

Annex

Operation and Maintenance Manual

for

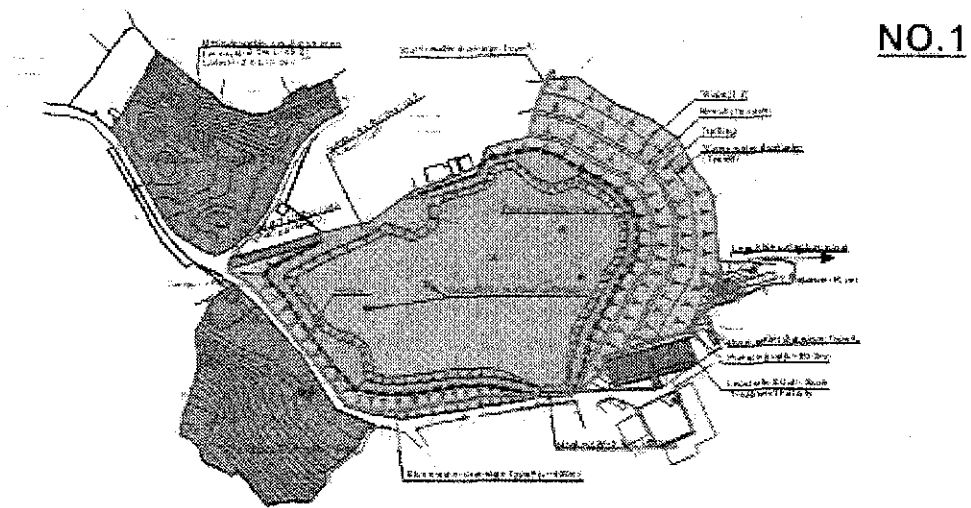
Controlled Landfill Site at Gohagoda in Kandy

1 Waste discharging and covering soil

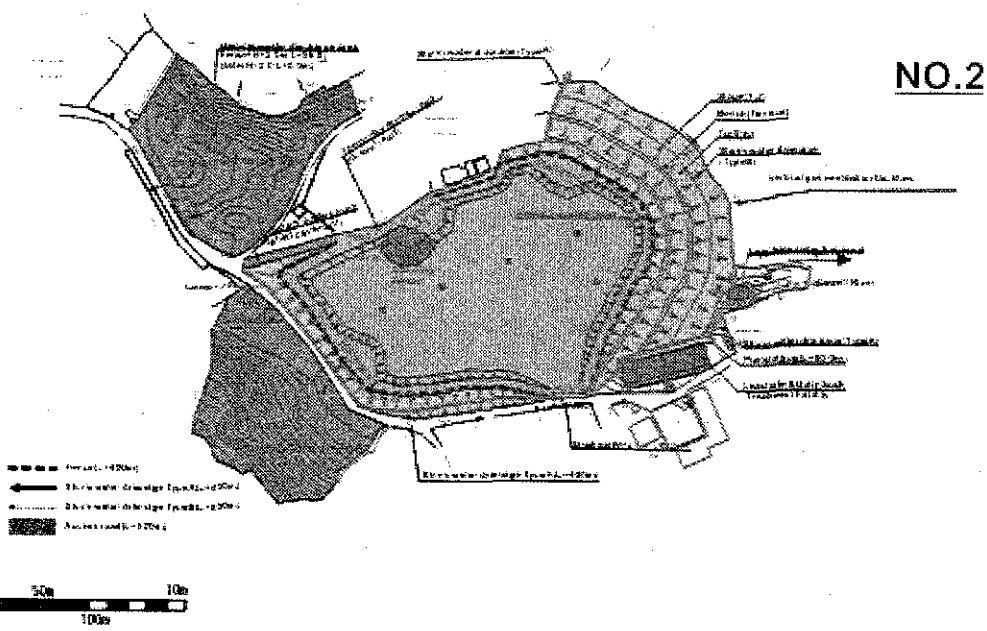
The waste shall be discharged to the landfill site from the three platforms. The waste discharging procedure is as follows.

- 1) The waste shall be discharged to the down at the landfill site from platforms.
- 2) Bulldozer shall move and compact the waste. The waste must not be scattered and it must be minimize as less as possible in order to decrease the amount of covering soil.
- 3) When the dimension of compacted waste is approximately two (2) meter height, twenty (20) meter width and twenty (20) meter length, it covered by soil.
- 4) The thickness of covering soil is approximately twenty (20) cm and it shall be done twice or three times a week.
- 5) The area where is covered soil on the waste will become temporary access road for collection vehicle, therefore it must be compacted well by Bulldozer.
- 6) The steel plates can be utilised for the travelling of collection vehicle, when it is rain.

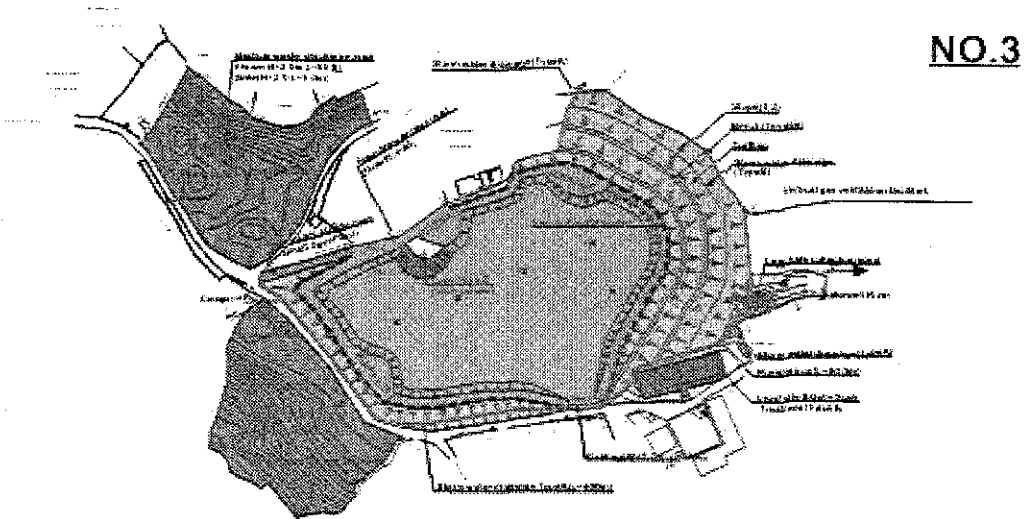
The following figures show the operation procedure of discharging waste and covering soil.



