In order to examine the workability of the proposed Basic Plan and to make the Plan more practical, a pilot project consisting of collection experiment and experiment on sanitary landfill operation was carried out for one month from the middle of February in cooperation with DCTC.

The collection experiment was taken over by DCTC from the middle of March and is still being continued. The experiment on sanitary landfill, however, was not taken over by DCTC due to the budget constraint for the employment of landfill equipment such as bulldozers.

2) Collection Experiment

a. Objective

The objective of the collection experiment is to examine the workability of the proposed collection plan in the Basic Plan. The main objectives of the proposed collection plan in the Basic Plan are described as follows:

i. extension of collection service to the whole population of the Vientiane urban area;

ii. establishment of a self-sustainable collection system by the Beneficiary-Pay-Principle under which service recipients pay waste collection fees;

iii. establishment of an efficient and reliable collection system under which regular services can be provided. In concrete terms, the curb and bell collection for the residential and commercial area are proposed; and

iv. establishment of public cooperation for cleaning-up roads, drains and public areas.

b. Selection of experimental areas

The Study Team set up the following criteria on the selection of the experimental areas;

i. In order to increase the colletion service ratio from present very low ratio(4.8% in the residential area) to 50% by 1995, and then to 100% by 2000, it is necessary to set up a strategy and tactics for the expansion of collection services in other areas based on the experiment.
Therefore, non-collection areas which are semi-urbanized and less-urbanized area should be selected as the experimental areas.

ii. upon consideration of the main objectives collection experiment, the experiment should be taken over by DCTC. As such the experiment should achieve some favorable results.

iii. In terms of the favorable results, the experiment should prove that at least operation and maintenance cost of the experiment should be covered by the fee collected from the experimental areas. In addition, the experiment should be successfully done in order to extend the collection services in these areas.

iv. Consequently, the ratio of participation in the experiment (percentage of contract service recipients among Ban residents) should be more than 25% and an efficient collection work should be done in the areas.

v. Since available vehicle for the experiment was only one vehicle supplied by JICA and it was necessary to expand the collection services to other areas after the experiment, the experimental areas should be limited to

three Bans.

Based on the above-mentioned criteria, Ban Dong Mieng, Ban Sisavath Kang and Ban Sisavath Tay were selected as experimental areas.

Number of families wishing to enter into a contract and the participation ratio was 30% as shown in Table 6. It must be, however, noted that this ratio was obtained by the only one month preparation for the experiment and the ratio before the experiment was about 0%.

Table 6 Number of Families Wishing to enter into a Contract and the Participation Ratio

Name of Ban	No. of Families	Contract Families	Ratio (%)	Final Selection
Dong Mieng	382	133	35	Yes
Thong Sang Nang	333	59	17.7	No
Sisavath Kang	276	75	27	Yes
Sisavath Tay	358	98	27	Yes
Sisavath Neua	174	19	10.9	No

c. Detailed design

A detailed design was done according to the terms of the contract for collection services and the location of families who were willing to enter into a contract. Collection routes and bell collection points were drawn according to the basic data and collection schedule. The location map of contract service recipients, collection routes and points, and collection routes for cleaning-up of roads, drains and public areas of the experimental areas were also prepared in the maps.

d. Implementation by the Study Team

The collection experiment was implemented by the Study Team in the three experimental areas from February 24 to March 18, 1992. During the experiment the following studies were carried out in order to examine the workability of the proposed plan:

- time and motion study (collection time, the distance for the transport of waste, collection amount of waste, etc.);
- community consciousness survey (comparison of the CCS before and after the experiment);
- examination of operation and management system of collection vehicles;
- examination of the administrative system of workers; and
- examination of the accounting system.

e. Continuation by DCTC

The collection experiment was taken over by DCTC from the middle of March 1992, and the results included the following:

i. Number of families and shops under contract with DCTC is kept almost the same number as when experiment commenced.

ii. The results of the balance of revenue and expenditure for four months are as shown below.

Revenue	:	1,651,910 kips
Expenditure	:	1,111,390 kips
Balance	:	+ 540,520 kips

Table 7 Balance of Revenue and Expenditure

Unit : Kips

	Revenue	Expenditure	Balance
March	402,110	353,490	+ 48,620
April	455,400	155,630	+ 299,770
May	405,400	291,100	+ 114,300
June	389,000	311,170	+ 77,830
Total	1,651,910	1,111,390	+ 540,520

iii. Amount of waste hauled to KM 18-DS from the commencement of observation by the truck scale (November 11, 1991) to the commencement of collection experiment (January 23, 1992) is shown as follows:

DCTC	:	6.1 ton/day (35%)
Private Contractors	:	7.8 ton/day (45%)
Direct Haulage	:	3.5 ton/day (20%)
Total	:	17.4 ton/day (100%)

The change in the amount of waste hauled to KM 18-DS from February to May is shoen below:

DCTC	:	7.7 ton/day (37%)
Private Contractors	:	8.4 ton/day (40%)
Direct Haulage	:	4.7 ton/day (23%)
Total	:	20.8 ton/day (100%)

The waste collection capability of DCTC increased by 1.6 ton/day in comparison with before the experiment. 1.6 ton/day is equivalent to 26% of the present waste collection capability of DCTC.

