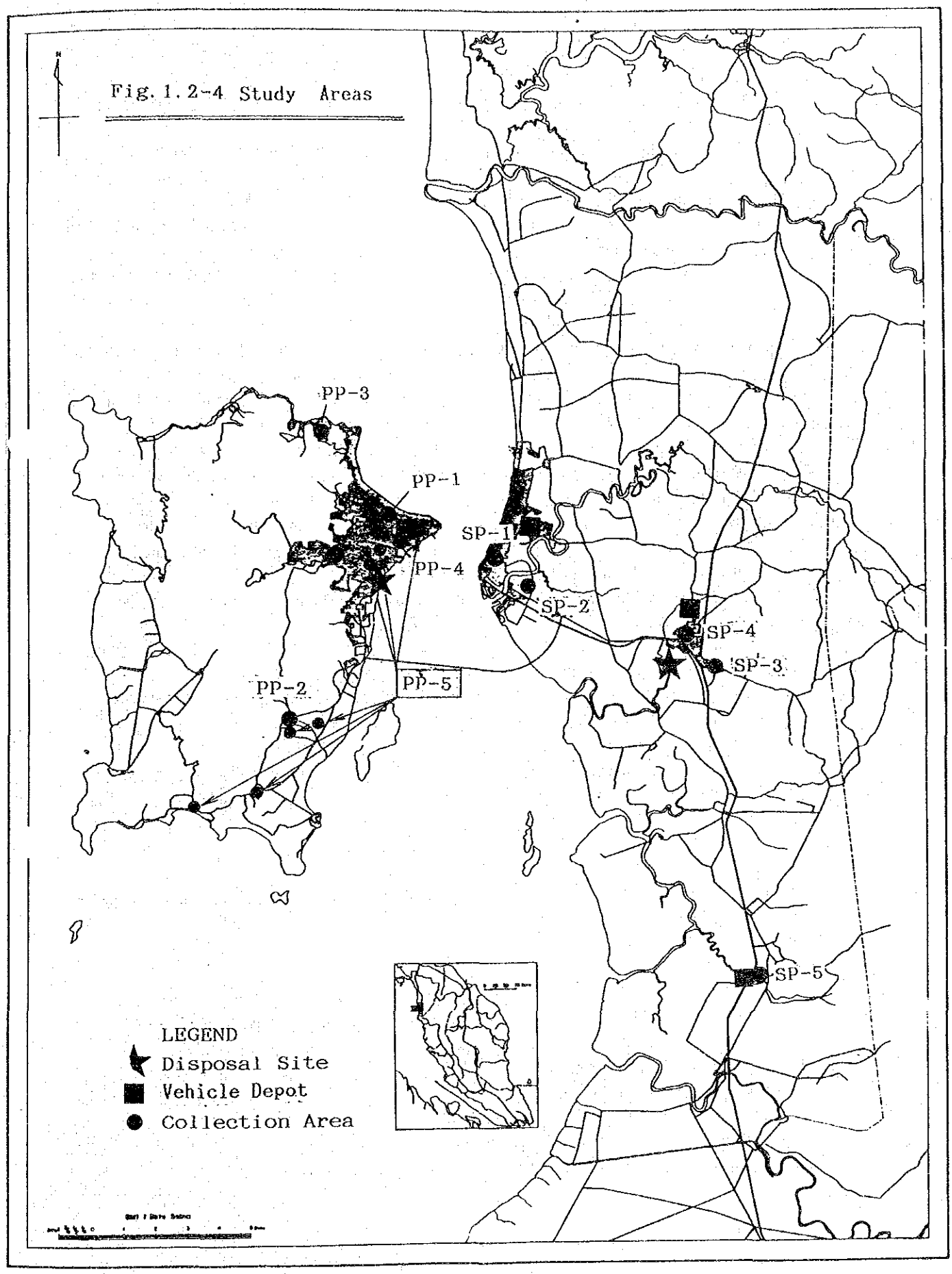


Fig. 1.2-4 Study Areas
PP-3
PP-1
SP-1
PP-4
SP-2
SP-4
SP-3
PP-2
PP-5
SP-5
LEGEND
Disposal Site
Vehicle Depot
Collection Area

(3) Execution Method

a. Time Recording

The followings time were recorded in the field with a watch.

① The time of departure from vehicle depot
② The time of arrival at and departure from each point of a collection route
③ The time of arrival at and departure from disposal site
④ The time of arrival at vehicle depot

The time consumption in each step were calculated later in the office.

b. Distance

The followings distance in kilometer were recorded in the field with odometer of passenger car.

① The recording of distance in kilometer at the time of departure from vehicle depot
② The recording of distance in kilometer at the time of arrival at each station
③ The recording of distance in kilometer at the time of arrival at disposal site
④ The recording of distance in kilometer at the time of arrival at vehicle depot

The distance between each destination was calculated later in the office based on the recorded distance in kilometer at each point.

c. Dustbin

Dustbins were counted and classified according to their size and types.

d. Mapping

The following information was marked in the map.

① Collection route
② Collection points
③ Direction of vehicle depot
④ Direction of disposal site
⑤ Serial numbers of the collection points

e. Road Condition

The following information was recorded.

① Condition of pavement
② One-way streets
③ Parking problem areas
④ Slopes
⑤ Obstacles

(4) Assignment of Study Team Member

The study in the field was carried out in cooperation with Health Inspectors and Overseers. As previously stated, one of the purpose of this study was transfer of technology.
Study team was consisted of the 4 members with driver. And duties and responsibilities of each member were assigned in preparation stage. The followings were the assignment of each study team member.

- Group Leader —— Dustbin study(size, condition, number), road condition, crew behavior, collection vehicle(condition, loading ability, covering area)
- Member A —— Mapping of the route and dustbin set-out points
- Member B —— Time, distance and weight measurement
- Driver —— Trace the solid waste collection vehicle

1.3 Results

Present condition of solid waste collection and haulage in MPPP and MPSP which was obtained through "Time and Motion Study" is as follows.

(1) Summary of Collection and Haulage Work

— MPPP

Types of collection vehicle followed are shown below:

① Side Loader (with mechanical unloading facility, loading weight : 3.5t)
② Compact Loader (loading capacity : 10m³)
③ Multi-Lift (capacity of container : 7 m³)

a. Side Loader

Side Loader is assigned mainly to residential and commercial area. Crew of council and contractors team consisted of 6 and 5 workers respectively including driver. Total transportation distance of both collection bodies were about 35 km, they were almost the same. But in case of contractors, working time was longer and amount of waste collected was more than council.

b. Compact Loader

In MPPP, Compact Loader with lifting equipment was used to collect bulk bin waste. The bulk bin was mainly provided to residential area and its capacity was about 1 m³. Crew consisted of 6 workers including driver, and total working time was about 4.5 hours. Number of trips was only once but amount of collection waste was 5.5 ton per trip. Amount of waste collected by compact loader of MPPP was twice more than that of MPSP. This might be the difference in apparent specific gravity of waste and compaction ratio of the vehicle.

c. Multi-Lift

Multi-Lift has been used by three contractors in MPPP. The vehicle lifts container which was provided mainly to market area and kampung and hauls it to disposal site. Crew consisted of 2 workers including driver. It was very hard work because of number of trips (8 trips), total working time (7.5 hours), and total transportation distance (200km).

Mean amount of waste in the containers hauled to disposal site was 1.35 ton.

— MPSP

Types of collection vehicle traced by Study Team are shown below:

① Compact Loader(with lifting equipment, loading capacity: 10m³)
② Open Dump (loading capacity:10m³)
③ Mini Compact Loader (loading capacity:4 m³)

These vehicles and crew members belong to council.

a. Compact Loader

Compact Loader was assigned mainly to residential and commercial area. Crew consisted of 5 workers including driver. Total working time was about 6 hours including a time to inspect and wash a vehicle. Work is usually finished by 13 o'clock. Total transportation distance was about 50 km and number of trips were twice or three times a day. Mean amount of hauled waste was about 3 ton per trip except final trip. It is because loading weight of vehicles is not always full at final trip.

b. Open Dump

Open Dump was assigned mainly to commercial area (shopping street and market). Crew consisted of 6 workers including driver. Total working time was about 4.5 hours and total transportation distance was about 35 km (2trips a day). Mean amount of hauled waste is about 2 ton per trip.

c. Mini Compact Loader

Mini Compact Loader was assigned mainly to kampong area and new village. Crew consisted of 5 workers including driver. Total working time was about 3 hours and number of trips is once a day because of Saturday. It is usually twice a day. Collected waste from Nibong Tebal area is usually hauled to Pulau Burang disposal site, but in this time to measure its weight it was hauled to Permatang Pauh disposal site. Therefore, the distance from collection area to disposal site was longer than normal route. Amount of hauled waste was about 1.5 ton per trip.

Table.1.3-1 Summary of Collection and Haulage Work

Date	Area Code	Type of Collection Waste	Type of Vehicle	Loading Capacity	Number of Workers	Number of Trips	Number of Stations	Total Working Time (hr.min.sec.)	Total Distance (km)	Total Weight of Collection Waste (ton)
8,Mar. (TUE)	SP-1	Shop Houses Waste	Compact Loader	10 m³	5	2	43 (22+21)	6° 05′ 00″	43.8	4.74 (2.73+2.01)
9,Mar. (WED)	SP-2	Household Waste	Compact Loader	10 m³	5	3	51 (18+20+13)	6° 41′ 50″	55.0	8.27 (3.23+3.29+1.75)
10,Mar. (THE)	SP-3	Household Waste	Compact Loader	10 m³	5	2	57 (34+23)	6° 00′ 00″	59.9	5.70 (3.40+2.30)
11,Mar. (FRI)	SP-4	Shop Houses Waste	Open Dump	12 m³	6	2	61 (25+36)	4° 30′ 00″	34.5	4.16 (1.91+2.25)
12,Mar. (SAT)	SP-5	New Village Waste	Mini Compact Loader	4 m³	5	1	30	3° 00′ 15″	59.8	1.51
15,Mar. (TUE)	PP-1	Shop Houses Waste	Side Loader Contractor	3.88 t	5	3	80 (40+28+12)	5° 37′ 58″	36.7	6.02 (2.33+2.23+1.46)
16,Mar. (WED)	PP-2	Household Waste	Compact Loader	10 m³	6	1	29	4° 37′ 05″	75.0	5.65
17,Mar. (THE)	PP-3	Household Waste	Side Loader	3.50 t	6	2	74 (47+27)	4° 46′ 23″	34.4	2.89 (1.88+1.01)
18,Mar. (FRI)	PP-4	Household Waste	Side Loader Contractor	3.29 t	5	4	79 (30+16+23+10)	6° 17′ 19″	38.6	4.71 (1.24+1.52+0.99+0.96)
19,Mar. (SAT)	PP-5	Market Waste	Multi Lift Contractor	7 m³	2	8	8	7° 23′ 00″	198.9	10.81

(2) Working Time

Ratio of collection and transportation time to total time when a collection vehicle starts at depot and returns to depot is shown in Tab. 1-4.

— MPPP

Departure time of council's collection vehicles from depot is usually at 7:00. On the other hand, vehicles of contractors usually start between at 6:00 and at 6:30. Both of them finish collection and haulage work by about 12:30.
Mean ratio of working time for each work item except PP-5 (Multi-Lift system) in MPPP is shown below.

Mean Ratio of Working Time for Each Item in MPPP

Collection Time	45%
Transportation Time (between stations)	20%
Transportation Time (other transportation time except between stations)	25%
Other (breakfast, discharge time at disposal site, time for washing and inspection a vehicle etc.	10%
Total Working Time	100%

In both collection areas of PP-1 and PP-4 assigned by contractors, collection time accounted for 52% of all working time. The reason was not only number of trips (3 or 4 times a day) but also collection system. In these areas, door to door collection system was provided and collection efficiency has not been sufficient.
In PP-5 using Multi-Lift, working time was mainly spent for transportation.

— MPSP

Departure time of collection vehicles from depot is usually between at 6:30 and at 7:00. Work is finished at least by 13:00 ~13:30 including the time to wash and inspect a vehicle. Consequently, there was not so much difference among working time of these areas studied this time. Mean ratio of working time for each work item is shown below.

Mean Ratio of Working Time for Each Work Item

Collection Time	35%
Transportation Time (between stations)	16%
Transportation Time (other transportation time except between stations)	27%
Others (breakfast, discharge time at disposal site, time for washing and inspection a vehicle etc.)	22%
Total Working Time	100%

If waste collected from SP-5 (Nibong Tebal) had been hauled to ordinary disposal site (Pulau Burang), it would have become as follows.

Ratio of Working Time in Case of Usual route (SP-5)

Collection Time	67 min.	56%
Transportation Time (between stations)	16 min.	13%
Transportation Time (except between stations)	12 min.	10%
Other	25 min.	21%
Total Working Time	120 min.	100%

Ratio of collection time (67%) is higher than any other area. Because in this New Village, solid waste was discharged to side of a road without using any dust-bin or with using bad conditional bamboo-basket.