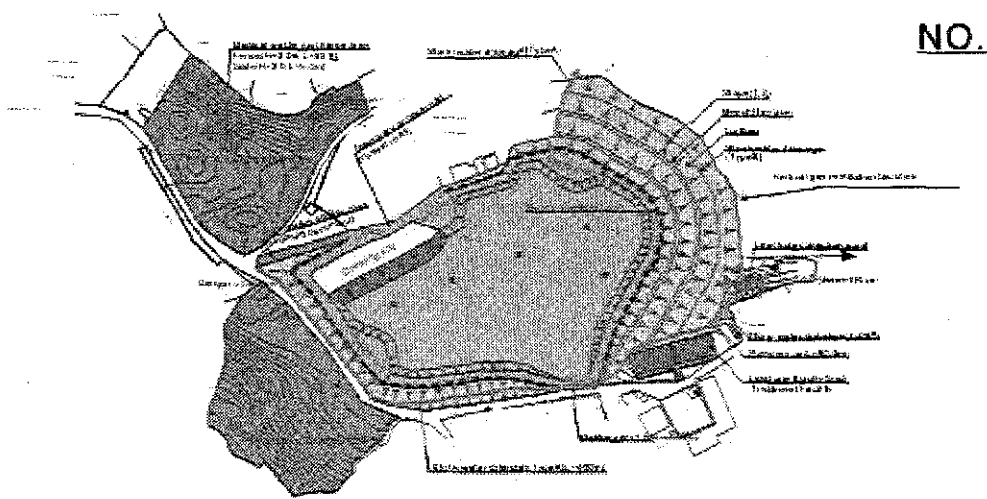
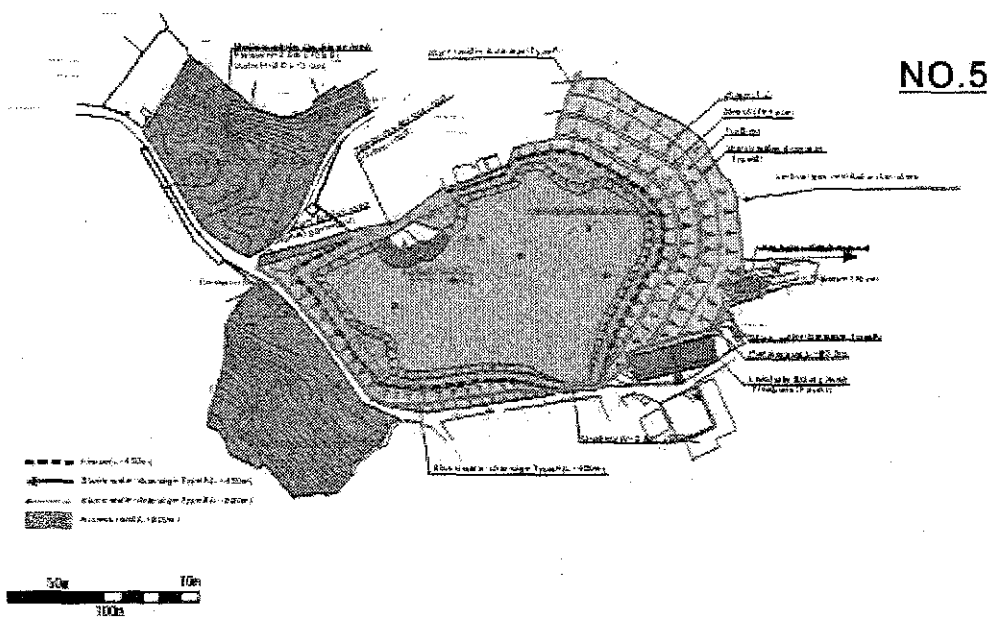
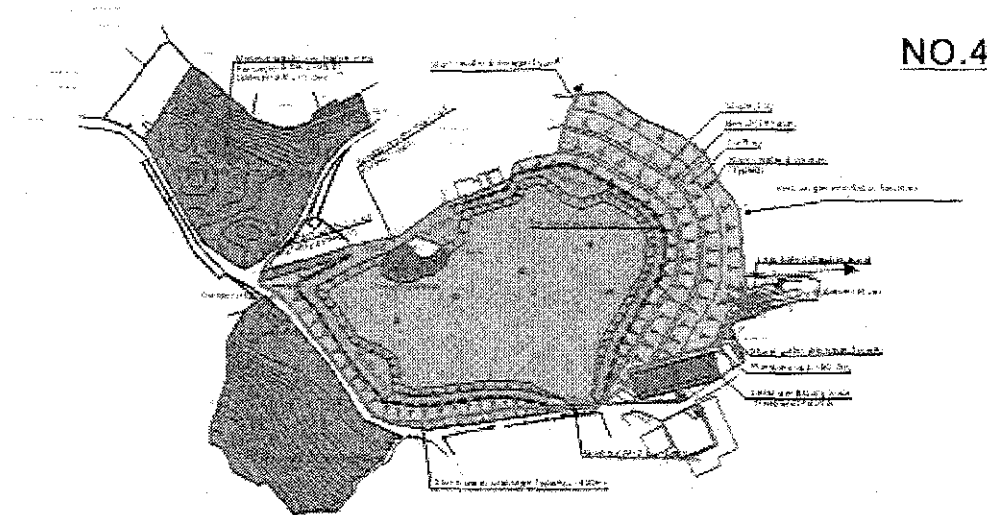
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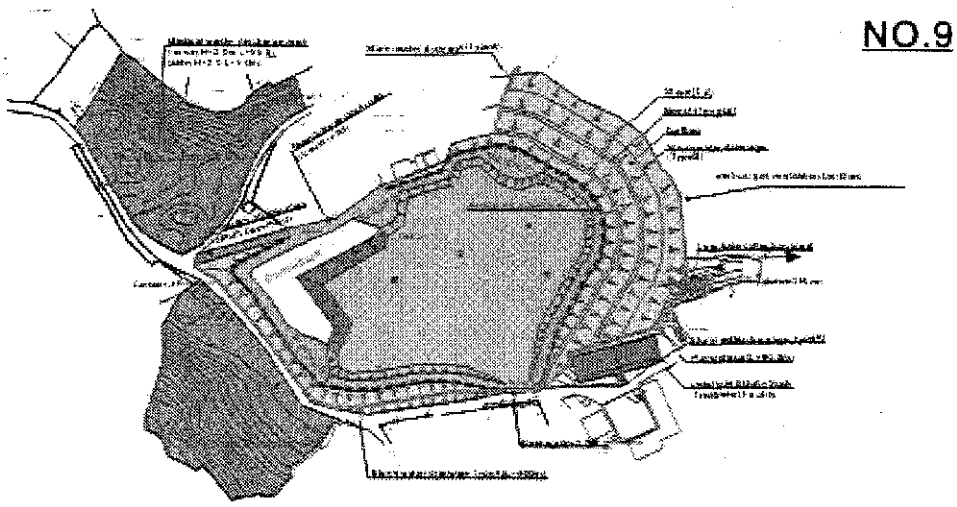
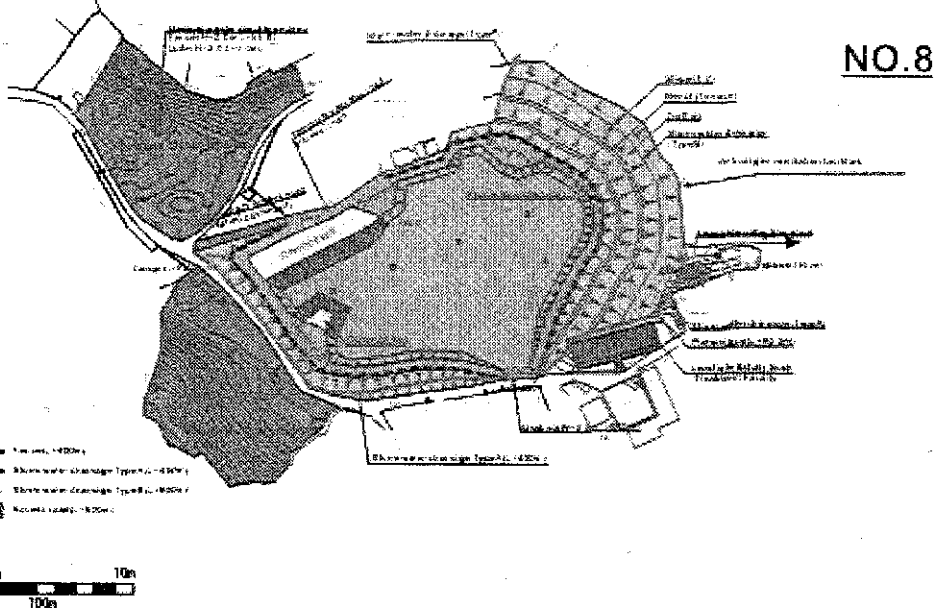
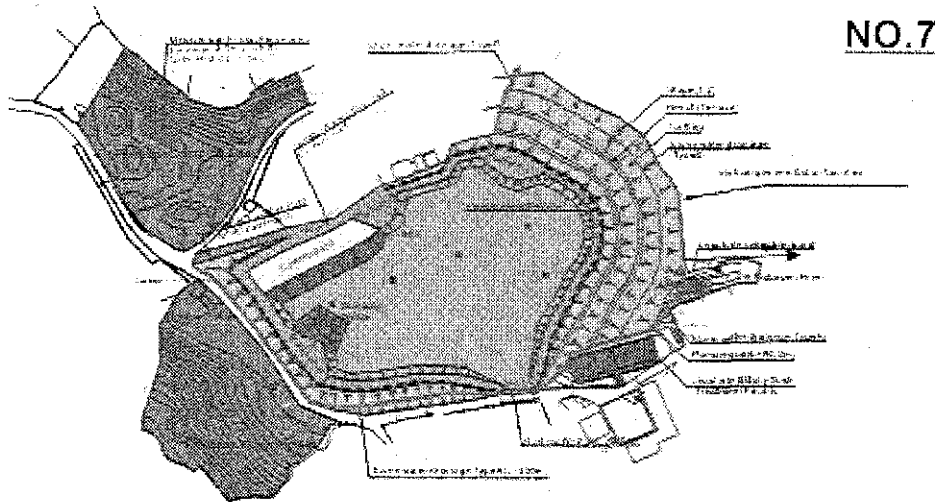