3) Experiment on Sanitary Landfill Operation

a. Objectives of the experiment

The objectives of the experiment on sanitary landfill operation were:

i. to demonstrate the impact of environmental improvement at the present KM 18-DS by the execution of sanitary landfill operation;

ii. to examine the workability of the level 2 sanitary landfill development and operation proposed for the first priority project of the Basic Plan; and

iii. to identify the problems and obstacles to be solved to successfully execution sanitary landfill development and operation at level 2.

However, in order to obtain the first objective, it was necessary to execute the following immediate improvement measures:

i. to clean-up scattered waste and those disposed at the entrance, etc.;

ii. to prepare good access roads within the KM 18-DS; and

iii. to fence the front of the site.

The above-mentioned measures have been executed at the time of the experiment on sanitary landfill operation.

b. Implementation

i. site development plan

The following site development works were done at KM 18-DS prior to the commencement of the experiment on sanitary landfill operation:

- cleaning-up of the site;
- construction of an enclosing bund;
- construction of good access roads; and
- improvement of the entrance.

The site development works commenced on February 13, 1992 and the sanitary landfill operation started on February 23, 1992.The experiment ended on March 21, 1992. For the execution of sanitary landfill development and operation, the following equipment and vehicles were deployed according to the demand of the works:

- a bulldozer;
- a hydraulic excavator;
- three dump trucks;
- a wheel loader; and
- a motor grader.

4.3 Findings from the Implementation of Immediate Improvement Plans and Pilot Project

Immediate improvement plans and pilot project were proposed by the JICA Study Team and implemented by DCTC in cooperation with the Study Team. Through the implementation of these projects, the following were concluded:

a. Bell and curb collection system

Curb and bell collection system is cost-effective and workable in Vientiane in view of the results of the collection experiment executed by the DCTC and Study Team in three collection experimental areas. The system can provide efficient and reliable collection services.

b. Collection service

Some of the residents and shops in the area requested for the collection of other waste not stipulated in the contract. By continuous explanation and instructions, however, only contracted wastes were strictly collected. Finally, the residents understood the principle.

c. Extra fee

In order to respond to the request for the discharge of extra amount of waste, the charging of extra tickets (250 kips/basket) was proposed to residents and shops who temporarily discharged large amount of waste.

d. Cleaning-up of public area

As for the cleaning-up of roads, drains and public areas through public cooperation, the sanitary environment of the experimental areas could be improved in a step by step basis through further efforts such as the implementation of public campaigns and education, in order to achieve public cooperation in its cleansing services. The CCS conducted before and after the experiment proved that the ratio of the Public Cleansing Day Participants increased from 60% to 80% in the experimental areas.

e. Experiment by DCTC

The following aspects were concluded through the collection

experiment taken over by DCTC:

- The number of contracted households was kept constantly at about 310 to 330. The proposed accounting system, operational system for the weighbridge and organization set up for the experiment have been well maintained in these four months (from March to June 1992).

- During the four months operation of collection experiment, the proposed fee collection system has been carried out successfully. Then the surplus of the experiment, which was drawn up from the total revenue and expenditure including maintenance cost, summed up to 540,520 kips. This proved that DCTC would be able to replace the vehicle after 7 years according to the following calculation

  540,520 x *2 x **3 x 7 years = 22,701,840 kips
  Note:
  * 2 ; Working days per week can be 5 days instead of 2.5 days
  ** 3 ; 12 months/4 months = 3

  The price of vehicle procured and supplied by JICA for the experiment was 22 million kips including 10% of spare parts and transportation cost.

- In order to keep the Beneficiary-Pay-Principle, and maintain and increase number of participants in the collection experiment, the following measures are required:

  . erasure of the contract marks on the baskets of the household who canceled waste collection service contract;

  . continuous campaign for and solicitation of non-participants; and

  . provision of punctual and reliable collection services.

f. Role of fee collectors

The role of the fee collectors is considered quite important. Their two major duties are to conduct contract negotiations and collect fees and to act as the medium of the DCTC administrators and the residents in order to improve SWM in the area. These duties are important factors in the extension of collection services.

g. Extension of collection service

Extension of the collection service to the whole population of the Vientiane urban area can be achieved by adopting a stepwise approach.

Details are described in section 4.5, Strategy for Expansion of Collection Area.

h. Beneficiary-Pay-Principle

Establishment of a self-sustainable collection system by 1995 shall be realized through the Beneficiary-Pay-Principle under which service recipients pay waste collection fees.

i. Sanitary landfill

Since site development tremendously improved the image of KM 18-DS, the authorization of KM 18-DS as a disposal site and the land acquisition work was smoothly done. In addition, a special budget for the improvement of the site and land acquisition was allocated by the Municipality.

The experiment on sanitary landfill operation proved that the Municipality was capable of improving disposal standards with the equipment required for sanitary landfill.

j. Weighbridge

The weighbridge system is essential in analyzing, planning and managing waste collection and haulage.

k. Improvement of accounting system

In the collection experiment, the personal computer was used to make the accounting and ledger sheets which contributed to the improvement of the SWM accounting system.

l. Improvement of fee collection system

With regard to fee collection, the potential possibilities for the establishment of self-finance was proven when punctual services were given. Moreover, a new extra charge concept was induced by the experiment.

4.4 Feasibility Study of the First Priority Project

1) Contents of the First Priority Project

The Basic Plan consists of various projects. Among these is the first priority project regarding the technical system in 1995 (Phase I), and the outline is as shown below.