Fig. 1.3-1 Working Time

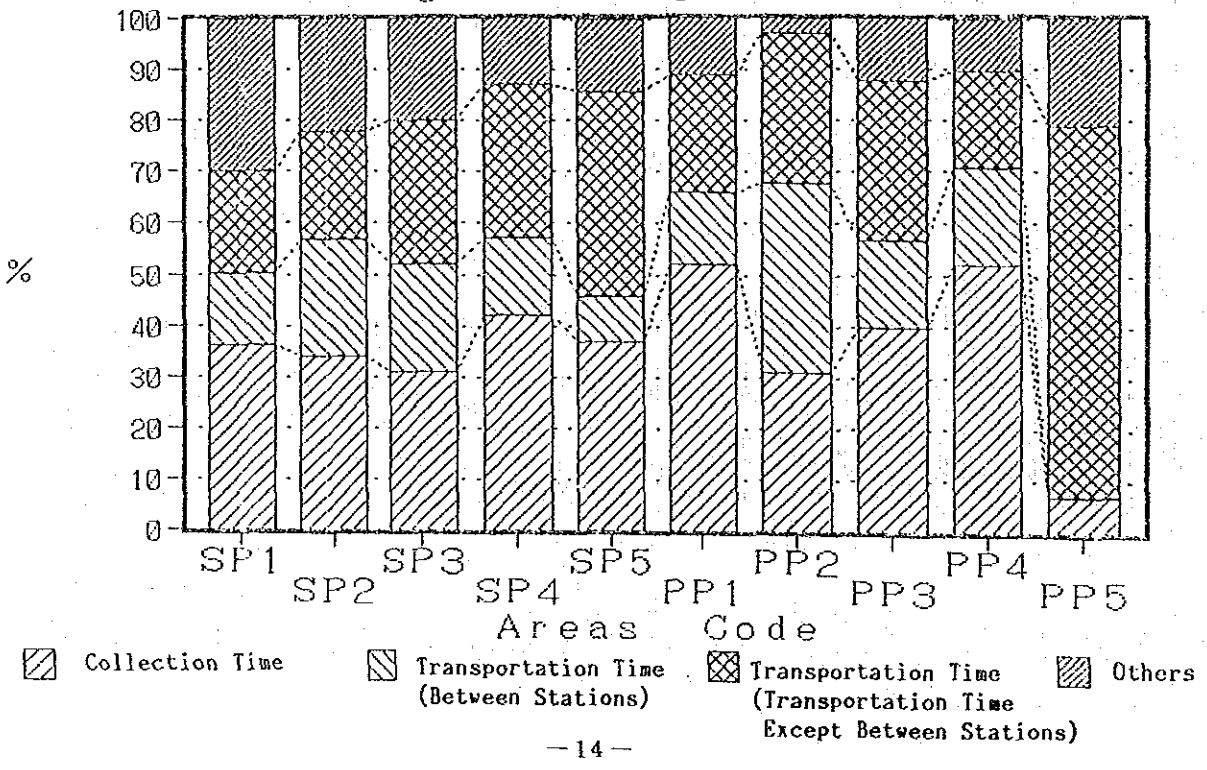


Table. 1.3-2 Working Time

Collection Area	Working Time		Total Time (min)	Collection Time (min)	Transportation Time (min)		Others (min)
	Departure Time from Garage	Arrival Time at Garage			Between Stations	Others	
SP1	7:00:00	13:05:00	365(100%)	133(36%)	51(14%)	73(20%)	108(30%)
SP2	6:52:50	13:34:40	401(100%)	137(34%)	92(23%)	84(21%)	88(22%)
SP3	6:35:00	12:35:00	360(100%)	111(31%)	75(21%)	100(28%)	74(20%)
SP4	6:37:00	11:37:00	300(100%)	113(38%)	41(14%)	82(27%)	64(21%)
SP5	6:45:45	9:46:00	180(100%)	67(37%)	16(9%)	72(40%)	25(14%)
PP1	6:23:19	12:01:17	338(100%)	175(52%)	47(14%)	79(23%)	37(11%)
PP2	6:51:42	11:28:47	277(100%)	87(31%)	102(37%)	80(29%)	8(3%)
PP3	7:08:30	11:54:53	286(100%)	114(40%)	49(17%)	89(31%)	34(12%)
PP4	6:07:23	12:24:42	377(100%)	195(52%)	70(19%)	70(19%)	42(10%)
PP5	6:00:00	12:23:00	443(100%)	30(7%)	0(0%)	317(72%)	96(21%)

Note: ( ) shows ratio to total time.

(Reference)

Collection Area	Total Time (min)	Collection Time (min)	Transportation Time (min)		Others (min)
			Between Stations	Others	
※1	675(100%)	444(66%)	169(25%)		62(9%)
※2	255(100%)	140(55%)	10(4%)	60(24%)	45(18%)
※2	370(100%)	188(51%)	25(7%)	87(24%)	70(19%)
※2	390(100%)	227(58%)	21(5%)	81(21%)	61(16%)

※1 : Seremban ※2 : Petaring Jaya

(3) Transportation

— MPPP

Mean transportation distance in MPPP is shown below.

		Average (km)	Council (km)	Contractor (km)
Garage ——————→	Collection Area	8.92	15.05	4.83
Collection Area ←——→	Disposal Site	5.77	7.73	5.48
Last Station ——→	Disposal Site	4.95	8.60	4.22
Disposal Site ——→	First Station	6.90	5.10	7.05
Collection Area		6.99	15.43	3.37
Disposal Site ——→	Garage	2.94	1.05	4.20

The relation to distance of each stations and type of vehicles and dust bins in MPPP is shown below except PP-5.

Distance of Each Stations

Collection Area	Type of vehicles	Type of Dust Bins	Distance (m)
PP-1 (Commercial Area)	Side Loader	Private Dust Bin	76
PP-3 (Residential Area)	Side Loader	〃	105
PP-4 (〃)	Side Loader	〃	222
PP-2 (〃)	Compact Loader	Container	328

— MPSP

There are three depots in MPSP and each three districts have one depot . Collection work in each district is carried out using the vehicle of each depot .

Location of Depot

District	Location of Depot
North	Batter worth
Central	Bukit Mertajam
South	Jawi

And waste collected is disposed of at two disposal sites in MPSP. One is Permatang Pauh Butterworth disposal site and another is Pulau Burang disposal site.
This time, all collection waste were hauled to Permatang Pauh Butterworth disposal site in order to measure the loading weight.
Mean transportation distance is shown as follows .

		Distance (mean)
Garage ⟶	Collection Area	2.76 km
Collection Area ⟷	Disposal Site	8.32 km
Last Station ⟶	Disposal Site	8.90 km
Disposal Site ⟶	First Station	7.16 km
Collection Area		4.99 km
Disposal Site ⟶	Garage	12.90 km

The relation to distance of each stations and type of vehicles and dust bins is shown below.

Distance of Each Stations

Collection Areas	Type of Vehicles	Type of Dust Bins	Distance (m)
SP5 (New Village)	Mini Compact Loader	No Dust Bin and No Container	23
SP4 (Commercial Area)	Open Dump	Private Dust Bin	44
SP1 (Commercial Area)	Compact Loader	Container	158
SP3 (Residential Area)	Compact Loader	Container	344
SP2 (Residential Area)	Compact Loader	Container	394

Table. 1.3-3 Distance of Transportation

Area Code	Trip	Garage 1st. Station (km)	Dump Site 1st. Station (km)	1st. Station Last Station (km)	Last Station Dump Site (km)	Dump Site Garage (km)	Number of Station	Mean Distance of Between each Station (m)
SP-1	1st.	4.1	—	3.2	5.1	—	22	145
	2nd.	—	3.4	3.6	4.7	19.7	21	171
		—	—	—	—	—	43	158
SP-2	1st.	4.5	—	10.8	4.4	—	18	600
	2nd.	—	4.6	5.9	4.0	—	20	295
	3rd.	—	3.9	3.4	3.5	10.0	13	262
		—	—	—	—	—	51	394
SP-3	1st.	1.0	—	8.1	11.9	—	34	238
	2nd.	—	12.5	11.5	12.7	2.2	23	500
		—	—	—	—	—	57	344
SP-4	1st.	1.9	—	0.6	3.9	—	25	24
	2nd.	—	11.4	2.1	11.4	3.2	36	58
		—	—	—	—	—	61	44
SP-5	1st.	2.3	—	0.7	27.4	29.4	30	23
PP-1	1st.	11.1	—	3.1	2.1	—	40	78
	2nd.	—	3.7	2.3	3.7	—	28	82
	3rd.	—	1.2	0.7	3.4	5.4	12	58
		—	—	—	—	—	80	76
PP-2	1st.	23.5	—	38.5	11.7	1.3	29	1,328
PP-3	1st.	6.6	—	3.4	6.6	—	47	72
	2nd.	—	5.1	4.4	7.5	0.8	27	163
		—	—	—	—	—	74	105
PP-4	1st.	1.4	—	5.2	2.7	—	30	173
	2nd.	—	1.8	4.3	2.1	—	16	269
	3rd.	—	2.1	6.3	2.7	—	23	274
	4th.	—	3.5	1.7	2.7	2.1	10	170
		—	—	—	—	—	79	222
PP-5	1st.	2.0	—	0.0	1.9	—	1	—
	2nd.	—	9.6	0.0	9.8	—	1	—
	3rd.	—	12.5	0.0	12.2	—	1	—
	4th.	—	17.7	0.0	7.6	—	1	—
	5th.	—	9.1	0.0	7.7	—	1	—
	6th.	—	16.8	0.0	1.9	—	1	—
	7th.	—	4.4	0.0	1.3	—	1	—
	8th.	—	2.2	0.0	1.5	5.1	1	—
		—	—	—	—	—	8	—

(4) Loading Ability

Loading ability of collection vehicles are estimated based on the study result.

a. Compact Loader with lifting eqipment

In MPSP, study team traced two types compact loaders. One is 10m³ of loading capacity and another is 4 m³.
In MPPP, compact loader whose loading capacity is 10 m³ was picked up for the study.
Compaction ratio of collection waste loaded these collection vehicle was calculated according to the formulation shown below.

[① Mean amount of loading waste per trip except final trip (ton / vehicle)] / [Apparent Specific Gravity] = [② Mean capacity of loading waste per trip (m³ /vehicle)]

② / [③ Loading capacity (m³ /vehicle)] = [④ Compaction Ratio]

Compaction Ratio

Area Code	Type of Collection Waste	* Apparent Specific Gravity	① ton/ vehi-cle	② m³ / vehi-cle	③ m³ / vehi-cle	④ Compaction Ratio
SP-1	Shop House Waste	0.160	2.73	17.06	10	1.706
SP-2	Household Waste	0.175	3.26	18.63	10	1.863
SP-3	Household Waste	0.175	3.40	19.43	10	1.943
SP-5	New Village Waste	0.153	1.51	9.87	4	2.467
PP-2	Household Waste	0.285	5.65	19.82	10	1.982

* Apparent Secific Gravity was adopted from result of waste composition analysis done by the Study Team.

Generally, compaction ratio of compact loader is approximately 2.5 to 3 against waste whose apparent specific gravity is about 0.2.

b. Open Dump

Side Loader (loading capacity : 10 m³) and Open Dump (loading capacity : 10 m³) were traced respectively in MPPP and MPSP.
The ratio of actual loading weight to loading capacity of each vehicle was calculated by following formulation .

[① Mean amount of loading waste per trip except final trip (ton / vehicle)] / [Apparent Specific Gravity] = [② Mean capacity of loading waste per trip (m³ /vehicle)]

② / [③ Loading capacity (m³ /vehicle)] = [④ Ratio of Loading Ability]

Ratio of Loading Ability

Area Code	Type of Collection Waste	* Apparent Specific Gravity	① ton/ vehicle	② m³ / vehicle	③ m³ / vehicle	④ Ratio of Loading Ability
SP-4	Shop House Waste	0.160	2.08	13.00	10	1.300
PP-1	Shop House Waste	0.204	2.28	11.18	10	1.118
PP-3	Household Waste	0.190	1.88	9.89	10	0.989
PP-4	Household Waste	0.190	1.18	6.21	10	0.621
PP-5	Market Waste	0.175	1.35	7.71	7	1.101

* Apparent Secific Gravity was adopted from result of waste composition analysis done by the Study Team.

(5) Working Efficiency

Working efficiency per one worker including driver is shown in Tab. 1-6. Maximum amount of collection waste per one worker per hour is 1,081 kg / worker/hour in PP-5. It is collection system using Multi- Lift .
Conversely, minimum amount is 270 kg / worker /hour in SP-3. It is door to door collection system in residential area.
Amount of collection waste per one worker per hour are compared with each other based on collection areas and type of dust bins.