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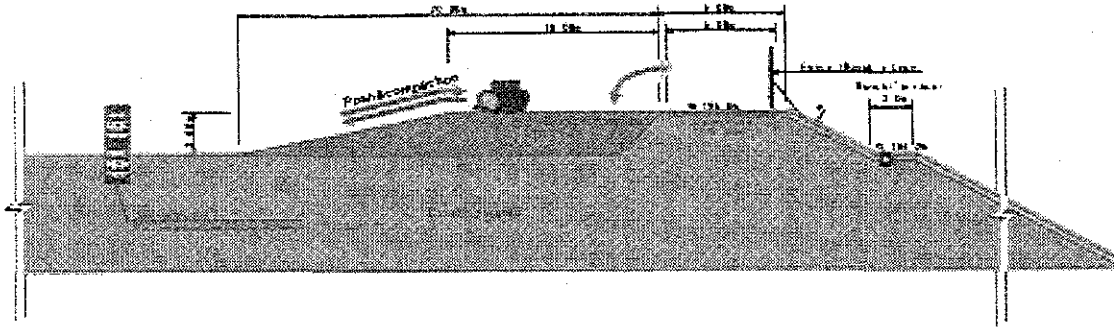


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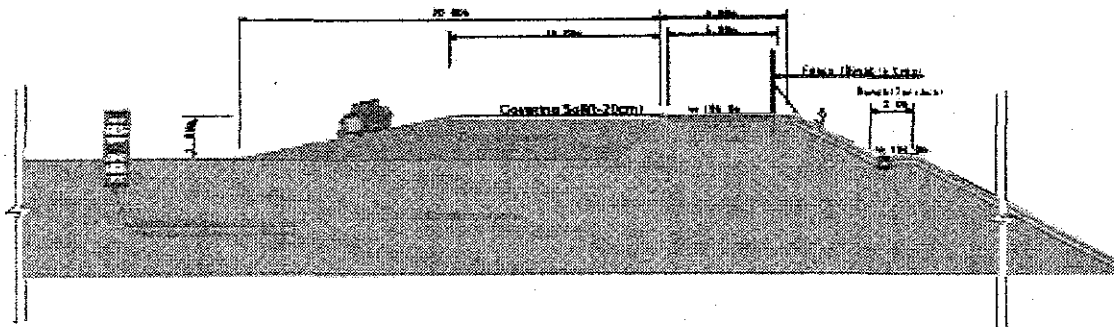




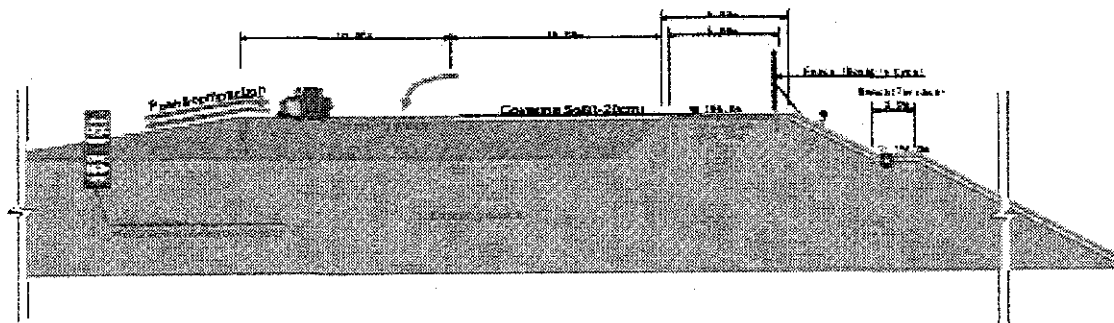
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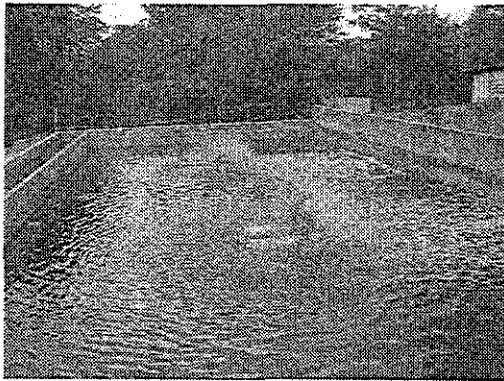


2 Leachate Treatment

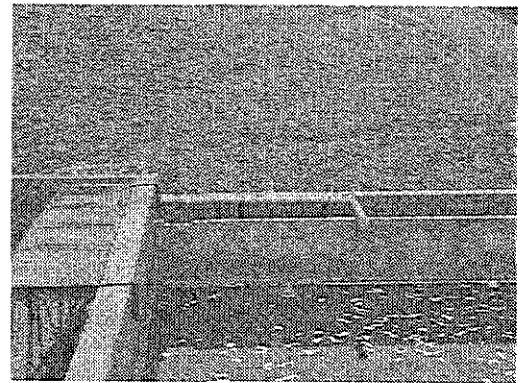
2.1 Leachate and gully suck tanks

The operation and maintenance of leachate and gully suck tanks is as follows

- The aerators shall be operated two hours in the morning and two hours in the evening everyday.
- The leachate treatment facility requires removing of sludge periodically and to be discharged to the landfill site whenever necessary
- Connection pipe between upper tank and lower tank and effluent pipe from lower tank shall be clean once a week.
- Removing of floating materials (shopping bags, paper and so on) and bulky waste (Tire, wood and so on)
- Add grease and service aerators every three months



The aerators shall be operated for four hours per day

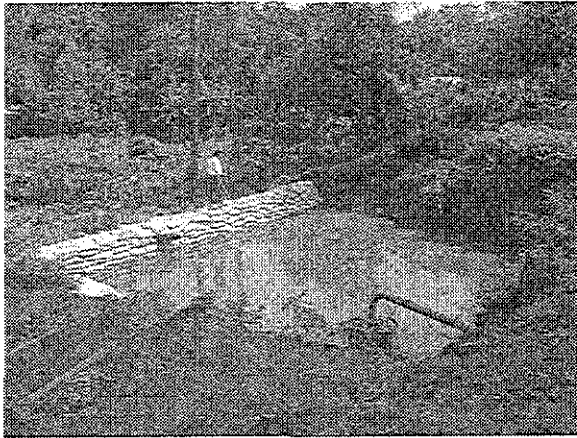


Cleaning of pipes is required once a week

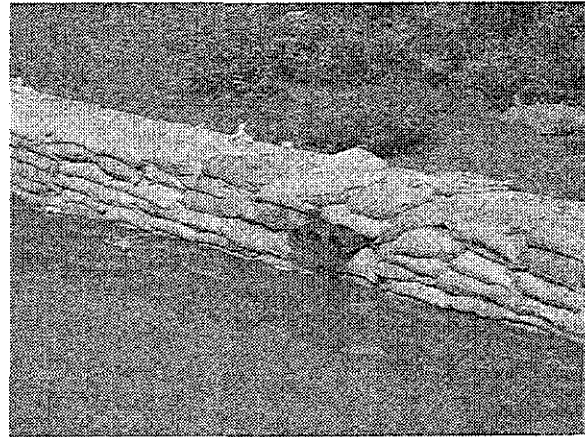
2.2 Leachate collection pond

The operation and maintenance of leachate collection pond is as follows

- Operate pump every morning
- To repair damaged sandbags
- To clean effluent pipe once a week
- To clean the inlet culvert once a week
- To remove the sedimentary soil every three months
- To check the function of pump and to remove the obstacles for the pump every day.



Leachate collection pond



Cleaning of effluent of Leachate collection pond

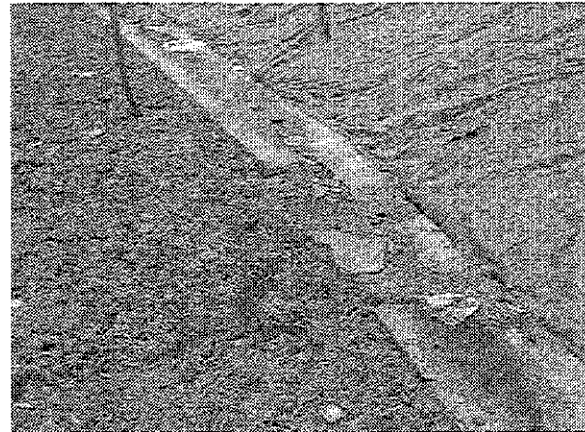
2.3 Leachate collection pipe on the terrace

The maintenance of leachate collection pipe is as follows

- To remove the obstacles at the effluent of leachate collection pipe
- When the seeping out of leachate is found on the terrace, the leachate collection pipe might be cloggy. The obstacles shall be removed in order to discharge the leachate properly.



Removing the obstacles at the effluent



Removing of the obstacles of cloggy leachate collection pipe

3 Finished slope

The maintenance of finished slope is as follows.

- To repair the damaged slope in accordance with 1:2 slope degree
- To water the turff at least every three days in order to protect the slope during dry season.
- To limit livestock to enter the landfill site. When the livestock is found, you must inform to MOH immediately.