- Extension of collection service area;
- Establishment of appropriate transfer system for institutional wastes;
- Establishment of public cooperation for cleaning-up roads and drains;
- Establishment of proper operation and maintenance system; and
- Construction and execution of a sanitary landfill (level 2) at the KM 18-DS.

2) Design Conditions

The following are the design conditions of the first priority project:

- target year	;	1995
- target area	;	Vientiane urban area
- population	;	163,100 persons
- collection service coverage in residential area	;	50% (4.8% at present)
- service population	;	81,500 persons
- collection amount	;	68.3 ton/day
by Vientiane Municipality		(58.3)
by private contractor		(10.0)
- road sweeping service by Vientiane Municipality	;	15 km
- cleansing activity through public cooperation	;	48 Bans (villages)
- length of road for sprinkling water	;	150 km
- final disposal amount	;	72.3 ton/day

- final disposal level ; level 2
- waste stream ; as shown in Fig. 11.1-1 of the Main Report

3) Preliminary Design

a. Collection and haulage

The discharge and storage system and collection and haulage system to be achieved by 1995 is shown in Table 8 and 9, respectively.

Main equipment necessary is as follows:

- close dump trucks 14 units
- detachable container trucks 3 units
- container (5 m^3) 29 units
- motorcycle for fee collection 18 units
- pick-up for inspection 1 unit

Table 8 Outline of Proposed Discharge and Storage System in 1995

Generation Source	Source Separation	Type of Refuse Bins	Storage & Discharge Points	Discharge Frequency
Residential Area	Continuance of present system - Partly separate discharge (Food waste is separated as food for domestic animals.)	Continuance of present system - Bamboo basket	- Designated road sides or designated	- Once a week
Commercial Area	Continuance of present system - Partly separate discharge (Food waste is separated as food for domestic animals.)	Continuance of present system - Bamboo basket	- Designated road sides or designated	- Once a week (more than twice a week)
Market	Continuance of present system - Mixed discharge	- Communal container	- Placing a container in the premises	- Everyday
Office	Continuance of present system - Mixed discharge	- Communal container	- Placing a container in the premises	- Everyday
Hospital	- Separate discharge (Infectious waste should be segregated from other wastes.)	- Communal container	- Placing a container in the premises	- Everyday

Table 9 Outline of Proposed Collection and Haulage System in 1995

Generation Source	Service Coverage(%)	Collection Frequency	Mixed or Separate Collection	Collection System	Collection Time	Collection Tools	Haulage Method	Transfer System
Residential Area	100 %	- Once a week	- Mixed collection	- Curb collection and bell collection	- Day time	-Not necessary	- Dump truck (10m3)	- Without transfer
Commercial Area	100 %	- Once a week (more than twice a week.)	- Mixed collection	- Curb collection and bell collection	- Day time	-Not necessary	- Dump truck (10m3)	- Without transfer
Market	100 %	- According to the rotation	- Mixed collection	- Station collection	- Day time	-Not necessary	- Detachable container truck(5m3)	- Transfer from the station
Office	100 %	- According to the rotation	- Mixed collection	- Station collection	- Day time	-Not necessary	- Detachable container truck(5m3)	- Transfer from the station
Hospital	100 %	- According to the rotation	- Separate collection	- Station collection	- Day time	-Not necessary	- Detachable container truck(5m3)	- Transfer from the station

b. Road sweeping, drain cleansing and grass cutting

The outline of the road sweeping, drain cleansing and grass cutting systems to be achieved by 1995 is shown in Table 10.

Main equipment necessary for the project is as follows:

- container	11 units
- water truck	2 units
- small dump truck	3 units
- wheel loader	1 unit
- grass cutter	10 units

c. Final disposal

The lay-out of the main facilities is shown in Fig. 2. The following site development works and equipment are necessary for the project.

i. site development works (level 2)

- clearing & site preparation : clearing plants, cleaning-up waste disposed, etc.
- main facilities : enclosing structures, drainage system and access road.
- environment protection facilities : buffer zone and gas removal facilities
- building and accessories : site office and fence

ii. equipment

- bulldozer	1 unit
- hydraulic excavator	1 unit
- dump truck	1 unit

- water truck (when necessary, the one for cleansing works can be used)

Table 10 Outline of Proposed Road Sweeping, Drain Cleansing and Grass Cutting System in 1995

Type of Cleansing Service	Cleansing System	Cleansing Area and Length	Cleansing Equipment	Cleansing Frequency
Road Sweeping	・Manual sweeping by labourers ・Station collection system using containers(5m3) ・Haulage method by detachable container trucks	Present road covered by the sweeping services (15km*)	Detachable container truck and container	Everyday except on sundays and holidays
Sprinkling Road	・Mechanical sprinkling roads with water	150 km (65% of roads in VM)	Water trucks	Once a week
Drain Cleansing	・Manual cleaning by labourers * ・Loading method by wheel loader ・Haulage method by small dump trucks	Drains of roads covered by the sweeping services (15km*)	Small dump trucks & a wheel loader	Once every six
Grass Cutting	・Grass cutting by cutting machines ・Station collection system using container(5m3) ・Haulage method by detachable container trucks	Side of road covered by the sweeping services (15km*)	Grass cutters	Every two months
Cleansing Activity through Public Cooperation	・Cleaning by residents and collection and haulage by the Municipality	50% of Vientiane urban area	Small dump truck & wheel loader	Once every two months

Note; * The road length which recives sweeping services.