Collection Area	Type of Dust Bin	Amount of collection waste per worker per hour (kg / worker /hour)
Residential Area	Container	[SP-2] 724 [SP-3] 616 [PP-2] 661
	Private Dust Bin	[PP-3] 258 [PP-4] 290
Commercial Area	Container	[SP-1] 428
	Private Dust Bin	[SP-4] 290 [PP-1] 413
	Hauled Container for Multi-Lift	[PP-5] 1,081
Kampong (New Village) Area	No Dust Bin and No Container	[SP-5] 270

Table. 1.3-4 Working Efficiency

Area Code	Number of Crew members (including driver)	Net Load (ton)	Collec - tion Time (min.)	Amount of Collection Waste	
				(ton/day / worker)	(kg /hour /worker)
SP1	5	4.74	133	0.948	428
SP2	5	8.27	137	1.654	724
SP3	5	5.70	111	1.140	616
SP4	6	4.16	113	0.832	442
SP5	5	1.51	67	0.302	270
PP1	5	6.02	175	1.204	413
PP2	6	5.65	86	0.948	661
PP3	6	2.89	114	0.482	258
PP4	5	4.71	195	0.942	290
PP5	2	10.81	* 30	5.405	1,081

* In PP-5, collection time means time of loading container by Multi-Lift.

(reference)

Area Code	Number of Crew members (including driver)	Net Load (ton)	Collec - tion Time (min.)	Amount of Collection Waste	
				(ton/day / worker)	(kg /hour /worker)
*1	4	5.47	444	1.368	185
*2	4	3.66	140	0.915	392
*2	4	5.72	188	1.430	456
*2	4	5.63	227	1.408	372

*1: Seremban *2: Petaring Jaya

(6) Comments

① Generally, there were no problem observed on behavior of collection workers and cooperation among crew. In MPPP, it was not noticed a difference of working efficiency between council and contractors.
For instance, amount of collection waste per worker per hour was 258 kg/worker/hour (for council) and 290kg/worker/hour (for contractor). These areas are residential area and solid waste is collected by side loader. But in case of contractors, working time was longer and number of trips were more than council.

② In MPPP, condition of communal container(bulk bin) was good. In MPSP there were many communal containers whose conditions were not so sufficient. It seemed that maintenance and management of communal containers are not proper in MPSP.

③ The locations of some communal containers (bulk bins) provided to residential areas in MPPP were far from the center of each collection zone. It must be hard works for heapers to collect waste from individual premise (generation soure of waste) and to cart it away to a container.

④ The capability of the workshop in MPSP for maintenance and repairing collection vehicles seems to be unsufficient because a puncture of the vehicle traced by the Study Team was not able to be repaired in the workshop.

⑤ The collection works of commercial area in MPPP took a lot of time and efforts because collection workers had to collect waste from bin behind premises and to carry it to the collection vehicle at main road.

⑥ In commercial area, major collection system was door to door system. In this area, waste is discharged using plastic or metal bucket from each premise. Discharge system using communal container seems to be suitable to improve collection efficiency. It may be difficult however to find enough space to set containers in this area because of narrow road and few vacant land.

⑦ In Kampung and New Village (MPSP) areas, most of waste is discharged at road side without any dust bin and container except for bamboo baskets observed in a few collection points. Waste therefore is scattered in and around storage yard and it makes collection efficiency worse than other collection areas.

⑧ Multi-Lift collection system is employed by a contractor in MPPP, and its collection efficiency is certainly good.
But it seemed to be hard work for driver because of number of trips (8trips) ,working time (7.5 hours) and transportation distance (200km).

Survey Sheets and Maps of Collection Route

Trip time, Distance and Speed

8,MAR,1988 SP-1

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st. Trip	Garage→ 1° Station	9'00"	4.1	27.3
	1° Station → Last Station (only transportation)	29'06"	3.2	6.6
	1° Station → Last Station (only collection)	1° 17'48"		
	Last station→ Dump Site	13'40"	5.1	22.4
	Discharge Time at Dump Site	14'53"		
	Sub-Total	2° 24'27"	12.4	
2nd. Trip	Dump Site → 1° Station	8'42"	3.4	23.4
	1° Station → Last Station (only transportation)	22'05"	3.6	9.8
	1° Station → Last Station (only collection)	55'16"		
	Last station→ Dump Site	13'30"	4.7	20.9
	Discharge Time at Dump Site	13'20"		
	Sub-Total	1° 52'53"	11.7	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		*1° 27'40"	19.7	
Total		5° 44'00"		

* It is included the time of mending a puncture.

Trip time, Distance and Speed

9,MAR,1988

SP-2

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st. Trip	Garage→ 1° Station	19'40"	4.5	13.7
	1° Station → Last Station (only transportation)	50'05"	10.8	12.9
	1° Station → Last Station (only collection)	56'45"		
	Last station→ Dump Site	10'55"	4.4	24.2
	Discharge Time at Dump Site	9'55"		
	Sub-Total	2° 27'20"	19.7	
2nd. Trip	Dump Site → 1° Station	13'50"	4.6	20.0
	1° Station → Last Station (only transportation)	28'50"	5.9	12.3
	1° Station → Last Station (only collection)	52'55"		
	Last station→ Dump Site	8'15"	4.0	29.0
	Discharge Time at Dump Site	11'20"		
	Sub-Total	1° 55'10"	14.5	
3rd. Trip	Dump Site → 1° Station	8'10"	3.9	28.7
	1° Station → Last Station (only transportation)	13'15"	3.4	15.4
	1° Station → Last Station (only collection)	27'45"		
	Last station→ Dump Site	8'00"	3.5	26.3
	Discharge Time at Dump Site	12'30"		
	Sub-Total	1° 19'40"	10.8	
Final Destination → Garage		15'20"	10.0	39.1
Total		5° 47'30"	55.0	

Trip time, Distance and Speed

10,MAR,1988

SP-3

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st. Trip	Garage→ 1° Station	13'00"	1.0	4.6
	1° Station → Last Station (only transportation)	37'16"	8.1	13.0
	1° Station → Last Station (only collection)	1°04'21"		
	Last station→ Dump Site	24'13"	11.9	29.5
	Discharge Time at Dump Site	9'28"		
	Sub-Total	2°28'18"	21.0	
2nd. Trip	Dump Site → 1° Station	17'38"	12.5	42.5
	1° Station → Last Station (only transportation)	38'13"	11.5	18.1
	1° Station → Last Station (only collection)	46'47"		
	Last station→ Dump Site	20'04"	12.7	38.0
	Discharge Time at Dump Site	9'30"		
	Sub-Total	2°12'12"	36.7	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		*1° 1'15"	2.2	
Total		5°41'45"	59.9	

* It is included the time of washing a vehicle.

Trip time, Distance and Speed

11,MAR,1988

SP-4

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st.Trip	Garage→ 1° Station	4'40"	1.9	24.4
	1° Station → Last Station (only transportation)	21'00"	0.6	1.7
	1° Station → Last Station (only collection)	51'20"		
	Last station→ Dump Site	23'00"	3.9	10.2
	Discharge Time at Dump Site	15'00"		
	Sub-Total	1°55'00"	6.4	
2nd.Trip	Dump Site → 1° Station	24'45"	11.4	27.6
	1° Station → Last Station (only transportation)	20'00"	2.1	6.3
	1° Station → Last Station (only collection)	1°01'45"		
	Last station→ Dump Site	22'30"	11.4	30.4
	Discharge Time at Dump Site	8'00"		
	Sub-Total	2°17'00"	24.9	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		7'00"	3.2	27.4
Total		4°19'00"	34.5	

Trip time, Distance and Speed

12,MAR,1988

SP-5

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st. Trip	Garage→ 1° Station	2'40"	2.3	51.8
	1° Station → Last Station (only transportation)	15'57"	0.7	2.6
	1° Station → Last Station (only collection)	1°07'28"		
	Last station→ Dump Site	38'10"	27.4	43.1
	Discharge Time at Dump Site	25'00"		
	Sub-Total	2°29'15"	30.4	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		31'00"	29.4	56.9
Total		3°00'15"	59.8	

Trip time, Distance and Speed

15,MAR,1988

PP-1

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st. Trip	Garage➡ 1° Station	15′ 30″	11.1	43.0
	1° Station ➡ Last Station (only transportation)	27′ 46″	3.1	6.7
	1° Station ➡ Last Station (only collection)	1° 18′ 40″		
	Last station➡ Dump Site	10′ 35″	2.1	11.9
	Discharge Time at Dump Site	7′ 02″		
	Sub-Total	2° 19′ 33″	16.3	
2nd. Trip	Dump Site ➡ 1° Station	7′ 53″	3.7	28.2
	1° Station ➡ Last Station (only transportation)	12′ 54″	2.3	10.7
	1° Station ➡ Last Station (only collection)	1° 10′ 29″		
	Last station➡ Dump Site	10′ 21″	3.7	21.4
	Discharge Time at Dump Site	5′ 14″		
	Sub-Total	1° 46′ 51″	9.7	
3rd. Trip	Dump Site ➡ 1° Station	10′ 03″	1.2	7.2
	1° Station ➡ Last Station (only transportation)	6′ 32″	0.7	6.4
	1° Station ➡ Last Station (only collection)	26′ 15″		
	Last station➡ Dump Site	11′ 33″	3.4	17.7
	Discharge Time at Dump Site	6′ 21″		
	Sub-Total	1° 00′ 44″	5.3	
Final Destination ➡ Garage		12′ 58″	5.4	25.0
Total		5° 20′ 06″	36.7	

Trip time, Distance and Speed

16,MAR,1988

PP-2

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st.Trip	Garage→ 1° Station	50′ 56″	23,5	27,7
	1° Station → Last Station (only transportation)	1° 42′ 24″	38,5	22,6
	1° Station → Last Station (only collection)	1° 26′ 35″		
	Last station→ Dump Site	22′ 36″	11,7	31,1
	Discharge Time at Dump Site	8′ 25″		
	Sub-Total	4° 30′ 56″	73,7	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		6′ 09″	1,3	12,7
Total		4° 37′ 05″	75.0	

Trip time, Distance and Speed

17,MAR,1988

PP-3

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st. Trip	Garage→ 1° Station	22′ 05″	6.6	17.9
	1° Station → Last Station (only transportation)	31′ 02″	3.4	6.6
	1° Station → Last Station (only collection)	72′ 23″		
	Last station→ Dump Site	23′ 50″	6.6	16.6
	Discharge Time at Dump Site	5′ 55″		
	Sub-Total	2° 35′ 15″	16.6	
2nd. Trip	Dump Site → 1° Station	16′ 15″	5.1	18.8
	1° Station → Last Station (only transportation)	17′ 55″	4.4	14.7
	1° Station → Last Station (only collection)	41′ 45″		
	Last station→ Dump Site	23′ 20″	7.5	19.3
	Discharge Time at Dump Site	10′ 19″		
	Sub-Total	1° 49′ 34″	17.0	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		3′ 24″	0.8	14.1
Total		4° 28′ 13″	34.4	

Trip time, Distance and Speed

18,MAR,1988

PP-4(1)

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st.Trip	Garage→ 1° Station	3′ 32″	1.4	23.8
	1° Station → Last Station (only transportation)	30′ 24″	5.2	10.3
	1° Station → Last Station (only collection)	52′ 20″		
	Last station→ Dump Site	9′ 45″	2.7	16.6
	Discharge Time at Dump Site	4′ 20″		
	Sub-Total	1° 40′ 21″	9.3	
2nd.Trip	Dump Site → 1° Station	7′ 16″	1.8	14.9
	1° Station → Last Station (only transportation)	14′ 20″	4.3	18.0
	1° Station → Last Station (only collection)	58′ 43″		
	Last station→ Dump Site	5′ 24″	2.1	23.3
	Discharge Time at Dump Site	5′ 34″		
	Sub-Total	1° 31′ 17″	8.2	
3rd.Trip	Dump Site → 1° Station	6′ 15″	2.1	20.2
	1° Station → Last Station (only transportation)	19′ 20″	6.3	19.6
	1° Station → Last Station (only collection)	40′ 44″		
	Last station→ Dump Site	9′ 11″	2.7	17.6
	Discharge Time at Dump Site	6′ 03″		
	Sub-Total	1° 21′ 33″	11.1	
~~Final Destination → Garage~~				
~~Total~~				

Trip time, Distance and Speed

18,MAR,1988

PP-4(2)

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
4th. Trip	Garage→ 1° Station	7'28"	3.5	28.1
	1° Station → Last Station (only transportation)	6'22"	1.7	16.0
	1° Station → Last Station (only collection)	43'29"		
	Last station→ Dump Site	12'51"	2.7	12.6
	Discharge Time at Dump Site	6'40"		
	Sub-Total	1°16'50"	7.9	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		7'52"	2.1	16.0
Total		5°57'53"	38.6	

Trip time, Distance and Speed

19,MAR,1988

PP-5(1)