To repair the slope

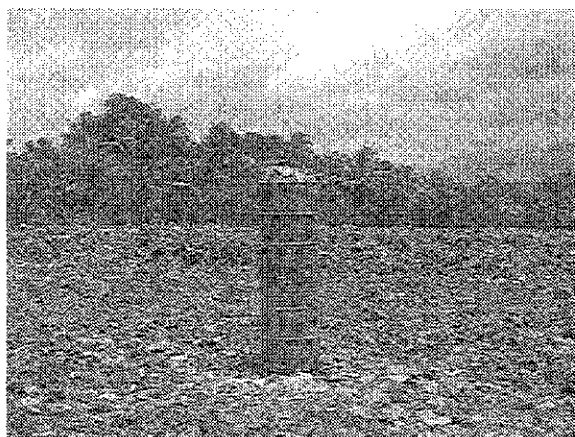


To water the turff in order to protect the slope

4 The other facilities

4.1 Extension of Gas Ventilation Facility

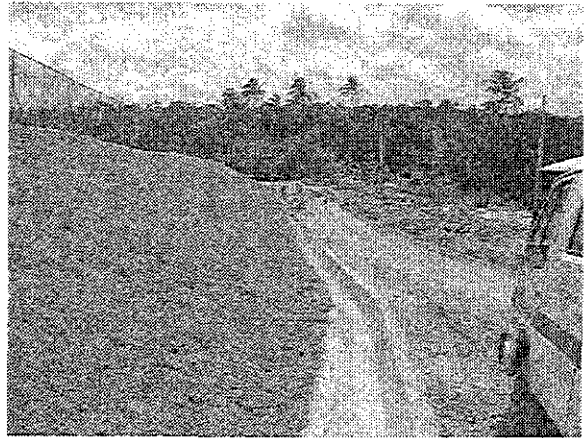
The role of gas ventilation facility is emission of methane gas which is generated through decomposing of discharged waste. The waste shall be discharged to surrounding of gas ventilation facility carefully.



Gas Ventilation Facility

4.2 Storm water drainage

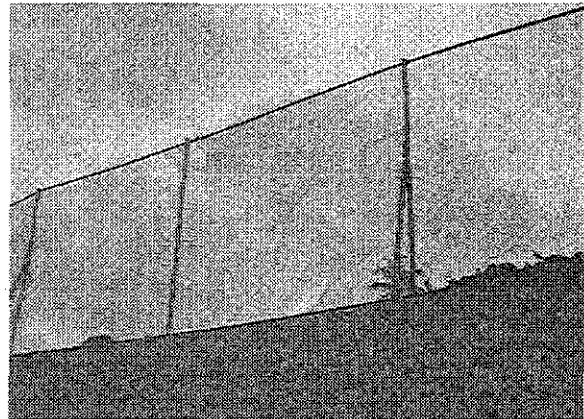
The role of storm water drainage is to divert the storm water from landfill site to outside. Storm water drainage shall be cleaned twice a month



Storm water drainage

4.3 Fence

The role of fence is to avoid the scattering waste. The fence shall be repaired when it is damaged by livestock and so on.



Repairing of damaged fence

4.4 Access road

The role of access road is to approach the place where the collection vehicles discharge waste.

The access road shall be repaired immediately when it is damaged.



Access road on the embankment

4.5 Medical waste discharge area

Medical waste discharge area in the Gohagoda landfill site is just temporary facility. Therefore all hospitals in Kandy have to establish the proper treatment system of medical waste as soon as possible.

5 Prohibited activity

The following activities are strictly prohibited.

- To discharge waste to back yard of control house
- To discharge gully suck to the landfill site or storm water drainage except for the gully suck treatment facility
- To discharge waste which comes from slaughter house to the outside of landfill site
- To discharge medical waste, which consists of mainly body parts, to the outside of medical discharge area.
- To sell waste which comes from slaughter house and gully suck as fertilizer
- To sell diesel of Bulldozer
- To permit entrance of livestock to the landfill site
- Burning of waste of any time
- Entrance of children to the landfill site

Chapter J

*Survey on the Loan Demand for
SWM Projects*

Contents

Chapter J Survey on the Loan Demand for SWM Projects

J.1	Objective of observational study in local authorities	J-1
J.2	Contents of questionnaires and results	J-1

J.1 Objective of observational study in local authorities

JICA Study team has been carried out educational seminars and Pilot projects etc. to the secondary cities. It has seen some successful improvement of the people of cities and environmental of the cities. The Ministry of Home Affairs Provincial Councils & Local Government has been carried out of observational study of “Need assessment survey on funding for solid waste management in local authorities”

The observation of this survey is to assess the potential demand for grant aid or soft loans on solid waste management projects initiated by local authorities.

J.2 Contents of questionnaires and results

Questionnaires were collected from responders who are 4 units of MC, 9 units of UC and 3 units of PS.

a. General question and results

Name of authority _____

Population _____ Persons

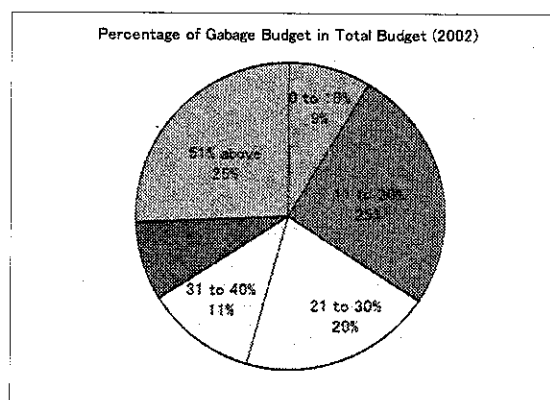
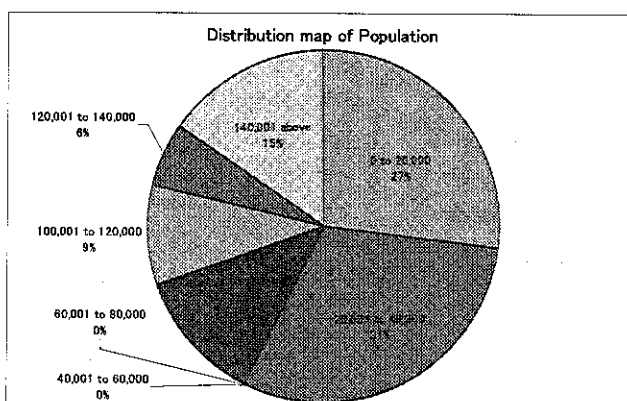
Total Budget in 2002

Total expenditure: _____ Rs

Recurrent expenditure _____ Rs

Capital expenditure _____ Rs

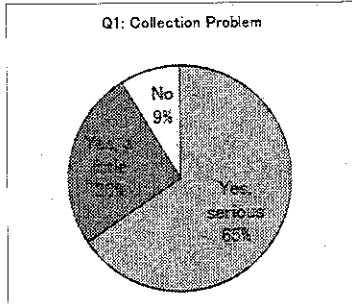
Total Budget for Garbage work in 2003 _____ Rs



b. Questionnaire and results

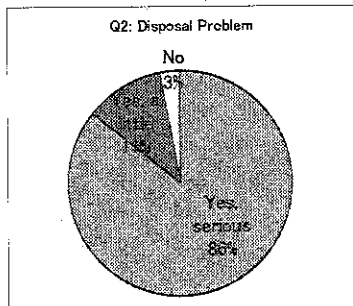
Q1. Do you have any garbage **collection** problem in your L.A.?

- a) Yes, serious.
- b) Yes, a little
- c) No



Q2. Do you have any garbage **disposal** problem in your L.A.?

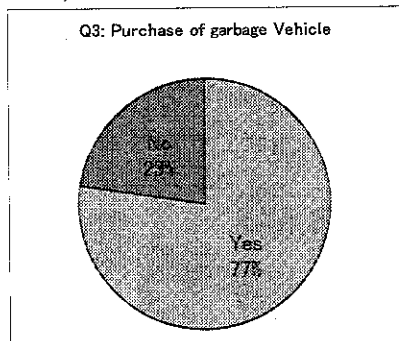
- a) Yes, serious.
- b) Yes, a little
- c) No



Suppose government support for investment (Concessional loan at 5% interest) is available.

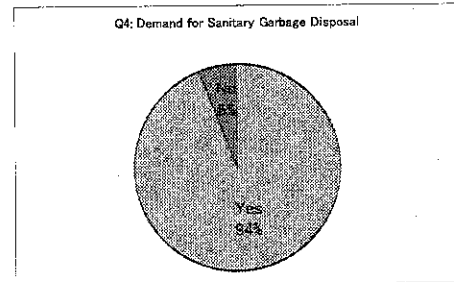
Q3. Does your L.A. want to purchase **garbage collection vehicles**?