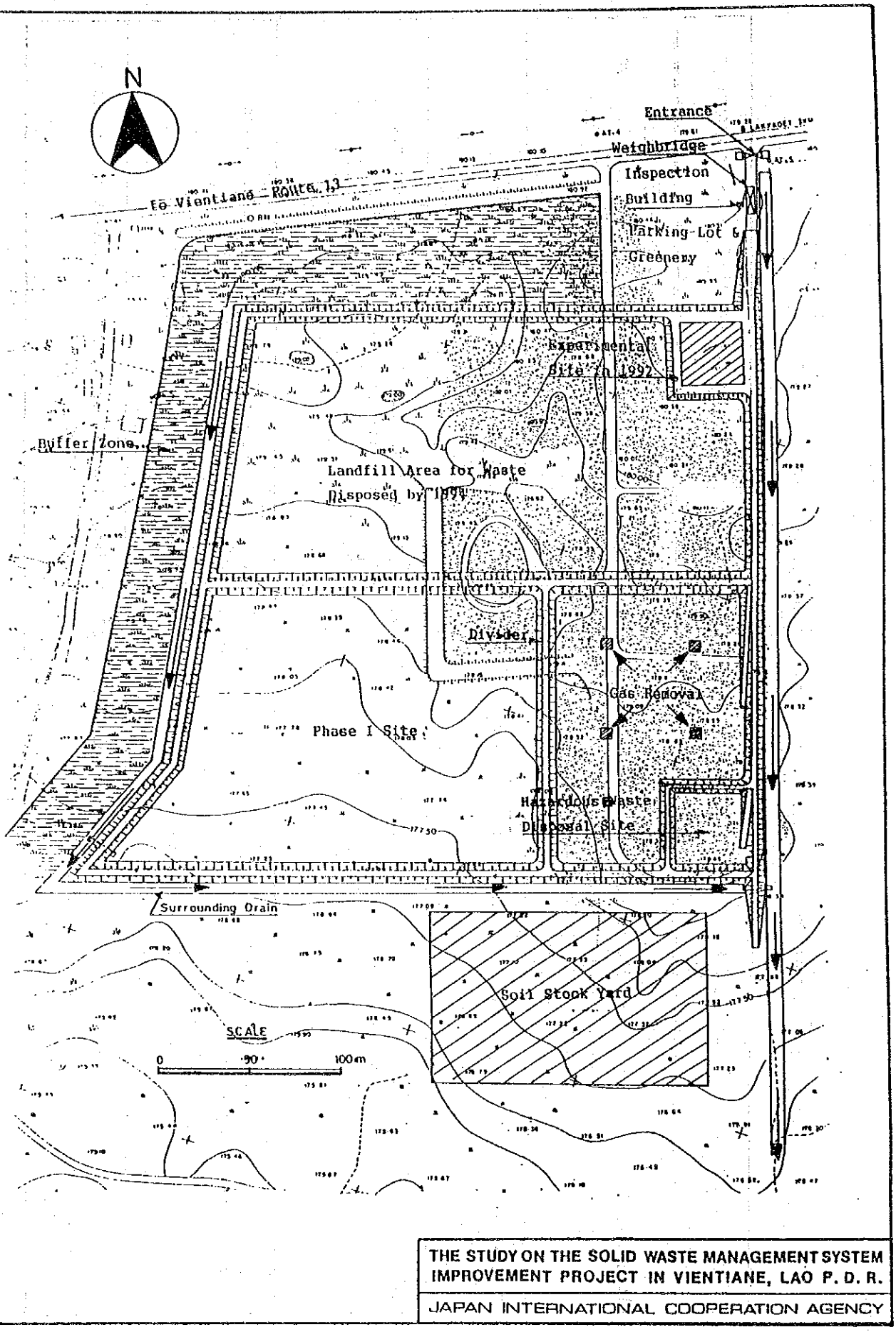

Fig. 2 Layout of Main Facilities

d. Operation and maintenance of equipment

In order to establish proper operation and maintenance system for vehicles and equipment, a maintenance shop is planned to be constructed in the compound of previous State Sanitary Company (SSC) of the Municipality located at the KM 7 on the way to the KM 18-DS. A layout of the maintenance shop is shown in Fig. 3.

In order to carry out periodical maintenance and to ensure the efficient operation of vehicles and equipment, the following equipment is necessary for the project.

- equipment for general maintenance & repair
- equipment for tire shop
- equipment for tool and spare parts storage
- equipment for office work
- equipment for inspection pits
- equipment for field storage

4) Institutional Plan

a. Organization

i. organization scheme

In order to realize the Basic Plan, the establishment of the USD (Urban Service Department) is proposed. For the smooth implementation of the first priority project, the USD is to be set up by 1995. An organization scheme, as shown in the Fig. 4, is proposed for the new Urban Service Department of the Vientiane Municipality which would be established by employing additional personnel in addition to the existing cleansing personnel deployed.