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
1st.Trip	Garage→ 1° Station	6'50"	3.2	17.6
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	5'43"		
	Last station→ Dump Site	6'56"	3.1	16.4
	Discharge Time at Dump Site	14'20"		
	Sub-Total	33'49"	6.3	
2nd.Trip	Dump Site → 1° Station	17'03"	15.4	33.8
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	3'34"		
	Last station→ Dump Site	20'44"	15.8	28.4
	Discharge Time at Dump Site	4'48"		
	Sub-Total	46'09"	31.2	
3rd.Trip	Dump Site → 1° Station	23'39"	20.1	31.7
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	2'48"		
	Last station→ Dump Site	23'10"	19.7	31.6
	Discharge Time at Dump Site	6'29"		
	Sub-Total	56'06"	39.8	
~~Final Destination → Garage~~				
~~Total~~				

Trip time, Distance and Speed

19,MAR,1988

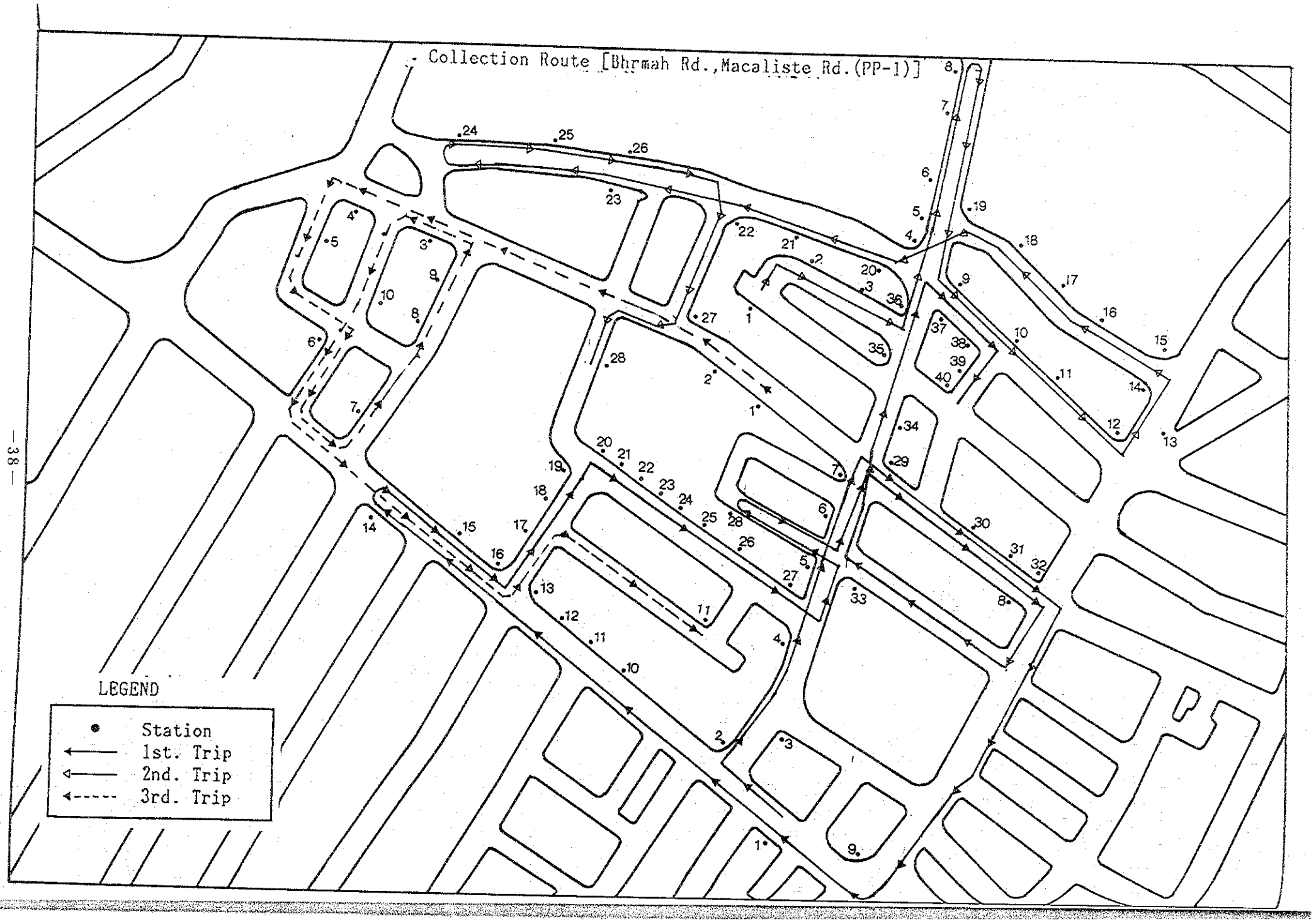
PP-5(2)

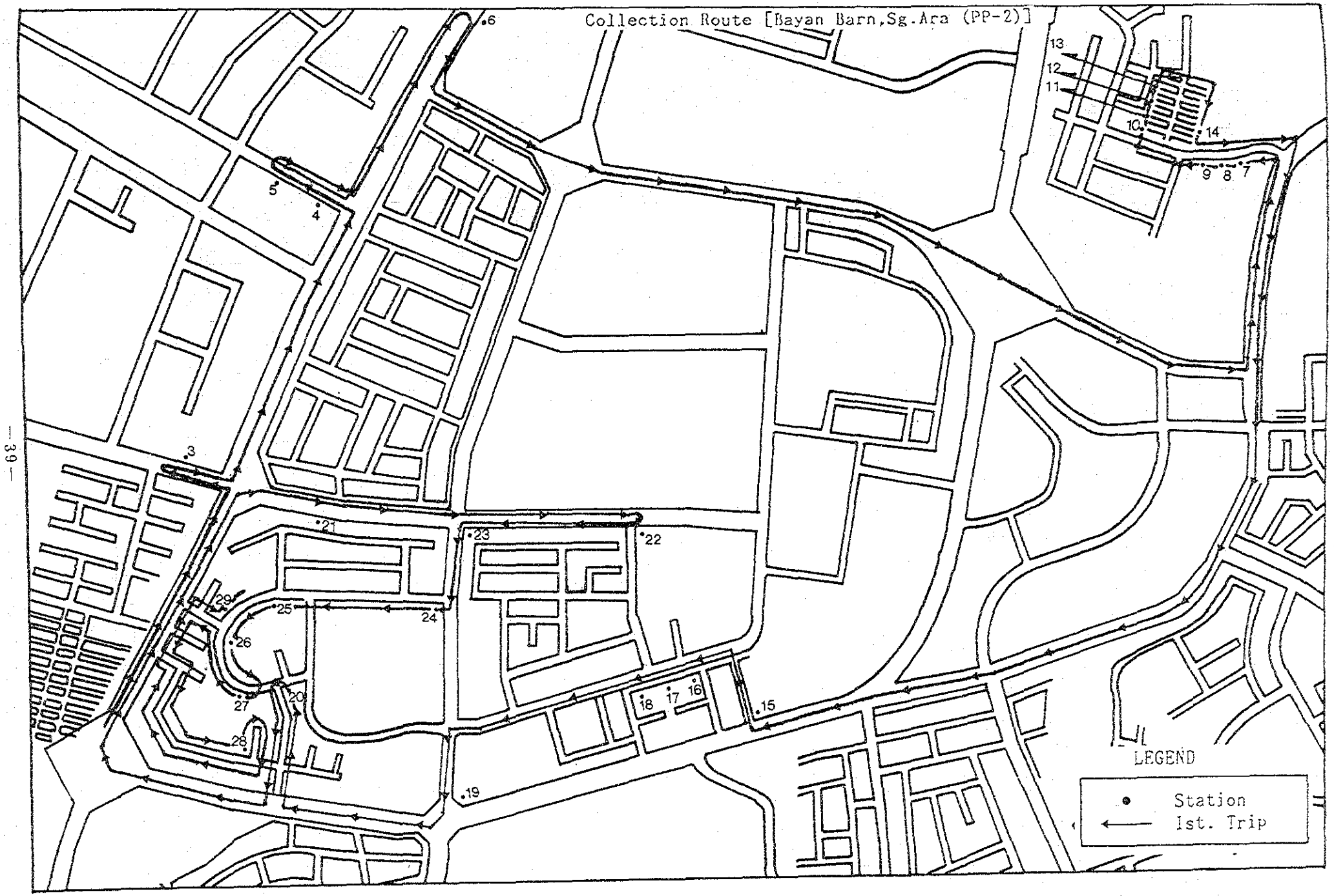
Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
4th. Trip	Garage→ 1° Station	42'06"	28.5	25.2
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	3'08"		
	Last station→ Dump Site	21'00"	12.2	21.7
	Discharge Time at Dump Site	5'45"		
	Sub-Total	1°11'59"	40.7	
5th. Trip	Dump Site → 1° Station	17'23"	14.7	31.4
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	2'59"		
	Last station→ Dump Site	17'56"	12.4	25.8
	Discharge Time at Dump Site	5'53"		
	Sub-Total	44'11"	27.1	
6th. Trip	Dump Site → 1° Station	37'04"	27.0	27.2
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	6'18"		
	Last station→ Dump Site	9'43"	3.1	11.7
	Discharge Time at Dump Site	8'38"		
	Sub-Total	1°01'43"	30.1	
~~Final Destination → Garage~~				
~~Total~~				

Trip time, Distance and Speed

19,MAR,1988 PP-5(3)

Items		Time (Min. Sec.)	Distance (km)	Speed (km/hr.)
7th. Trip	Garage→ 1° Station	18'26"	7.1	14.3
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	2'48"		
	Last station→ Dump Site	6'54"	2.1	11.3
	Discharge Time at Dump Site	4'44"		
	Sub-Total	32'52"	9.2	
8th. Trip	Dump Site → 1° Station	12'00"	3.5	11.0
	1° Station → Last Station (only transportation)	0	0	
	1° Station → Last Station (only collection)	2'50"		
	Last station→ Dump Site	7'42"	2.4	11.7
	Discharge Time at Dump Site	6'03"		
	Sub-Total	28'35"	5.9	
Trip	Dump Site → 1° Station			
	1° Station → Last Station (only transportation)			
	1° Station → Last Station (only collection)			
	Last station→ Dump Site			
	Discharge Time at Dump Site			
	Sub-Total			
Final Destination → Garage		28'07"	9.6	11.3
Total		6°43'39"	198.9	


Collection Route [Bhrmah Rd., Macaliste Rd.(PP-1)]
LEGEND
Station
1st. Trip
2nd. Trip
3rd. Trip