- a) Yes
- b) No



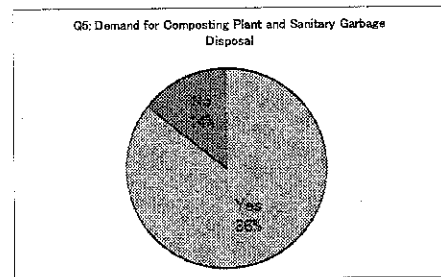
Q4. Does your L.A. want to construct **sanitary garbage disposal site**?

- a) Yes
- b) No



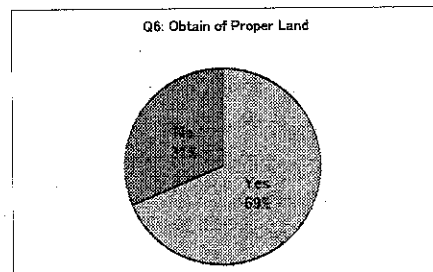
Q5. Does your L.A. want to construct **composting plant and a sanitary garbage disposal site for projects**?

- a) Yes
- b) No



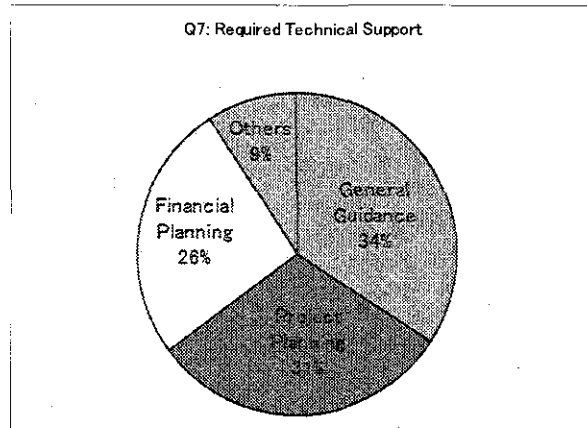
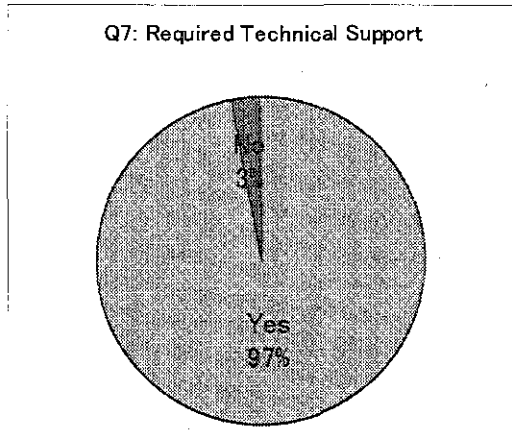
Q6. Do you think you can manage to obtain **proper land** for a disposal site or a composting plant?

- a) Yes
- b) No



Q7. Together with loan assistance, what kind of technical support do you need?

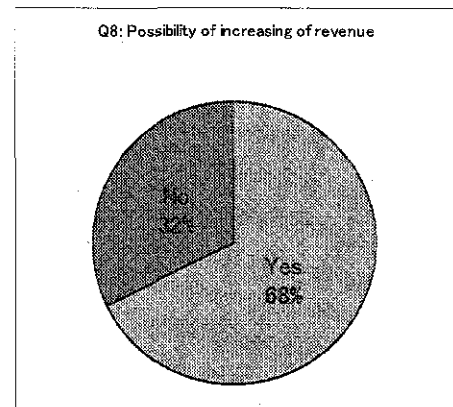
- a) General guidance for the solid waste management plan.
- b) Consulting service for the project planning
- c) Consulting service for the financial planning
- d) Others (Please specify)



In order to improve the quality of services for solid waste collection and disposal, it requires **increasing the budget allocation** for operation and maintenance, and debt servicing (Say, Rs 5-50 million depending on size of city);

Q8. If you are requested to increase your municipal revenue **as a condition** to obtain support (grant/soft loan) from the government, can you manage to do it?

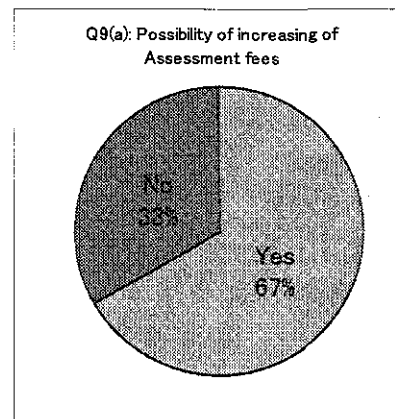
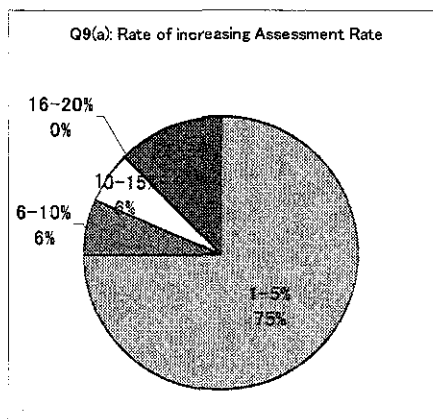
- a) Yes
- b) No



Q9. What are the possible measures to **increase revenue** in your municipality?

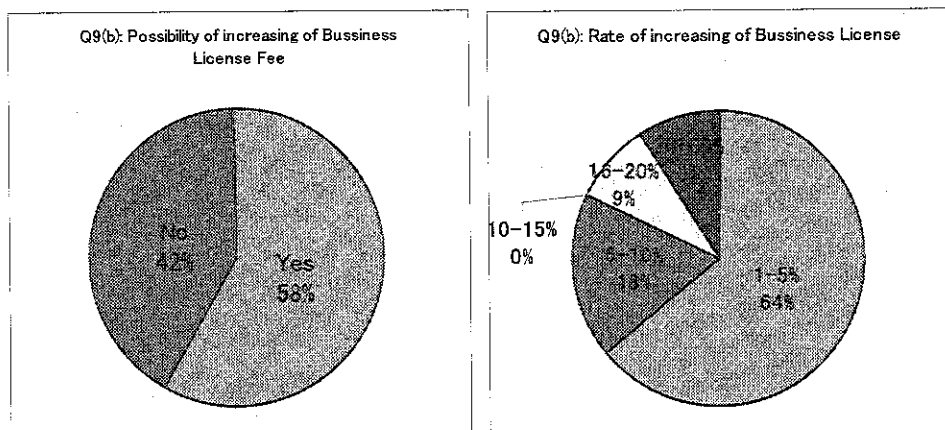
- a) To increase Assessment Rates (Yes/No)

If yes, total amount of assessment rates can be increase by ()%, by increasing from present rate of ()% to new rate of ()%.



b) To increase Business License Fees, if you are allowed to do so. (Yes/No)

If yes, what is the percentage ()% of increase?



c) What are the other measures to increase revenue?

(Please specify)

	Description	Number of vote
1	Government service charge	12
2	Rental fees for public space	11
3	Related waste management	7
4	Others	1

Chapter K

Prototype SWM Projects and Cost Estimates

Contents

Chapter K Prototype SWM Projects and Cost Estimates

K.1	Price of basic construction materials, consumables and services in current market	K-1
K.2	Equipment cost and lifetime for storage and discharge of waste	K-2
K.3	Equipment cost for Collection and Transport of waste	K-3
K.4	Prototype SWM projects	K-3
K.4.1	Categorization of SMW projects.....	K-3
K.4.2	Small Size Landfill.....	K-4
K.4.3	Medium Size Landfill	K-4
K.4.4	Large size landfill.....	K-6
K.4.5	Aptness of Initial and O&M cost against Capacity of landfill.....	K-7
K.4.6	Compost plant	K-8
K.4.7	Reasonable cost range for SWM project.....	K-10

List of Tables

Table K-1:	Current market price of construction materials and consumables.....	K-1
Table K-2:	Current market prices of several services.....	K-2
Table K-3:	Equipment cost for storage and discharge of waste	K-2
Table K-4:	Estimated Equipment cost for collection and transport of waste	K-3
Table K-5:	Average cost of O&M for Small Size Landfill.....	K-4
Table K-6:	Initial investment cost for Medium size landfill.....	K-5
Table K-7:	O&M cost for medium size landfill.....	K-5
Table K-8:	Initial investment cost for Medium size landfill.....	K-6
Table K-9:	O&M cost for medium size landfill.....	K-7
Table K-10:	Project cost for static pile composting system (Capacity 6 ton/day).....	K-9
Table K-11:	Unit cost for static pile composting system.....	K-9
Table K-12:	Project cost for windrow composting system (Capacity 6 ton/day).....	K-9
Table K-13:	Unit cost for windrow composting system.....	K-9
Table K-14:	Project cost for vessel composting system (Capacity 6~8 ton/day)	K-10
Table K-15:	Unit cost for vessel composting system	K-10

List of Figures

Figure K-1:	Initial cost against Generation.....	K-7
Figure K-2:	Initial cost VS Landfill area	K-8
Figure K-3:	Project Cost Range	K-10

K.1 Price of basic construction materials, consumables and services in current market

Prior to estimate SMW projects cost, JICA Study team had been surveyed several price which related to Solid Waste Management.