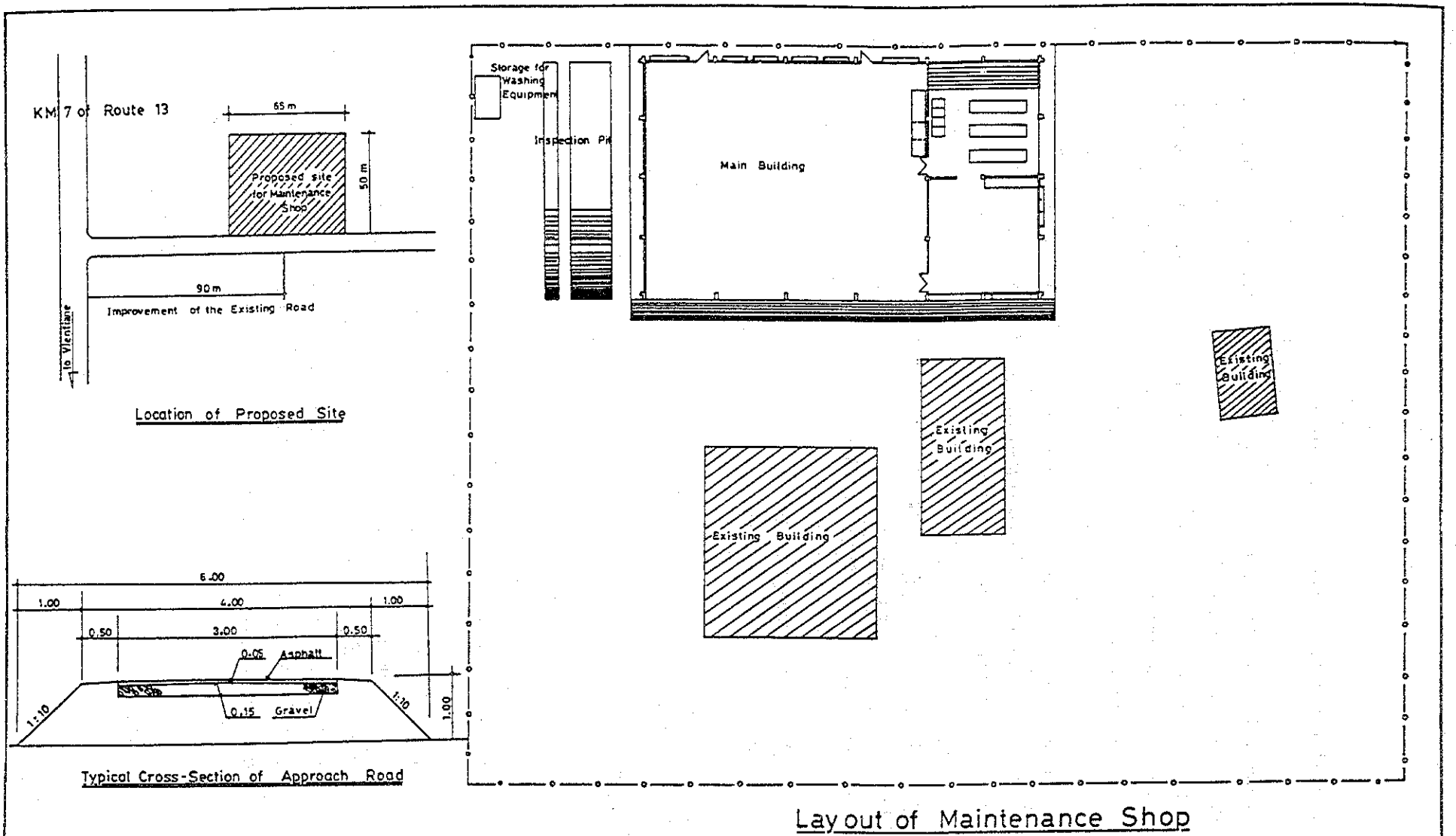

Fig. 3 Site Development and Layout of Maintenance Shop

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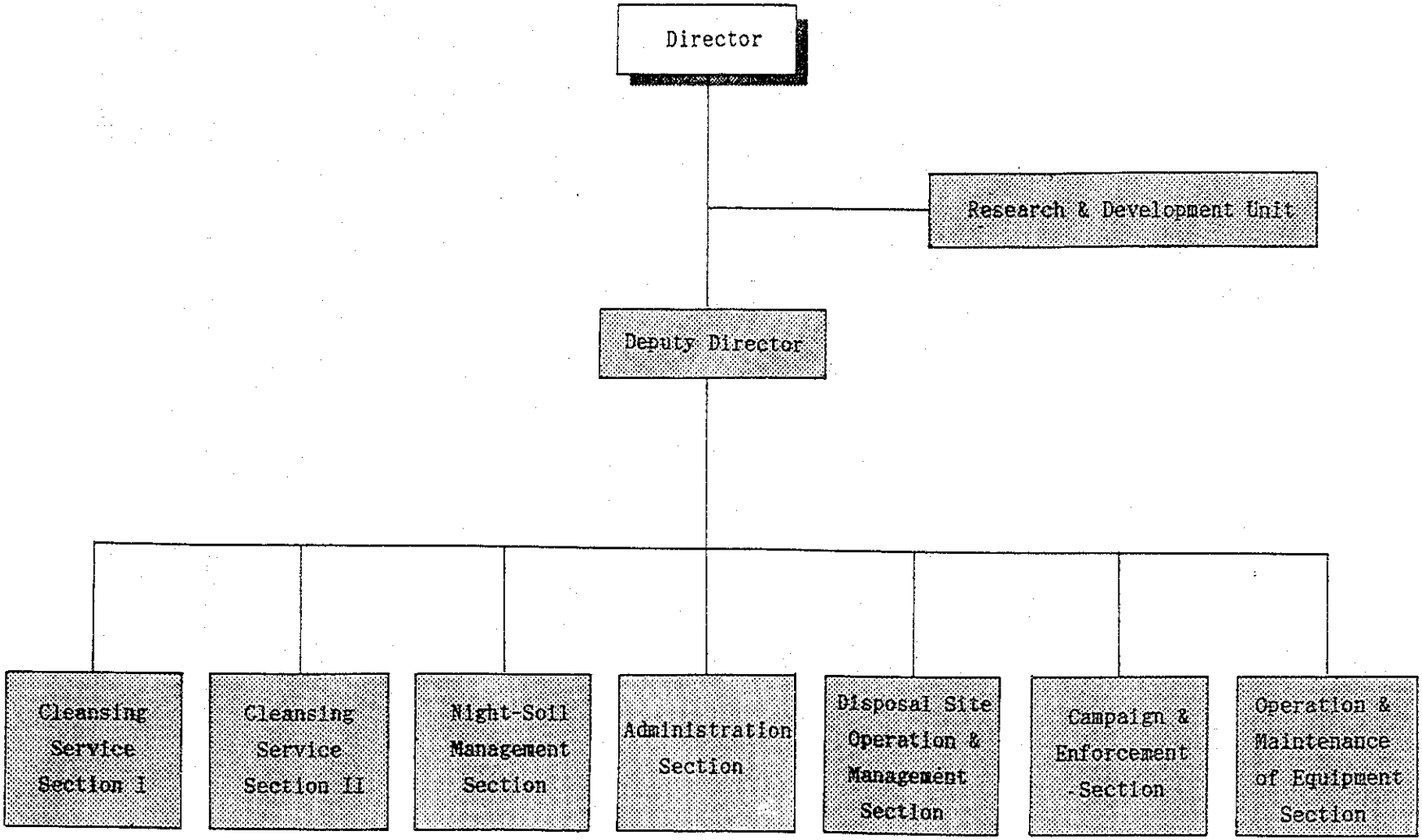

Fig. 4 Proposed Organization of the USD

ii. manpower scheme

Personnel requirements projected for 1995 according to sections are shown in Table 11. In total, 197 persons, a size about three times larger than the present manpower size, will be required. 130 persons shall be recruited.

b. Finance

i. basic concept

The establishment of 100% self-finance system through fee collection in 2000, i.e. the Beneficiary-Pay-Principle, is the main objective. Although the participant ratio in the collection experiment was about 30%, by considering the income level and fee set up (1,000 kips/household/month), the residents of Vientiane Municipality were found to be rather willing and cooperative in the payment of collection fees. It is however, also necessary to examine a self-finance system by means of the cross-subsidy through the introduction of a new tax system for the Municipality or the increase of the present land tax. Further, in addition to maintaining the Beneficiary-Pay-Principle, it is also important to make efforts which would ensure a fixed collection time, the equal allocation of shares concerning the collection fees, and the use and flow of the fees collected.

ii. fee collection system

The fee collection system proposed according to the services is as shown below:

- Basic collection services (by bamboo baskets) : Basic Fee
- Extra discharge (by bamboo baskets) : Extra Fee
- Large discharge (by means of containers) : Special Fee
- Disposal service : Tipping Fee

Table 11 Proposed Number of Personnel According to Section (1995)