Collection Route [Bayan Barn,Sg.Ara (PP-2)]
1
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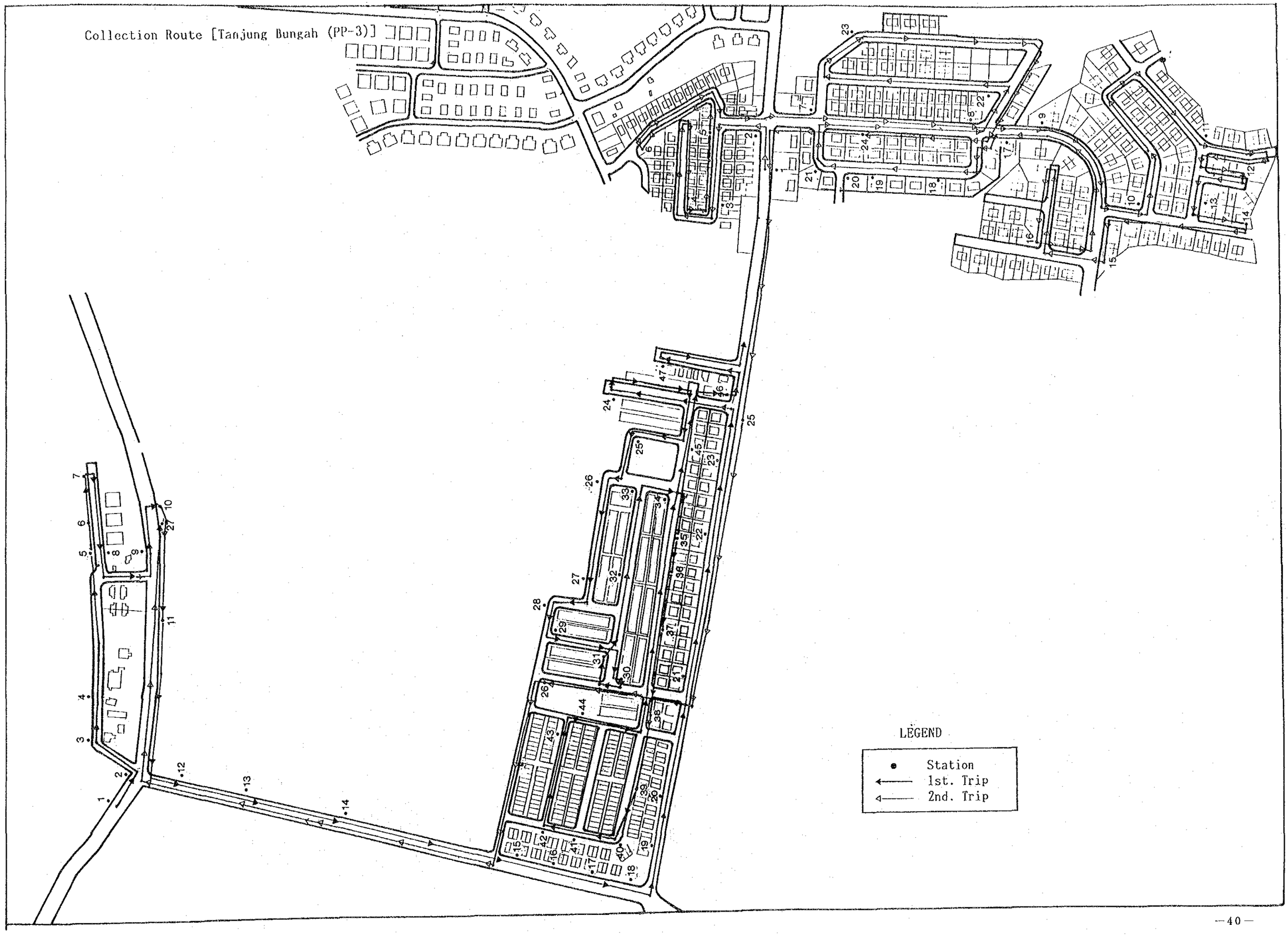
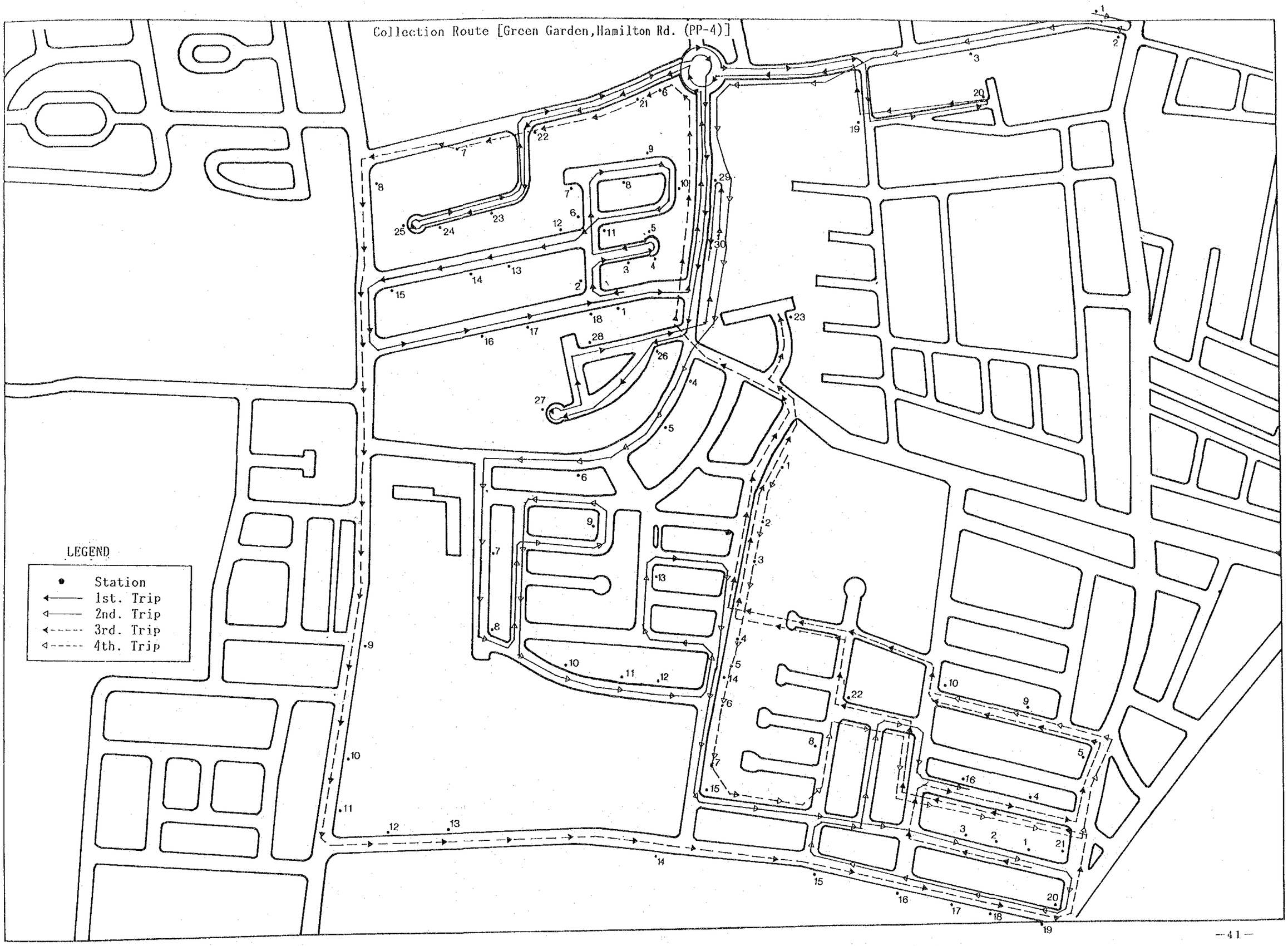
27
28
29
LEGEND
Station
1st. Trip

Collection Route [Tanjung Bungah (PP-3)]

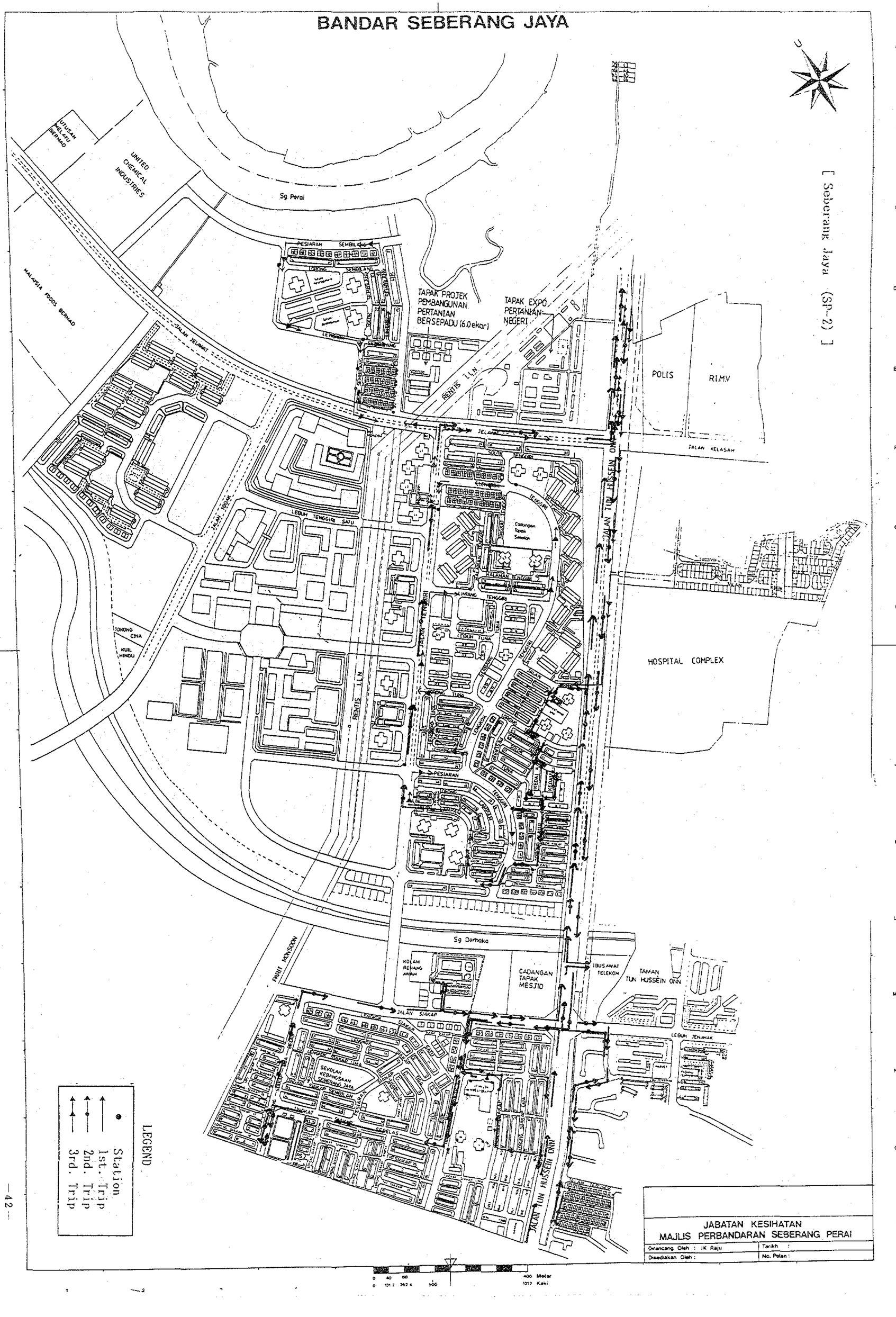


Collection Route [Green Garden, Hamilton Rd. (PP-4)]



BANDAR SEBERANG JAYA

[Seberang Jaya (SP-2)]

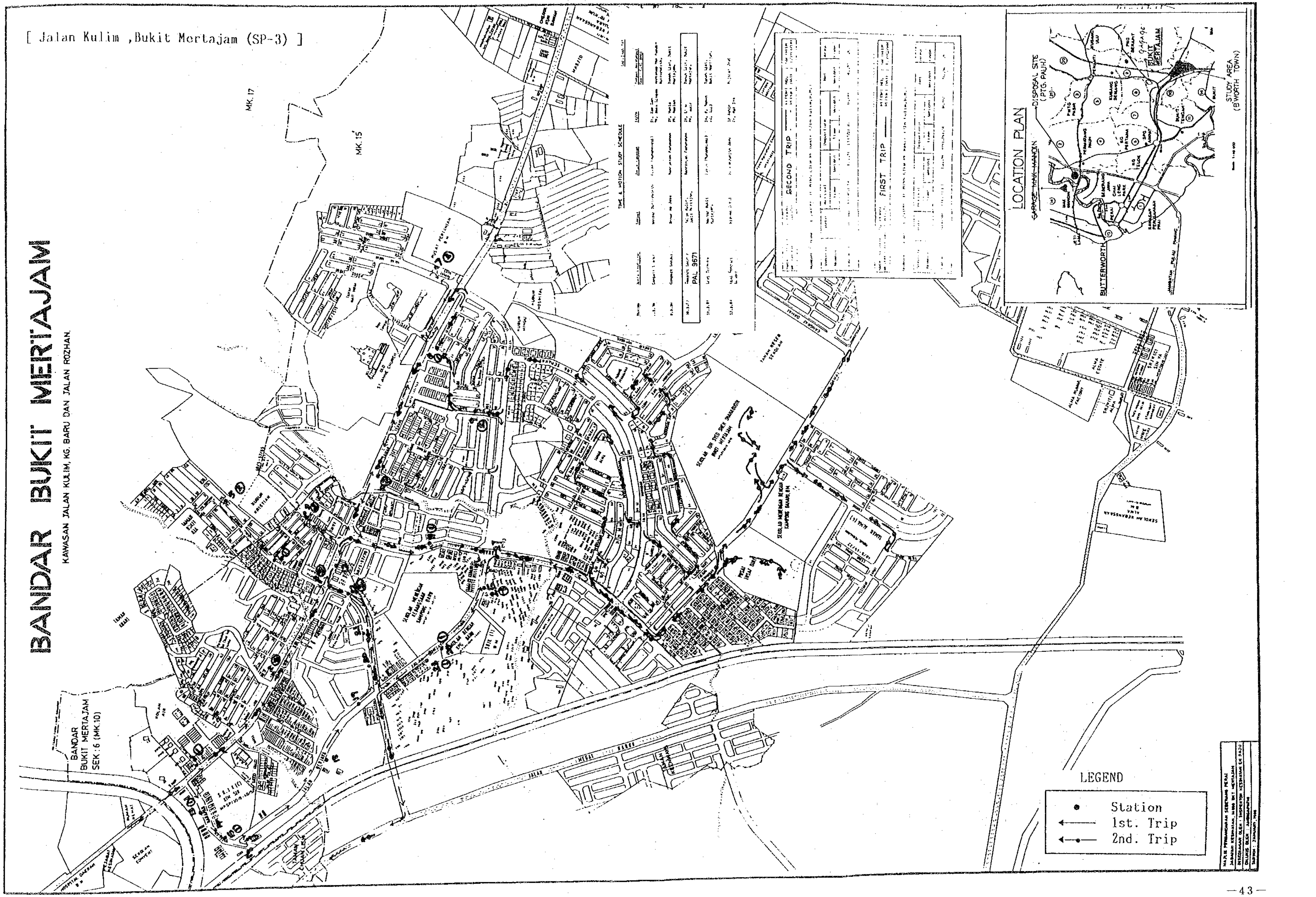


LEGEND

- Station
- 1st. Trip
- 2nd. Trip
- 3rd. Trip

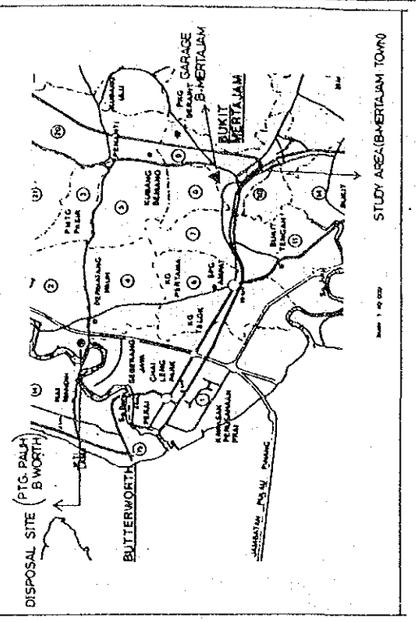
JABATAN KESIHATAN MAJLIS PERBANDARAN SEBERANG PERAI	
Direkabentuk Oleh : IK Raju	Tarikh :
Disediakan Oleh :	No. Pelan :