Basic cost for construction materials, consumables and services in current market are shown in Table K-1, Table K-2.

Table K-1: Current market price of construction materials and consumables.

Item No	Description	Unit	Rate (Rs)
1	Basic Construction Materials		
	Cement (Bag)	Per bag	460
	Course Aggregate (0-40mm)	Cum	1,500
	Rubble	Cum	1,230
	Sand (River or Mining)	Cum	1,390
	Ready mixed concrete (Fck 200kg/cm ² or equivalent)	Cum	8,600
	Reinforcement Bar	Tonne	84,000
	Mild Steel	Tonne	76,800
	High Tensile Steel	Tonne	80,000
	Timber (Hard Wood for Structure)	Ton or Cum	35,000
	Premixed Asphalt	Ton	3,840
	Concrete Pipe (D=150mm)	M	660
	Concrete Pipe (D=300mm)	M	720
	Concrete Pipe (D=450mm)	M	900
	Perforate Concrete Pipe (D=150mm)	M	1,980
	Perforate Concrete Pipe (D=300mm)	M	2,160
Perforate Concrete Pipe (D=450mm)	M	3,000	
2	Consumables		
	Gasoline	Litter	55
	Diesel oil	Litter	35
	Hydraulic Oil	Litter	130
	Engine Oil	Litter	125

Note: All prices were surveyed by JICA Study Team on August 2003

Table K-2: Current market prices of several services

Item No	Description	Unit	Rate (Rs)
1	Personal Cost		
	Manager	Man/Month	35,000
	Engineer	Man/Month	28,750
	Supervisor	Man/Month	25,000
	Machinery Operator	Man/Month	18,000
	Mechanic	Man/Month	15,000
	Collection Worker	Man/Month	10,000
Watchman	Man/Month	10,000	
2	Machinery Rental Cost (with operator)		
	Lorry (10ton)	No/day	11,520
	Lorry (8ton)	No/day	9,600
	Lorry (4ton)	No/day	7,200
	Lorry (2ton)	No/day	6,240
	Case Machine (JCB)	No/day	11,520
	Excavator (Bucket capacity 0.1 m3)	No/day	6,240
	Excavator (Bucket capacity 0.4 m3)	No/day	11,420
	Excavator (Bucket capacity 0.7 m3)	No/day	18,240
	Bulldozer (Class D4)	No/day	12,960
	Bulldozer (Class D6)	No/day	24,000
	Tractor	No/day	2,400
	Vibration Compactor (Handy type)	No/day	2,500
	Vibration Compactor (Machine weight 2 to 4 ton)	No/day	9,600
	Vibration Compactor (Machine weight 10 ton)	No/day	14,600

Note: All prices are surveyed by JICA Study Team on August 2003

Personal costs are included in the cost, such as Employee's pension, workman's insurance and other expenses related to the works.

K.2 Equipment cost and lifetime for storage and discharge of waste

Equipment cost and lifetime for storage and discharge of waste are shown in Table K-3

Table K-3: Equipment cost for storage and discharge of waste

Item No	Description	Unit	Rate (Rs)	Estimated Lifetime (Year)
1	Collection Item			
	Street Litter bin (Basket type)	No	1,500	2 ~ 3
	Street Litter Bin (Fixed half dram type)	No	1,300	2 ~ 3
	Street Litter Bin (movable half dram type)	No	1,700	2 ~ 3
	Litter Bin (Concrete type)	No	900	4 ~ 5
	Plastic Bucket (30 litter)	No	370	N/A
	Plastic Bucket (40 litter)	No	490	N/A
	Plastic Bucket (50 litter)	No	500	N/A
	Plastic Basket Litter Bin (20 litter)	No	90	N/A
	Plastic Basket Litter Bin (30 litter)	No	130	N/A
	Plastic Basket Litter Bin (50 litter)	No	495	N/A
2	Disposal Item			
	Plastic Bag (Medium)	Pcs	3	N/A
	Plastic Bag (Large)	Pcs	4	N/A

Note: All prices are surveyed by JICA Study Team on August 2003

K.3 Equipment cost for Collection and Transport of waste

Equipment cost for collection and transport of waste are shown in Table K-4

Table K-4: Estimated Equipment cost for collection and transport of waste

Item No	Description	Machinery cost (Rs)	O&M Cost (per year)			Estimated Life Time (Year)	Specification
			Repairing	Fuel, oil	Operator		
1							
	Tractor	1,200,000	200,000	600,000	150,000	6~8	
	Trailer (Open type)	200,000	50,000	N/A	N/A	3~4	
	Trailer (with cover type)	250,000	70,000	N/A	N/A	3~4	
	Compactor track	7,000,000	400,000	800,000	180,000	8~10	4ton(Japan)
	Skipper track	2,600,000	300,000	800,000	180,000	8~10	
	Skip container	300,000	50,000	N/A	N/A	3~4	
	Lorry	1,900,000	200,000	600,000	150,000	8~10	2ton(Japan)
	Lorry	2,700,000	300,000	600,000	150,000	8~10	4ton(Japan)
	Dumper Lorry	2,500,000	400,000	1,800,000	200,000	6~8	10ton(India)
	Bulldozer	6,800,000	600,000	1,200,000	220,000	8~10	D4 class
	Case Machine	4,800,000	400,000	1,200,000	220,000	10~15	JCB
	Excavator	7,800,000	700,000	1,800,000	220,000	7~8	Bucket Capacity 0.7m3

Note: All prices are surveyed by JICA Study Team on September 2003
All of machinery costs are brand-new price in Sri Lanka.

K.4 Prototype SWM projects

K.4.1 Categorization of SMW projects

Landfill may have different type of categorizations 1) Based on Topography of the project area, 2) Based on Amount of Daily waste generation etc. The study team shall be used "Based on amount of daily waste generation" it would be much familiar for person in charge of SWM.

The categorization is as follow;

- Small Size Landfill Daily waste generation ~ 10 ton/day
- Medium Size Landfill Daily waste generation 10 ton/day ~ 40 ton/day
- Large Size Landfill Daily waste generation 40 ton/day ~

Generally Life time of Plant will be design about 15 ~ 20 years except small size landfill. The reasons are

- 1) Take long time to obtain approval and permission from relevant authorities. It would be taken about 3 years.
- 2) Initial investment cost (Construction cost, Machinery purchase cost etc.) is high. Therefore if life time is designed short period, depreciation cost would be very high.

K.4.2 Small Size Landfill

K.4.2.1 Method of small sanitary landfill

The trench method of landfill is suited to the area where an adequate amount of cover material is available at the site and where the water table is not near to the surface. Typically, solid wastes are placed in trenches excavated in the soil. The soil excavated from the site is used for daily and final cover. The trenches vary from 30 to 100m in length, 1 to 2m in depth and 2 to 3m in width.

Characteristics are

- Not required big space
- Amount of disposed waste is a little therefore leachate treatment is not required.
- Not required heavy machinery (Bulldozer)
- Easy management

K.4.2.2 Budgetary cost for small size sanitary landfill

a. Initial Investment Cost

Not required.

b. Operational and Maintenance Cost

Average cost of O&M as below;

Table K-5: Average cost of O&M for Small Size Landfill

Unit: Per 100 ton

Description	Unit	Q'ty	Amount (Rs)	Remarks
Workmanship and Machinery cost	Ls	1	25,000 ~ 35,000	Excavation of trench and soil cover
Total	ton	100	25,000 ~ 35,000	

Generally O&M cost will be about range from 250 Rs/ton to 350 Rs/ton and Costs are mainly labour salary and machinery rental cost.