Position / Name of Section	Manager	Engineer	Supervisor	Technician (Mechanic) or Operator	Clerk or Fee Collector	Driver	Worker	Total
1. Research & Development Unit	1	-	-	1	-	-	-	2
2. Administration Section	4	-	-	-	24	-	-	28
3. Cleansing Services Section I	1	1	3	-	-	17	59	81
4. Cleansing Services Section II	1	-	2	1	-	6	29	39
5. Night-Soil Management Section	1	-	1	1	2	7	15	27
6. Disposal Site Operation & Management Section	1	-	-	2	1	1	1	6
7. Campaign & Enforcement Section	1	-	1	-	2	-	-	4
8. Operation & Maintenance of Equipment Section	1	-	1	4	4	-	-	10
Total	11	1	8	9	33	31	104	197

The basic fee, extra fee and special fee do not only cover the collection and transportation costs but also the final disposal cost.

In order to establish 100% self-finance system through fee collection, it is necessary to gradually increase the tariff up to the necessary cost share as shown in Table 12. However, it is difficult to increase the collection ratio from 50% to 100% by 2000 due to the considerable number of poor households. It shall be, therefore, necessary to reduce the proposed collection fee making up the deficit by means of the cross-subsidy through the introduction of a new tax system for the Municipality or the increase in the present land tax.

Table 12 Tariff for SWM

(Unit : Kips)

Fees \ Year	1995	1998
Basic Fee (per basket/month)	1,000	1,200
Extra Fee (per extra basket)	250	250
Special Fee (per container/month)*	30,000	50,000
Tipping Fee		
per small vehicle	600	900
per middle vehicle	800	1,200
per large vehicle	1,000	1,500

Note : * The Fee is determined based on once a week collection.
In case of twice a week or once a month collection, it is twice or one fourth of the settled fee, respectively.

5) Project Cost

a. Investment cost

The investment cost was estimated based on the 1992 prices by adding the cost of each items.