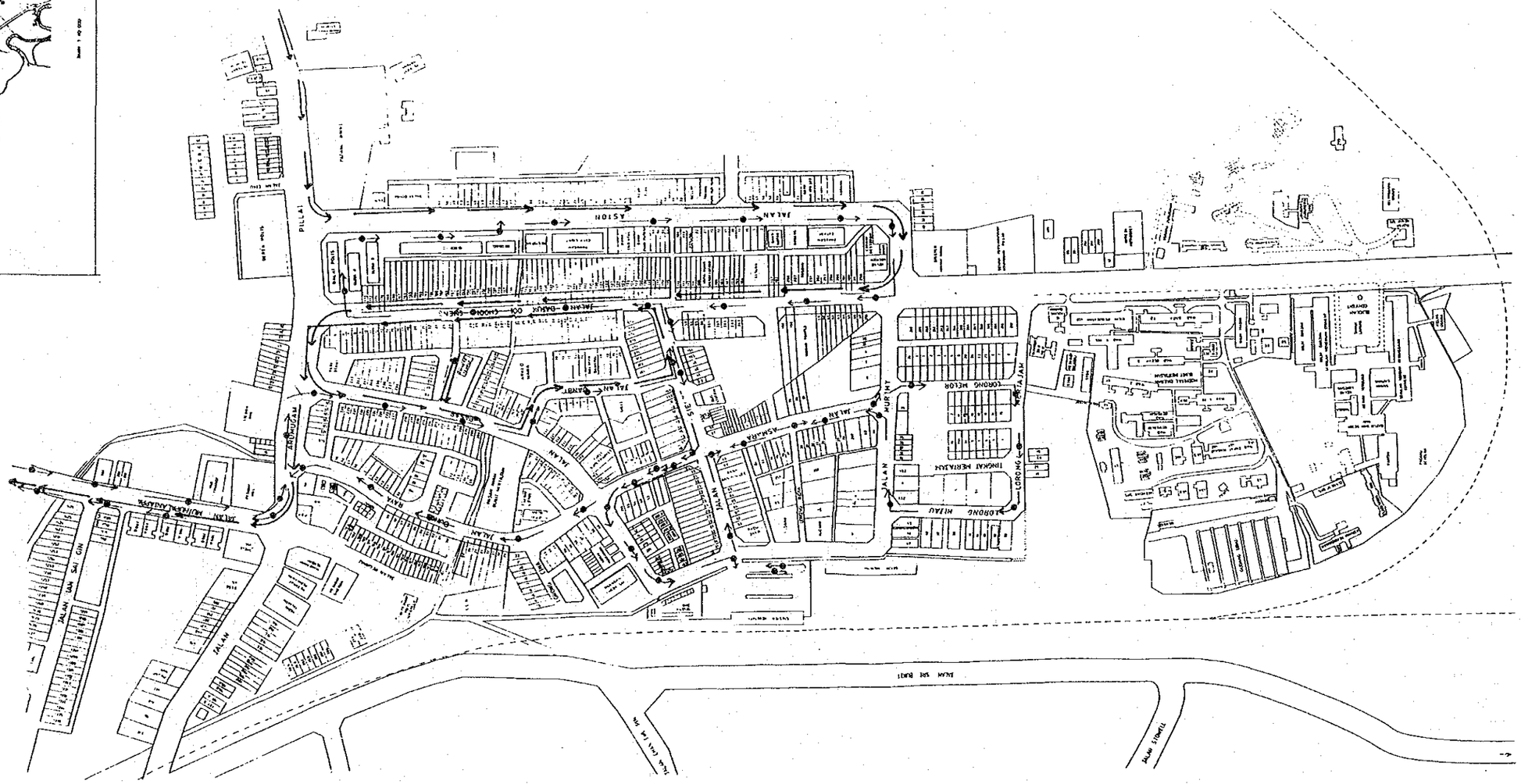
[Jalan Kulim ,Bukit Mertajam (SP-3)]



[Bandar Bukit , Mertajam (SP-4)]

LOCATION PLAN





LEGEND

- Station
- 1st. Trip
- 2nd. Trip

2 Results of Time and Motion for Workers

2.1 Objectives of Study

Workers are assigned in each area with specified work. Types of works involved are van labouring, heaping, drain cleasing, road sweeping, grass cutting, and beach cleansing.
The objectives of ``Time and Motion for Workers``are to obtain the scope of works, working time, eqipments for work, roll call place , working efficiency etc. of each heaper assigned at their respective area.

2.2 Method of Study

(Please refer to table given)

2.3 Scope of Work

(1) Name of worker: Mr. Kong Kein Ping

a. 13 July 1988

The heaper signed in at about 5.55 am in the office. Then, he walked through a kampung until he reached a house where he kept his equipment. He had a hand cart, a scoop and five bamboo baskets kept at the side of the house. Then, with all the equipment, he walked to Jalan Perak to start his work. He served about 40 shophouses along Jalan Perak before entering into a kampung. He did his job to near perfection although on some occasion, his collection work was crude. According to the overseer, the heaper is one of the best workers among his laborers. Although it was raining, he continued with his job and according to him, he prefers working in the rain because of the cooler weather. He served between 350-400 houses in the kampung area without taking tea break or stopping his work while it was raining. There was only one communal container kept in the area by the contractor. So, he had to walk all the way to the same container wherever it was placed. After finishing the collection in his area, he went back to his office to sign off at about 10 am.

Collection service: Door to door service by a heaper

Note: The heaper did not have a broom to sweep the waste on the ground. He merely used his hand and a shovel to pick rubbish from the ground.

Table. 2. 2-1

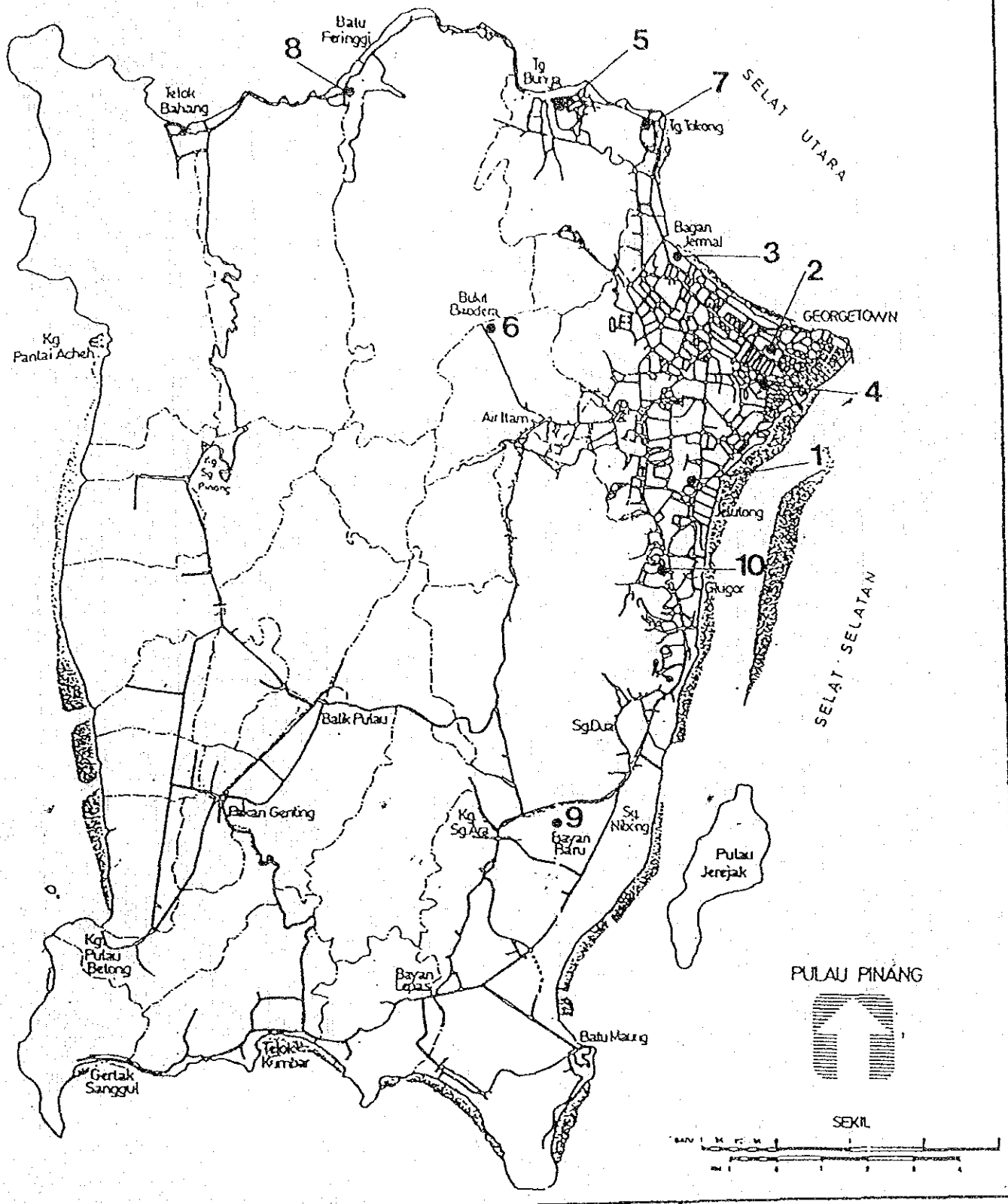
SURVEY AREA AND TYPE OF JOB (MPPP)

FILENAME: SURVEY AREA & TYPE OF JOB

DATE : 13/7/88 WEATHER : RAINY DAY (MORNING)

DATE : 21/7/88 WEATHER : ~~RAINY DAY~~

AREA NO	NAME OF SURVEY AREA	TYPE OF AREA	TYPE OF JOB					
			VAN LABORER	HEAPING	DRAIN CLEANSING	ROAD SWEEPING	GRASS CUTTING	BEACH CLEANSING
1	CHEMOR LANE, OFF PERAK ROAD	TOWN AREA, KAMPUNG HOUSES		○				
2	TRANSFER ROAD AND ARIFFIN ROAD	TOWN AREA			○			
3	GURNEY DRIVE, PENANG	TOWN AREA/ RESIDENCE						○
4	McCALLUM ROAD, PENANG	TOWN AREA/ RESIDENTIAL, SHOPHOUSE				○		
5	TANJUNG BUNGAH, PENANG	RURAL AREA	○	○				
6	MAIN RAOD AIR ITAM, JLN MATA KUCING, JLN SOON SENG KHENG, JLN KAMPONG MELAYU, THEAN TEIK GARDEN AND KAMPUNG PISANG	RURAL AREA/ KAMPUNG HOUSES	○					
7	PEPPER ESTATE (TANJUNG TOKONG)	RURAL AREA/ RESIDENTIAL AREA		○			○	
8	BATU FERINGGHI (BEACH)					○		○
9	TAMAN MELATI JAYA, BAYAN BARU	RESIDENTIAL AREA AND SHOPHOUSES		○	○	○		
10	BUKIT GELUGOR (PENANG)	SHOPHOUSES			○	○		



LEGEND:

Types of Job
1. Heaper
2. Drain Cleaner
3. Beach Cleaning
4. Road Sweeping
5. Heaping + Van
6. Van Labourer
7. Heaper + Drain Cleaner + Grass Cutter
8. Beach + Road Sweeping
9. Road Sweeping + Drain + Heaping
10. Drain + Road Sweeping

Name of Place
Office at Chenor Lane, of Perak Rd.
Kerawat - Junction of Transfer Rd./Griffin Rd.
Stall Complex, Gurney Drive
Old Weigh-Bridge, work-shop, Kpg. Java Bharu
Stall Complex, Hill Side, Tg. Bungah
Container, Hill Railway Rd., Air Itam
Roadside Opposite U.D.A Flats, Tg. Tokong Rd.