K.4.3 Medium Size Landfill

K.4.3.1 Method of medium size landfill

There are two type of medium size of landfill. One is Slope landfill which waste is placed along the sides of existing hill slope. The other one is waste is placed in valley, canyons, borrow pit. Extent landfill volume will be 55,000 to 290,000 ton. Reasonable height of landfill is range from 10 to 20m high

Heavy machinery is required for laying of waste and daily soil cover.

Characteristics are

- A large volume of waste will be disposed.

- Required leachate treatment facility
- Accessible of big waste collection vehicle.
- Required bulldozer (Laying of waste, daily cover of soil)

K.4.3.2 Budgetary cost for Medium size Landfill

a. Initial Investment cost

Estimated initial cost for Medium size landfill is as below.

Table K-6: Initial investment cost for Medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Pre-Construction				
Investigation	Ls	1	300,000 ~ 500,000	
Design	Ls	1	500,000 ~ 900,000	
Machinery Purchase	no	1	7,000,000	Bulldozer (D4 class)
Construction				
Leachate collection	Ls	1	1,600,000 ~ 2,000,000	
Leachate Treatment	Ls	1	1,300,000 ~ 1,500,000	
Gas Ventilation	Ls	1	30,000 ~ 50,000	
Storm Water Drainage	Ls	1	70,000 ~ 150,000	Surrounding of waste pile
Administration	Ls	1	2,500,000	Control House etc
Security facilities	Ls	1	650,000 ~ 1,200,000	
Access Road	Ls	1	600,000 ~ 1,200,000	
Gully sacker	Ls	1	1,000,000	
Healthcare waste pit	Ls	1	1,350,000	
Others	Ls	1	300,000 ~ 400,000	
Total			17,200,000 ~ 19,750,000	

Note: Cost is estimated based on existing ground have impervious soil (Permeability is less than 10-5cm/sec). Therefore if existing soil does not comply the requirement, Membrane sheet will be required. (Cost is 5,000 Rs/sq.m)

Generally required initial cost for medium size landfill is range about from **100Rs/ton to 300Rs/ton**.

b. Operation and Maintenance Cost

Estimated initial cost for Medium size landfill is as below.

Table K-7: O&M cost for medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Operational Cost				
Manpower Cost	Ls	1	11,500,000 ~ 19,000,000	Supervisor, labour, security machine operator etc.
Maintenance Cost				
Material Cost	Ls	1	1,500,000 ~ 2,000,000	Turf, Gas Ventilation pipe etc.
Machinery Cost	Ls	1	1,000,000 ~ 1,800,000	Fuel, Oil, Spare parts
Total			14,000,000 ~ 22,800,000	

Generally required O&M cost for medium size landfill are range about from **250Rs/ton to 400Rs/ton**.

K.4.4 Large size landfill

K.4.4.1 Method of medium size landfill

Type of filling is same as medium size landfill extent landfill waste volume would be more than 3,000,000 ton.

It is required at least 25,000sq.m to 30,000sq.m open area in valley, canyons, or borrow pit.

Characteristics are

- A large volume of waste will be disposed.
- Required leachate treatment facility
- Accessible of big waste collection vehicle.
- Required plural number of bulldozers (Laying of waste, daily cover of soil)

K.4.4.2 Budgetary cost for Medium Landfill

a. Initial Investment cost

Estimated initial cost for Medium size landfill (generation of waste volume from 50 ton/day to 100 ton/day) is as below.

Table K-8: Initial investment cost for Medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Pre-Construction				
Investigation	Ls	1	600,000 ~ 900,000	
Design	Ls	1	1,200,000 ~ 1,700,000	
Machinery Purchase	no	2	14,000,000	Bulldozer (D4 class)
Construction				
Leachate collection	Ls	1	2,600,000 ~ 3,900,000	
Leachate Treatment	Ls	1	1,500,000 ~ 2,000,000	
Gas Ventilation	Ls	1	50,000 ~ 100,000	
Storm Water Drainage	Ls	1	150,000 ~ 300,000	Surrounding of waste pile
Administration	Ls	1	4,100,000	Control House etc
Security facilities	Ls	1	2,300,000 ~ 4,000,000	
Access Road	Ls	1	1,650,000 ~ 2,000,000	
Gully sacker	Ls	1	1,650,000 ~ 2,000,000	
Healthcare waste pit	Ls	1	2,500,000 ~ 3,500,000	
Others	Ls	1	700,000 ~ 1,500,000	
Total			33,000,000 ~ 40,000,000	

Note: Cost is estimated based on existing ground have impervious soil (Permeability is less than 10-5cm/sec). Therefore if existing soil does not comply the requirement, Membrane sheet will be required. (Cost is 5,000 Rs/sq.m)

Generally required initial cost for medium size landfill is range about from **60Rs/ton to 100Rs/ton**.

b. Operation and Maintenance Cost

Estimated initial cost for Medium size landfill (generation of waste volume from 50 ton/day to 100 ton/day) is as below.

Table K-9: O&M cost for medium size landfill

Description	Unit	Q'ty	Amount (Rs)	Remarks
Operational Cost				
Manpower Cost	Ls	1	23,000,000 ~ 29,000,000	Supervisor, labour, security machine operator etc.
Maintenance Cost				
Material Cost	Ls	1	5,000,000 ~ 8,000,000	Turfing, Gas Ventiration etc.
Machinery Cost	Ls	1	22,000,000 ~ 27,000,000	Fuel, Oil, Spare parts
Total			50,000,000 ~ 64,000,000	

Generally required O&M cost for medium size landfill is range about from 110Rs/ton to 180Rs/ton.

K.4.5 Aptness of Initial and O&M cost against Capacity of landfill

Figure K-1 shows aptness of initial and O&M cost against carrying in waste.