Investment cost amounts to 2,450.9 million kips including engineering fees, physical contingency and price contingency as shown in Table 13.

Table 13 Investment Cost

(million Kips)

	Financial Cost			Economic Cost
	Foreign	Local	Total	
Collection Improvement	859.3	0.0	859.3	795.7
Cleansing	311.3	0.0	311.3	288.3
Final Disposal	480.8	176.2	657.0	597.1
Maintenance shop	199.1	53.0	252.1	233.3
Fee Collection	36.2	0.0	36.2	33.6
Sub-Total	1,886.7	229.2	2,115.9	1,948.5
Engineering Fee [1]	188.7	22.9	211.6	
Physical Contingency[2]	25.6	22.9	48.5	
Price Contingency [3]	56.6	18.3	74.9	
Total	2,157.6	293.3	2,450.9	1,948.5

1) 10% of investment cost
2) 10% of construction cost
3) 3% for foreign investment cost and 8% for local investment cost

b. Operation cost

Operation cost consists of the depreciation cost and the operation/maintenance cost which covers costs for fuel, personnel, construction and management, etc.

The operation cost in 1995 shown below in Table 14 was based on the above estimation.

Table 14 Operation Cost in 1995

(unit : million Kips)

	Depreciation Cost	Maintenance Cost	Fuel & Others	Personnel Expenses	Total
Collection	123.1	22.5	66.1	18.5	230.2
Cleansing	45.4	7.1	64.8	9.0	126.3
Final Disposal	102.6	5.3	12.7	1.7	122.3
Maintenance Shop	28.7			3.0	31.7
Management	4.7	1.0	3.5	9.2	18.3
Total	304.5	35.9	147.1	41.3	528.8

6) Project Evaluation

a. Technical evaluation

i. improvement of collection and cleansing works

Technically the extension of collection services, establishment of an efficient and reliable service by curb and bell collection system, and establishment of public cooperation for cleaning-up roads, drains and public areas pose no problems. These systems have been implemented smoothly as pilot projects in the collection experimental area and have been acknowledged by the residents.

ii. use of dump truck

According to the law of Vientiane Municipality, waste loaded in the collection vehicles should be covered in order to avoid scattering. The use of close dump trucks is considered to improve the collection work because loaded wastes will no longer require covers.

iii. construction of level 2 sanitary disposal site at KM 18-DS

From a technical view point, the construction and operation of level 2 sanitary disposal site, which is provided daily with soil cover to improve the landfill operation will not be difficult.

b. Environmental evaluation

A environmental evaluation is made and summarized in Table 15.

Table 15 Environmental Evaluation

	Construction Phase	Operational Phase
Noise	In some cases the noise level may be higher than the WHO's standard of 55 dB (A), but no adverse effect in daily life is expected.	Generation of noise from landfill equipment will be attenuated due to two meter high bund.
Dust/Odor	Adverse impact from dust would not be significant in comparison with the present crude open dumping.	The generation of dust can be controlled by water sprinkling. The daily cover can minimize the generation of odor.
Traffic Volume	No increase of traffic volume is expected.	Adverse impact due to concentration of carbon monoxide (CO) is very low.
Leachate	Nil	In comparison with the present crude open dumping, the landfill operation will be carried out in the limited area by the construction of enclosing bunds and dividers. This will reduce the generation of leachate. Accordingly, the adverse effect of leachates will be reduced in comparison with the present operation.
Impacts on Plant and Animal Communities	Nil	There seems to be no adverse effects observed on the plant and animal communities, because the site has been used as the only open dumping site in Vientiane for more than 20 years.
Impacts on Human settlements	Nil	There will be no additional adverse effects on the surrounding human settlements other than the present effects, because a sanitary landfill operation will mitigate the various adverse effects occurring at present. However, the Municipality or Nampapa Lao shall provide potable water to the surrounding settlements in order to avoid the use of groundwater for drinking as it may be contaminated by the landfill operation.

c. Social evaluation

The urban and surrounding area of Vientiane Municipality has faced serious environmental degradation due to the generation of solid waste with increasing complexity. Solid waste collection and disposal has become the causal factors of social and public health problems of great magnitude.

In non-collection areas, wastes are self-disposed at the premises or surrounding areas such as road-sides, mainly by means of open burning. Open burning activities produce air pollution which causes respiratory problem, and conjunctivitis.

Garbage dumping by the residents along roads and in drains causes the clogging of drains which leads to flood and the spread of some diseases, especially skin diseases. In the rainy season, water in bottles, tins and clogged drains breed mosquitoes that causes the outbreak of dengue fever.

It can be concluded, therefore, that the environment and public hygiene can be improved and maintained through cleansing works and solid waste collection services.

The level 2 sanitary landfill proposed will also upgrade the standard of living and public hygiene of the KM 18-DS as compared to the present situation.

d. Economic and financial evaluation

(1) Economic evaluation

i method of the evaluation

The economic evaluation is done based on the "Cost Minimum Method". Since the execution of waste collection and sanitary landfill is necessary for maintaining the basic functions of

the capital city, Vientiane, and there expects many benefits which could not be described in quantity (price), the equalitative analysis is conducted on the economic evaluation.

ii results of the evaluation

- collection and cleansing services improvement project

In view of the present poor hygiene caused by very limited waste collection services, expansion of regular collection services is essential to the urban life of Vientiane, and therefore, improvement of collection services is needed urgently.