Bayu Senja Opposite Batu Feringghi Police Station
near the Multilift Bin Site
Bayan Baru Market, Jalan Mayang Pasir

Container - Behind "Shell" Station in Lebuhraya
Binhas - behing Police Station and around Post Office

Fig. 2.2-1
Survey Area and Type of Job (MPPP)

Source

TIME and MOTION STUDY

for LABOURER

Table. 2. 2-2

SURVEY AREA AND TYPE OF JOB (MPSP) DATE : 14/7/88 WEATHER : FINE

AREA NO	NAME OF SURVEY AREA	TYPE OF AREA	TYPE OF JOB					
			VAN LABORER	HEAPING	DRAIN CLEANSING	ROAD SWEEPING	GRASS - CUTTING	- BEACH CLEANSING
1	MAK MANDIN, BUTTERWORTH	RESIDENTIAL AREA (HOUSING SCHEME)			○			
2	JLN BAGAN LUAR AND MARKET AT JLN JETTY LAMA	SHOPHOUSES AND MARKET		○		○		
3	CHAI LENG PARK	HOUSING ESTATE (RESIDENTIAL & SHOPHOUSES) MIDDLE INCOME		○	○	○		
4	TAMAN SIAKAP, SEBERANG JAYA	RESIDENTIAL AREA		○	○		○	
5	SEBERANG PRAI	RESIDENTIAL AREA-MIDDLE INCOME		○		○	○	
6	BUKIT MERTAJAM TOWN AREA (JLN ASTON)	SHOPHOUSES AND RESIDENTIAL AREA		○	○			
7	DESA DAMAI	MIDDLE-CLASS RESIDENCE		○	○			
8	TAMAN SEJATI, BUKIT TENGAH	RESIDENTIAL AREA -MIDDLE INCOME		○	○	○		
9	TAMAN BUKIT, BUKIT MERTAJAM	RESIDENTIAL AREA		○	○		○	
10	TAMAN BUKIT RIA	RESIDENTIAL AREA			○			

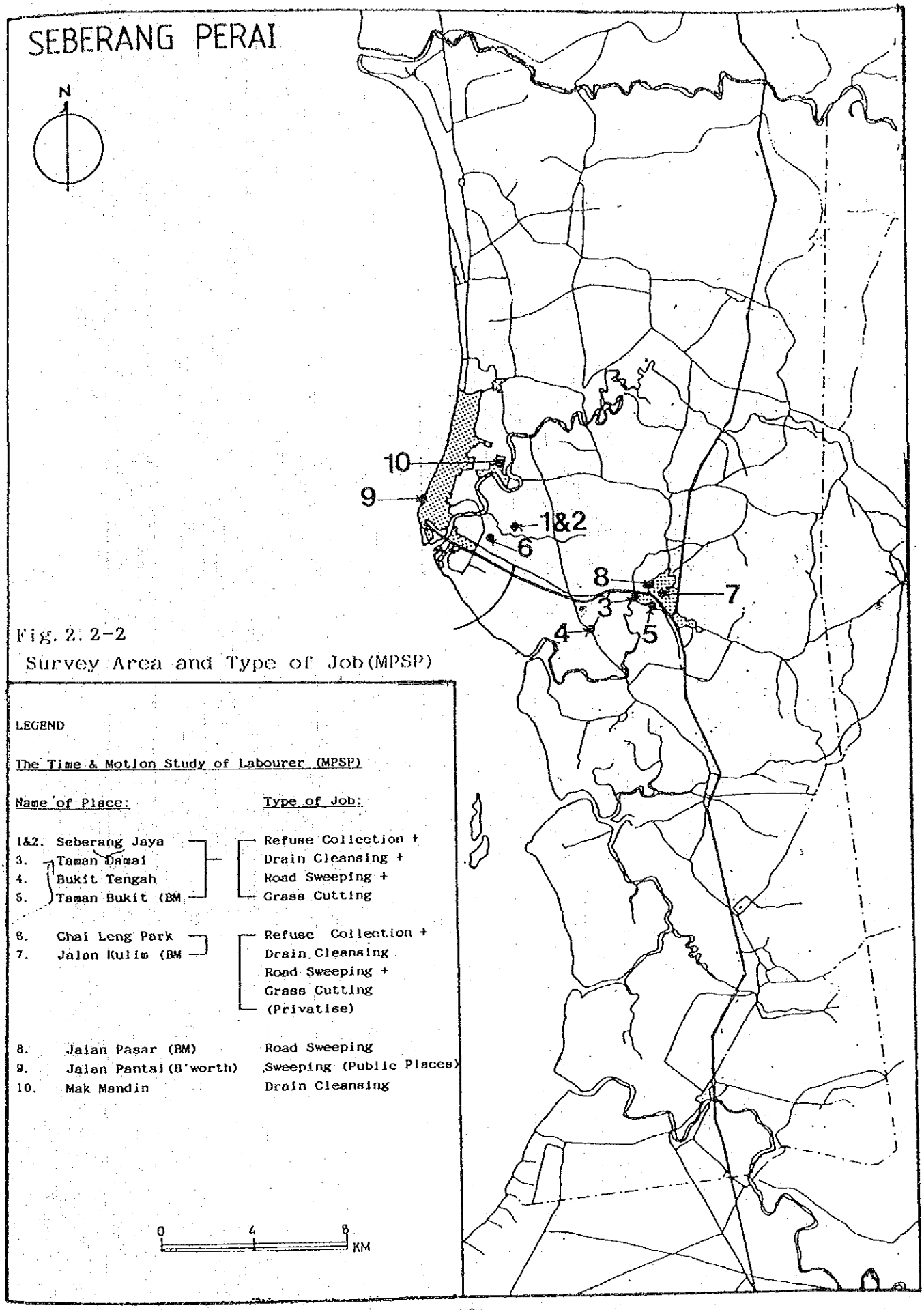


Fig. 2.2-2
Survey Area and Type of Job (MPSP)

Table. 2.2-3

ROLL CALL TIME AND ROLL CALL PLACE (MPPP)

DATE : 13,21/7/88

FILENAME: R/C TIME & R/C PLACE

Area No	Roll Call Time			Roll Call Place		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.
1	5.30 am - 6.00 am	10.00 am		WASTE DISPOSAL (PENANG) SDN BHD. (OFFICE) 312-E, JALAN PERAK, PENANG	WASTE DISPOSAL (PENANG) SDN BHD. (OFFICE) 312-E, JALAN PERAK, PENANG	
2	6.00 am - 6.30 am			FRONT OF THE MOSQUE, SURRONDED BY SHOP-HOUSES (TOWN AREA) TRANSPER ROAD	FRONT OF THE MOSQUE, SURRONDED BY SHOP-HOUSES (TOWN AREA)	
3	6.30 am - 6.45 am	11.15 am - 11.30 am		A STALL COMPLEX (PANTAI SELERA) ALONG GURNEY DRIVE	A STALL COMPLEX (PANTAI SELERA) ALONG GURNEY DRIVE	
4	6.30 am - 6.45 am	11.30 am		LOOK LIKE A FACTORY GUARD HOUSE IN KAMPUNG JAWA BARU	COMMUNITY HALL, JALAN PATANI, PENANG	
5	6.30 am			COMPLEX STALL		
6	6.30 am - 7.30 am			BESIDE A SHOPHOUSE (36H, JALAN AIR HITAM) WITHOUT SHELTER		
7	6.00 am - 6.15 am			IT IS A PERMANENT SHADE-BEHIND A COFFEE SHOP		
8	6.30 am - 6.45 am	11.30 am - 11.45 am	1.00 pm - 1.15 pm	INSIDE A "TRAILER TYPE OFFICE."	INSIDE A "TRAILER TYPE OFFICE."	INSIDE A "TRAILER TYPE OFFICE"
9	6.20 am - 7.00 am	10.30 am	1.55 pm - 2.05 pm	MARKET, BAYAN BARU	AT A SOCCER FIELD	MARKET, BAYAN BARU
10	6.30 am			CONTAINER (BUKIT GELUGOR)		

Table. 2. 2-4

ROLL CALL TIME AND ROLL CALL PLACE (MPSP) DATE : 14/7/88

Area No	Roll Call Time			Roll Call Place		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.
1	6.45 am - 7.00 am	-	-	IN A COFFEE STALL IN MAK MANDIN INDUSTRIAL AREA	-	-
2	7.00 am - 7.25 am	-	13.45 pm - 14.00 pm	MPSP BUILDING(INFRONT OF QUIT LAND COUNTER)	-	MPSP BUILDING (INFRONT OF QUIT LAND COUNTER)
3	6.55 am - 7.15 am	-	14.25 pm - 14.30 pm	INFRONT OF CINEMA COMPOUND	-	AT THEIR OFFICE IN THE AREA (RENT A HOUSE)
4	6.30 am - 6.40 am	-	-	PDC OFFICE (BESIDE FLAT AT LEBUH JENAHAK)	-	-
5	6.30 am - 7.00 am	-	-	PDC OFFICE BESIDE CARETAKER OFFICE	-	-
6	6.00 am - 6.10 am	-	-	INFRONT OF A COFFEE STALL IN JALAN PASAR	-	-
7	7.00 am - 7.15 am	-	12.45 pm - 1.00 pm	INFRONT OF STORAGE BUILDING IN DESA DAMAI COMPLEX	-	INFRONT OF STORAGE BUILDING IN DESA DAMAI COMPLEX
8	6.30 am - 7.00 am	-	-	BESIDE THE GENERATOR, SURROUNDED BY THE TERRACE HOUSE (MIDDLE INCOME RESIDENCE) AT THEIR STORE	-	-
9	7 .15am - 7.30 am	-	13.32 pm - 13.40 pm	A PERMANENT PLACE WHERE TOOLS AND WQUIPMENTS ARE KEPT, LOCATED ALONG JALAN BUKIT KECIL, TAMAN BUKIT, BUKIT MERTAJAM	-	- DITTO -
10	6.30 am 7.00 am	-	14.30 pm	ROAD PAVEMENT IN THE HOUSING ESTATE (NO SHED)	-	- DITTO -

b. 21 July 1988

The heaper started work at 6.15 am and followed his work routine as usual. His collection service today was even better than the previous day. (It may be because it did not rain today). The residents praised him today for his hard work and for his good collection service. (According to the residents, the heaper will even work on rainy days unlike the municipal workers).

The heaper salvaged a few items like bottles, shoes and tins from the waste collected today. According to the heaper, he receives approximately $40-$80 per month by selling the items salvaged from the waste. He finished heaping at about 9.20 am and took a rest while waiting for a garbage lorry to transfer the communal container (Type SCL can be shifted from one place to another) which is fixed in the kampung to another collection point inside the kampung where the heaper was waiting. The lorry arrived at about 9.45 am and the heaper started to load the garbage from the collection point into the lorry. He cleared the places near the collection point and finished at about 10.00 am. because the lorry driver was having a tea break. The lorry driver returned at 10.30 am and the heaper followed him to the dump site in Jelutong to dispose of the waste. They left for Jelutong at 10.30 am and returned at 10.50 am. After storing up his equipment, he walked to his office and signed out at about 11 am. The heaper used a bamboo broom to sweep the rubbish on the ground near the communal container. He hid the broom near the communal container.

The total weight of waste collected today was 900-1270 kg. (Measured from the weighing machine at the dump site).

(2) Name of Worker: Encik Osman Saad

a. 13 July 1988

Generally, the work had been properly done even though it was raining. However, the workers started work late due to the weather and could not do their work efficiently. He started work at 8.30 am.

b. 21 July 1988

The work was properly done even though he was not aware of the 'time and motion' check on him. However, his break was longer than the other day.

He also did road sweeping even though drain cleansing is his work. Hence, it takes time to clean an area. He had to cover several duties like drain cleansing, road sweeping, and cutting shrubs near the drain. The drain becomes stuck due to people throwing rubbish in the drain. Therefore, he cleared the rubbish in the drain first, cut the shrubs and then, he cleaned the drain. He had to do road sweeping because a large amount of leaves fall from trees in Transfer Road.

Note: Encik Osman Saad was on leave and Encik Ali Akbar b. Abd. Latif took over on this day.

(3) Name of Worker: Encik Osman bin Hassan

a. 13 July 1988

The overall work was handled well. However, the length of time needed to accomplish the job greatly depends on the quantity and on the weather condition. Basically, with heavy rain, more waste will be discharged. The present system of beach cleansing may not appear to be efficient. The area which had just been cleaned would turn dirty again due to rubbish being constantly washed by the sea waves. Thus, cleansing would not change the 'appearance' of the beach.