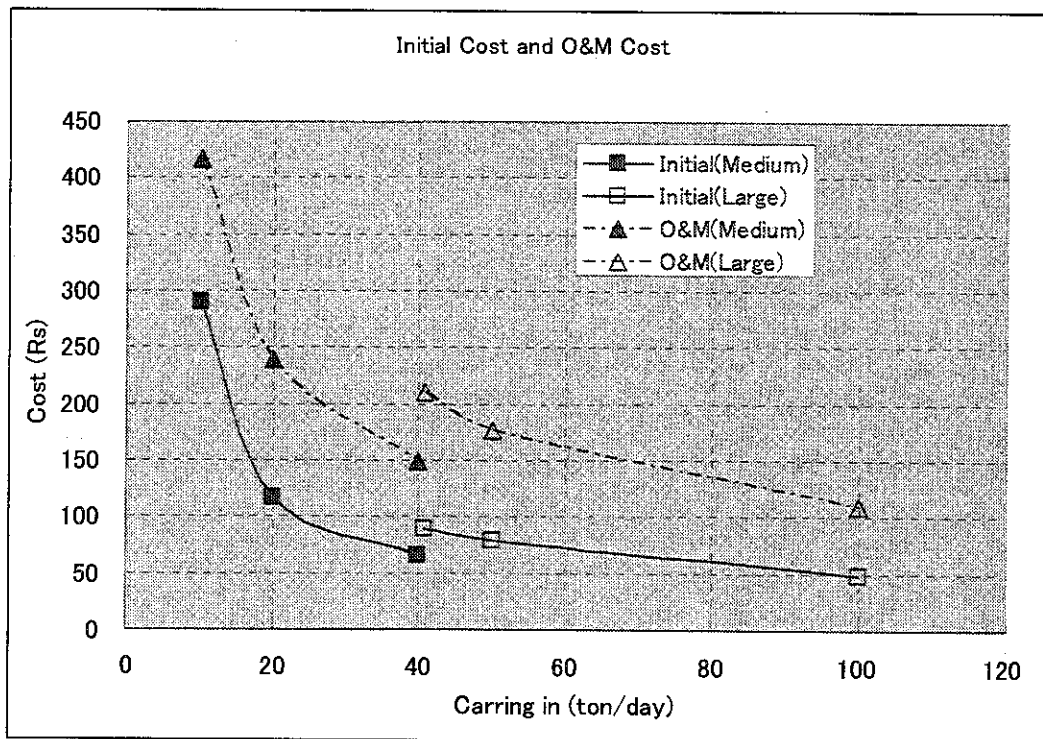


Figure K-1: Initial cost against Generation

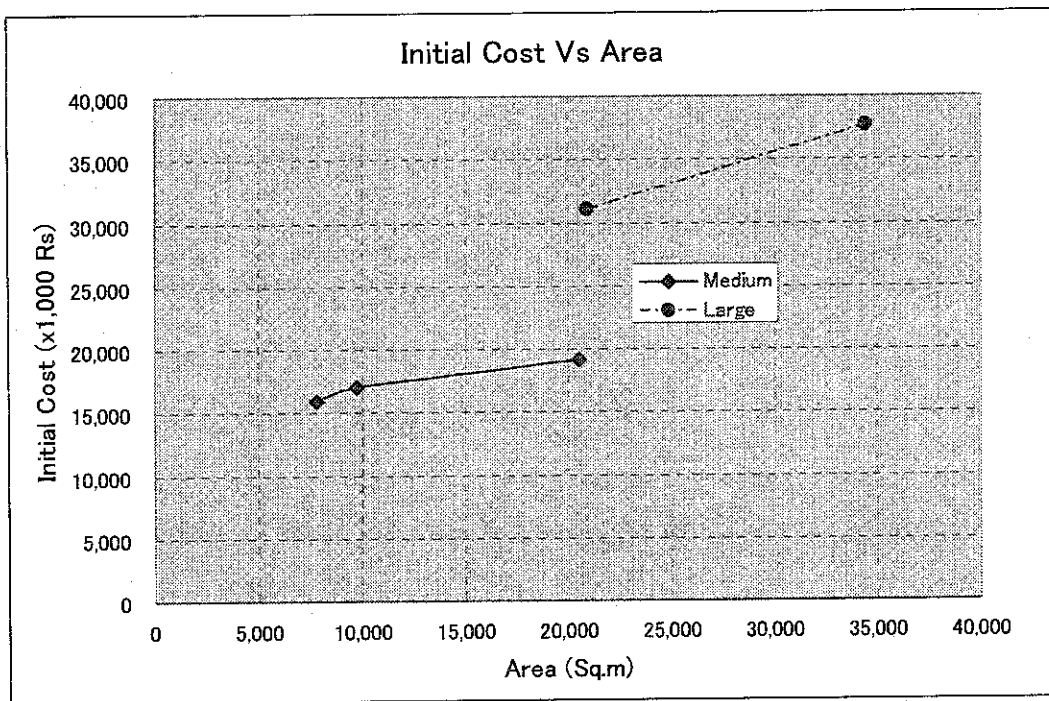


Figure K-2: Initial cost VS Landfill area

According to Figure K-1 and Figure K-2, when increasing of carrying in waste, the total cost is decreasing. Initial cost is increasing pro rata with project area. It is not depending on volume of carrying in waste. Therefore initial cost ratio is depending of height of received waste.

O&M cost is related with amount of carrying in waste, however it is almost constant with carrying in volume up to 40 ton/day. This means the same party will be able to operate up to 40ton/day over the volume 40 ton/day another operation party will be required.

K.4.6 Compost plant

Solid Waste Compost is defined as the bioconversion of waste into amorphous dark brown to black colloidal humus like substance under the conditions of optimum temperature, moisture and aeration.

If composting system use at same time with sanitary landfill, it is results to reducing of carrying in waste to the landfill site and it makes lifetime longer for landfill site.

Composting systems are categorized based on method of handling and aeration method.

- Static Pile Composting system
- Windrow Composting system
- In Vessel Composting system

K.4.6.1 Static pile composting system

The system does not required high level of technical skill for operation and maintenance.

Estimated project costs are as followings,

Table K-10: Project cost for static pile composting system (Capacity 6 ton/day)

Description	Unit	Q'ty	Amount (Rs)	Remarks
Initial cost				
Construction	Ls	1	500,000 ~ 1,000,000	
Operational Cost	Year	1	400,000 ~ 500,000	Supervisor, labour, security etc.
Maintenance Cost	Year	1	50,000 ~ 100,000	

Note: Cost does not included Land acquisition cost

Table K-11: Unit cost for static pile composting system

Description	Unit	Q'ty	Amount (Rs)
Initial cost	Year	1	25,000 ~ 50,000
Operational cost	Year	1	400,000 ~ 500,000
Maintenance Cost	Year	1	50,000 ~ 100,000
Total	ton	1,800	475,000 ~ 650,000
	ton	1	260 ~ 360

Note: Assuming initial investment cost amortize over a period of 20 years

The above cost does not included cost of disposal of residue.

The residue would generate 800kg from 1000kg of waste.

The product would be having commercial value of 2Rs/kg in market.

Example: Katana Compost Facility (Improved static pile system)

K.4.6.2 Windrow composting system

Generally manual mixing or mechanical mixing with machine, the system required some level of technical knowledge for construction and maintenance.

Estimated project costs are as followings,

Table K-12: Project cost for windrow composting system (Capacity 6 ton/day)

Description	Unit	Q'ty	Amount (Rs)	Remarks
Initial cost				
Construction	Ls	1	1,000,000 ~ 2,000,000	
Operational Cost	Year	1	400,000 ~ 500,000	Supervisor, labour, security etc.
Maintenance Cost	Year	1	30,000 ~ 50,000	

Note: Cost does not included Land acquisition cost

Table K-13: Unit cost for windrow composting system

Description	Unit	Q'ty	Amount (Rs)
Initial cost	Year	1	50,000 ~ 100,000
Operational cost	Year	1	400,000 ~ 500,000
Maintenance Cost	Year	1	30,000 ~ 50,000
Total	ton	1,800	480,000 ~ 650,000
	ton	1	260 ~ 360

Note: Assuming initial investment cost amortize over a period of 20 years

The above cost does not included cost of disposal of residue.

The residue would generate 800kg from 1000kg of waste.

The product would be having commercial value of 2Rs/kg in market.

Example: Chilaw compost facility (Manual mixing)

K.4.6.3 In Vessel Composting system

The system required high level of technical knowledge for construction and middle level technical skill for maintenance and operation.

Estimated project costs are as following,

Table K-14: Project cost for vessel composting system (Capacity 6~8 ton/day)

Description	Unit	Q'ty	Amount (Rs)	Remarks
Initial cost				
Construction	Ls	1	2,000,000 ~ 5,000,000	
Operational Cost	Year	1	700,000 ~ 900,000	Supervisor, labour, security etc.
Maintenance Cost	Year	1	70,000 ~ 100,000	

Note: Cost does not included Land acquisition cost

Table K-15: Unit cost for vessel composting system

Description	Unit	Q'ty	Amount (Rs)
Initial cost	Year	1	100,000 ~ 250,000
Operational cost	Year	1	700,000 ~ 900,000
Maintenance Cost	Year	1	70,000 ~ 100,000
Total	ton	2,100	870,000 ~ 1,250,000
	ton	1	420 ~ 600

Note: Assuming initial investment cost amortize over a period of 20 years and production of compost will be 7 ton/day. The above cost does not included disposal of residue. The residue would generate 800kg from 1000kg of waste. The product would be having commercial value of 2Rs/kg in market.

Example: Inclined step grated composting system (University of Peradeniya)

K.4.7 Reasonable cost range for SWM project

This is to summarize reasonable cost range for SWM project shown in Figure K-3.

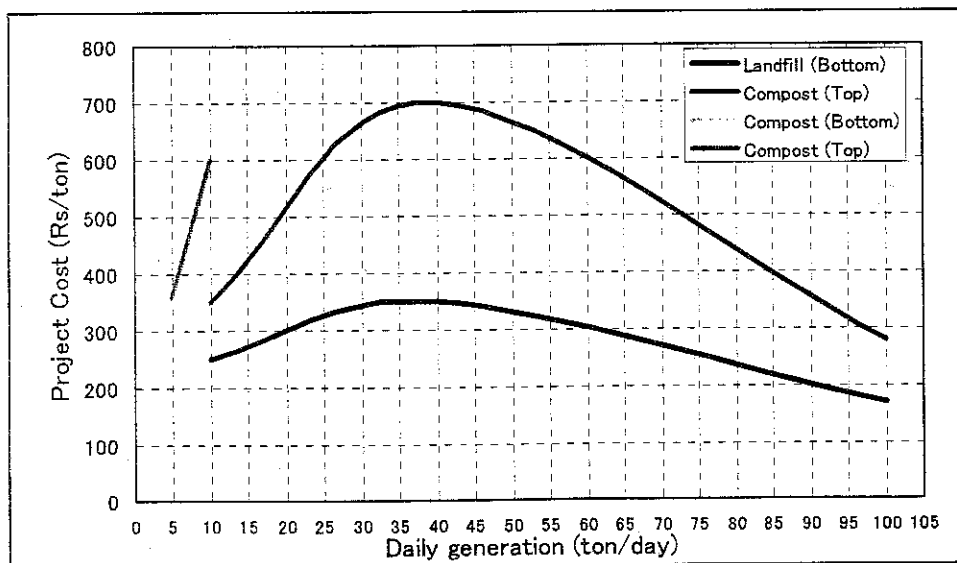


Figure K-3: Project Cost Range