The quantity of the waste collected on this day was estimated to be 40 bamboo baskets.

b. 21 July 1988

The beach cleaning team (a group of 10 men) was divided into 2 sub-groups today. One group consisted of 7 and the other 3 members. They started working in two different areas but moving moving in the opposite direction to finally meet up at a common place which was at the junction of Cantonment Road. Both teams stopped work at 10.30 am for for lunch break and continued again after 11.30 am.
They commenced work from Hai Seng Restaurant (but this time, both the sub-groups merged to form a group of 10 men) and trailed along the beach of Pantai Molek.
Kampung houses of the fishing villagers dominate the initial portion of the beach but later bushes and undergrowth prevailed the surveyed area.
The estimated amount of rubbish collected on this day was:-

After roll call until 10.30 am - 4 push carts (4'x4'x2')

After 11.30 am until 1.00 pm - 50-60 bamboo baskets

(4) Name of Worker: Encik Wan Abu Bakar

a. 13 July 1988

The road was wet and in some areas , the water was stagnant at the sides. So, according to the worker, the sweeping task would be difficult because the rubbish becomes stuck to the road surface.
The first roll call was at 6.30 am at the guard house and the second was at 11.30 am at the Balai Rakyat.

b. 21 July 1988

The previous worker did not show up at the work place. He was replaced by another worker at 7.15 am. According to the overseer, Encik Hussein (the relief worker) has only started work for only 4 months. His routine is drain cleansing. According to the overseer, the relief worker would not pay much attention on areas other than his own.

Hence, from this, it can be seen that the overseer is more supportive of Encik Wan Abu Bakar (the usual worker) with regards to work productivity. Encik Hussein only managed to complete 4.6 feet per minute compared with Encik Wan Abu Bakar with 7.7 feet per minute.

(5) Name of worker: Mr. Turunelakandau A/L Gowindarajoo

a. 13 July 1988

At any one time, there are 5 workers and 1 mandor when the van is moving. Meanwhile, 4 workers wait somewhere for their turns. According to the driver of the van, the first trip started at 6.30 am. (Surveyor did not have the chance to follow them because during that period, the 'heaping' survey was being carried out). The surveyor was asked to skip the second trip which began at 8.45 am due to lack of sitting space in the van.

b. 21 July 1988

The heaper had to go for a check-up at the clinic because of injury from two days ago during his work. He was relieved by a van laborer, Encik Azmi bin Ibrahim. Each worker wore gloves and carried 2 bamboo baskets, 1 bamboo broom and changkul. At Sea Home, 2 workers were dropped off to be picked up later.

Heaping was done at:-

Jln. Loh Poh Heng
Jln. Bahandin
Jln. Osman b. Abdul Rahman
Jln. Azyze
Jln. Sentosa
small lane off Jln. Tanjung Bungah

(6) Name of Worker: Encik Muthiah Ramanathan

a. 13 July 1988

Normally, the workers start work at 7.00 am and finish at 12.15 am. There were two trips to the dump site. The first trip covered the main road, Air Itam, Jln. Matang Kuching and Jln. Chor Seng Kheng. The second trip covered Kampung Melayu, Thean Teik Garden and Kampung Pisang. Collection was done by the heapers to the communal container at which the van came to collect. Two rectangular bins were used at Kampung Melayu and Thean Tek Garden and three bins were used at Kampung Pisang.

The dumping ground was at Pakau Street in Jelutong.

The amount of waste collected from the first trip was 1270 kg. and 1130 kg. from the second trip.

The average collected a day is usually 1500-1800 kg.

The sizes of the bins used by MPPP are:-

Rectangular bin	-	24 cubic feet
Mechanical bin (carried by SCL)	-	34 cubic feet
Round bin	-	2 cubic feet
Litter bin	-	1.5 cubic feet

The tools supplied by MPPP are gloves, canvas shoes (2 pairs/year), trousers, (2 pairs/year), shovel, bamboo broom, Chinese broom, coconut broom, brushes, bamboo rake, round bamboo basket (insufficient supply), hoe and drain scoop.

The tools which are not supplied by MPPP are raincoat, hat, shirt, safety helmet and face cover.

b. 21 July 1988

The areas with daily and direct collection and collection from the communal containers are:-

Zoo Road
Air Itam Road
Jln. Matang Kuching
Jln. Chor Seng Kheng

The areas with collection from the communal containers into the van are:-

Kampung Melayu
Thean Teik Garden
Kampung Pisang

The number of communal containers in each area are:-

Zoo Road	-	2
Air Itam Road	-	2
Jln. Chor Seng Kheng	-	3
Kampung Melayu	-	2
Thean Teik Garden	-	2
Kampung Pisang	-	3

The waste collected on the first trip was 1490 kg. and 1260 kg. for the second trip.

(7) Name of Worker: Encik Mohd. Yusof bin Che Long
Area name: Pepper Estate, Tanjung Tokong, Penang

a. 13 July 1988
The worker was doing his work perfectly and it seemed that the residents preferred his way of collection. He could only carry out heaping and grass cutting because it was raining heavily and it took a longer period of time. He cut the grass along the drain only. He did not manage to do any drain cleansing.

b. 21 July 1988
It was not raining so the worker could do heaping all over the area in Pepper Estate without taking a break. It seemed that he cleaned the drain the day before so he did grass cutting today. It also seemed like he could not take the heat from a very warm day.

(8) Name of Worker: Encik Nayan bin Taib
Area name: Batu Feringghi (Beach), Penang

a. 13 July 1988
The work could not be properly done because the worker only spent 15 minutes for this task. The amount of waste collected from road sweeping was 900 liters.
The beach cleansing area is about 3 km. from the roll call place. The worker had to use a bicycle to the site. He lost 15 minutes each way from doing so. The beaches are generally clean but it is difficult to predict on the amount of waste since it is related to the weather and the tide. The amount of waste collected today was 1440 liters.

b. 21 July 1988
Immediately after the roll call at 6.30 am, some workers went directly to the work site where the others were having breakfast at a nearby store. Mr Nayan started his assigned job immediately. The amount of waste collected from road sweeping was 180 liters x 6 trips = 1080 liters of mainly leaves.

The beaches are generally clean . The workers took only 1 hour 15 minutes to clean the area. The amount of waste collected was 180 liters x 2 trips = 360 liters

(9) Name of Worker: Encik Dullahi bin Mohd. Shah
Area name: Taman Melati Jaya, Bayan Baru

a. 13 July 1988
All the heaped waste was disposed of in communal containers. The worker could not finish cleaning the drain due to the rain. The drain waste is disposed of in the communal container. He normally takes 1-1.5 hours to do road sweeping.

b. 21 July 1988
The residents simply threw rubbish without using a bin or plastic bag and placed the rubbish on the ground. The worker was faced with the problem of having to remove commercial waste like metal scrap and taking it to the communal container. A lorry came to collect the waste at 8.10 am and finished at 8.17 am. There were 4 communal containers in this area. Some residents would dispose of their waste after the heaping has been done for the day.

(10) Name of Worker: Encik Hussein b. Abdullah
Area name: Bukit Gelugor, Penang

a. 13 July 1988
At 6.30 am, the worker reported to the roll call area. He started work late due to the rain (8 am). The supervisor came to check on the workers. Encik Hussein did well in cleaning the drain.

He started to sweep at the beginning of one row of shophouses and ended at the other end. The waste was collected into the wheel barrow and taken to the communal container. He swept the rubbish on to the side of the road before placing it in the wheel barrow. He finished work at about 12.00 pm.

b. 21 July 1988
A worker named Encik Ramu A/L Narayanan replaced Encik Hussein b. Abdullah today. He started to clean the drain at 11.15 am and finished at 12.13 pm. He also used a sickle to cut the grass near the drain. Then, he placed the waste in a bin by using a hoe. He was working very fast. (This could be because he knew he was been observed on) A mandor was with him during his work.

(11) Name of worker: Encik Ismail & Encik Lubir
Area name: Taman Siakap, Seberang Jaya, Seberang Perai

14 July 1988
Two men work together in these tasks. They started work at 6.40 am. They first collect the bins which are placed in the front of houses. Most of them have lids. They placed the rubbish in the communal container which they also push together. About 130 bins are cleared. They finished work at 7.30 am.

They started drain cleansing at 7.33 am. One used a hoe and the other used a broom to clean the drain. Both tools are about 12 feet long. All the waste was thrown into the wheel barrow. They also cut the grass beside the drain. They finished at 11.15 am. and about 1154 feet of drain had been cleaned.

For grass cutting, machine is used. After the grass was cut, they placed it in the wheel barrow which they pushed to a collection point. They finished this task at 1.10 pm.

(12) Name of Worker: Encik Mansor & Encik Abdul Samad
Name of area: Seberang Jaya, Seberang Perai

14 July 1988
According to the overseer, 6 bamboo baskets were not sufficient for the Siakap area. An additional 4 would be required to overcome the situation.

Road sweeping was carried out during these times:-

9.15 - 9.30	Tingkat Siakap Tiga	- 74 x 2 = 148
9.30 -11.15	Jln. Siakap	- 394 x 2 = 788
11.15 -11.30	Tingkat Siakap Sebelas	- 70 x 2 = 140

Priority is given to heaping and road sweeping rather than grass cutting. If heaping and road sweeping are not completed before lunch, it will be carried on after lunch instead of starting on grass cutting.

(13) Name of worker: Encik Ismail bin Saad
Type of Area: Desa Damai, Seberang Perai

14 July 1988
The overseer has divided Desa Samai into 9 service areas. In each service area, there is only 1 worker. He is responsible for rubbish collection drain cleaning, grass cutting and road sweeping. Encik Ismail is expected to do the four tasks everyday. He was assigned to relieve another worker today; hence , he could not finish his own work in his area. He only managed to collect the rubbish and clean the drain.

The bins were located behind the premises. Each bin is about 36 liters. Most of them did not have lids. The rubbish from the high rise flats were collected from the chute.

(14) Name of worker: Encik Ramli b. Sidek
Type of Area: Taman Sejati, Bukit Tengah, Seberang Perai

14 July 1988
The worker was responsible for doing several tasks like heaping, drain cleansing and road sweeping. The overseer was responsible for a few areas which were Taman Sejati, Taman Manis, Pekan Bukit Tengah and Taman Bukit Tengah. Certain areas were only covered by one worker if a lack of workers existed. In Taman Sejati, only one worker was responsible for heaping, drain cleansing and road sweeping. This was a reason for a longer time period taken to complete the work.

He started with heaping first which was followed by drain cleansing and then road sweeping. While cleaning the drain, he would also cut the grass near it.

(15) Name of Worker: Encik Hashim bin Harun
Area name: Taman Bukit, Bukit Mertajam, Seberang Perai

14 July 1988
In this residential area, the workers were divided into 3 sub-groups with 2 persons per group. Collection was carried out according to their respective area already allocated by the mandor.

Basically, the drain are well-maintained; however, cleaning of creepers and shrubs may be required along the drain. Daily work ie. heaping, road sweeping and grass cutting are subject to the worker's own discretion. Sometimes, he may not do all tasks in one day.

Grass cutting which is done here is not the normal process using sickle or machine. In this case, the shrubs are removed by using a hoe along the edge of the road and drain. Some patches of grass are not removed everyday but left until the following day to be removed.

(16) Name of Worker: Encik Mokthar Jaffar
Area name: Chai Leng Park, Seberang Perai

14 July 1988
The waste that is put into the communal container is collected by a private contractor lorry and finally disposed of at the municipal dumping site. Residents here do not cooperate with the cntractor and they throw remnants from tree cutting in front and behind their premises. This causes a problem for the worker. A second probelm is throwing waste after collection time.

The drains become clogged up and it is difficult for the worker to collect the waste.

Flooding takes place on the roads which causes difficulty for the worker to sweep.

(17) Name of Worker: Encik Husin bin Ahmad
Area name: Taman Bukit Ria (Seberang Prai)

14 July 1988
The work in this area is done by private contracter, Syarikat Haji ~~bin~~ Zain Mustaffa bin Yusoff. This area was hardly worked on when the cleaing tasks were handed by the MPSP to the private contracter. Drain cleaning had to be done thoroughly due to much soil sediments in the drain. Furthermore, each worker is responsible for multible tasks.

Every morning the worker's job is sort of a routine i.e. he sweeps the road and collects dustbins from house to house. Having done that, he will proceed to clean the drains if time permits. The local residents find his service quite satisfactory.

(18) Name of Workers : En. Said b. Kassim & En. Alex
Name of Area : Jln. Aston, Bukit Mertajam, Seberang Prai

14 July 1988
All the waste collected through heaping is dumped into a big bamboo basket which will be transfered subsequently into the communal container.

The two workers not only clean the drains but also sweep the shoulder of the drains. If the need arises they will put themselves inside the monsoon drain to carry out their work.

Grass cutting or grass poisoning is done in alternate days after drain cleaning is done. Today grass cutting was not carried out. Instead, they were asked by the overseer to carry some wood which was collected a few days back during gotong-royong. Wheel barrow was used as a means of transport to tranfer the wood to the collection point.

(19) Name of Worker : Encik Mohd. Sofian bin Daud
Name of Area : Jln. Bagan Luar and the Market at Jln. Jetty Lama, Seberang Perai

14 July 1988
The waste collected from heaping and road sweeping at Jln. Bagan Luar was 400 liters and 2750 liters at the market.

(20) Name of Worker: Encik Mat Desa
Area name: Taman Sri Nasib, Mak Mandin, Seberang Perai

14 July 1988
The drain cleaner started work at 7.15 am and finished at 10.45 am. He does two tasks each day ie. heaping and drain cleaning. Today, only drain cleaning was done as there was another worker to do heaping. He served 35 houses.