On the other hand, the establishment of the collection service project would create job opportunities in Vientiane where potential unemployment ratio is high.

In addition, as for the introduction of the container collection system to institutions, better impressions on market and hospitals will be expected as safety and cleanliness are maintained and the spreading of infectious diseases can be prevented. These are some other important indirect effects such as the beautification and sanitation of Vientiane.

The improvement of road sweeping and drain cleansing works will reduce the clogging of drains which may lead to flood and the spread of some diseases.

- final disposal improvement project

The shift from open dumping to sanitary landfill can improve public health and preserve the environment around the final disposal site.

The direct effects of road improvement works and soil

covering at the disposal site will lessen the possibilities of vehicular tire punctures by glass or nails, ensuring the working ratio of the collection vehicles.

- maintenance shop improvement project

The major effects of the improvement of the maintenance shop are the prolongation of the life of the vehicles and the augmentation of the working ratio.

Although present maintenance system only provides one trip per day of collection work, the proposed maintenance system will be improved to enable 3 collection trips/day to main streets of town and 2 collection trips/day to the surrounding area. Concurrently, a fixed collection time will be established and the collection services will be improved.

Above everything else, a fixed collection time would heighten the willingness of the residents to pay, as observed from their response in the collection experiment.

(2) Financial evaluation

i method of the evaluation

Since the project for the Feasibility Study is the Phase I project of the Basic Plan, the project is financially evaluated in the Basic Plan period.

ii preconditions

As the establishment of the self-financial system is the goal of the Basic Plan, additional and renewal investments are basically done by the internal fund reserves. The collection fee is set up as 1000 kips/month/household based on the results of the collection experiment. In order to operate

the solid waste management project, it is necessary to examine various financial conditions. In this report, especially financial sources of initial investment, collection fees, and financial sources of renewal investment are examined, and contents and results of the examination is shown in the table below. In the table, from case 1 to case 8 the inflation is not considered; i.e., inflation ratio is 0%. Only in case 9 and 10, the inflation is considered. The project period for the financial evaluation is 15 years; i.e., up to 2010, considering the life span of the equipment and facilities.

iii results of the evaluation

In case the fee is leaving by 2000 as proposed fee for 1995 without inflation, it is difficult to manage the project with the conditions of the initial investment covered by loan and additional and renewal investment coverd by the internal fund reserves (Revenue by cost (R/C) ratio until 2000 is 0.54). In case the initial investment is covered by grant, although the R/C ratio until 2000 is improved to 0.83, the FIRR (Financial Internal Rate of Return), is less than 1 and the calculation of FIRR is meaningless. The project is, however, still necessary, because the feasibility of an environmental improvement project like SWM improvement project is dertermined by the necessity for the Basic Human Needs and not by the profitability of the project.

If the initial investment is covered by grant without inflation and the increase of fees on colection and tipping fees is done in 1998 in order to cover necessary cost for both collection and disposal (Basic fee is 1.2 times more than the proposed fee in 1995 and tipping fee is 1.5 times of that.), the R/C ratio until 2000 is 0.87. However, the R/C ratio until 2010 becomes 1.09 and the FIRR is 9.2%. In case of with inflation, after 2007 the overall dept will increase steadily and shall incapacitate the internal reserves from

financing the new investments required due to the increase of the interest for the loan. On the other hand, if the half of the renewal investment is covered by the budget of the Municipality, the balance will be improved (In case of 3% inflation, the R/C ratio until 2010 is 1.03 and the FIRR is 4.5%.). Therefore, in order to maintain sound financial condition for solid waste management, the fee tariff shal be reviewed and increased or half of the renewal investment shall be financed by the VM budget.

It can be concluded, therefore, that the profitability of the SWM project will largely depend on the positive cooperation of VM and the financial support by any modes of grants, especially during the time of take off.

Results of Analysis

(unit:million kips)

Case	Main Contents of Examination	Balance in 2000	Total Debt in 2010	Balance until 2010
Base	Fainancial Source of the Initial Investment			
	Loan	50	2,507	Almost Balanced
	Grant	153	828	Black in 1998
Case 1	Innitial Investment Amount (Initial Investment by Loan)			
	80%	71	1,554	Black in 2000
	100%	50	2,507	ditto
	120%	28	3,475	Red in 2010
Case 2	Initial Investment Amount (Initial Investment by Grant)			
	80%	153	828	Black in 1996
	100%	153	828	Black in 1997
	120%	153	828	Black in 1998
Case 3	Construction of Disposl site(1997) (Initial Investment by Grant)			
	Level 2	167	776	Black in 1998
	Level 3	153	828	Black in 1999
Case 4	Basic Fee (Initial Investment by Loan)			
	80%	−132	6,122	Always Red
	90%	−41	4,303	ditto
	100%	50	2,507	Black in 2000
Case 5	Basic Fee (Initial Investment by Grant)			
	80%	−19	1,122	Almost Balanced
	90%	67	828	Black in 1998
	100%	153	828	ditto
Case 6	Extra Fee (Initial Investment by Grant)			
	0%	−52	1,838	Always Red
	100%	153	828	Black in 1998
Case 7	Loan Condition (Repayment Period)			
	10 years with 3 years grace period	17	4,095	Always Red
	20 years with 3 years grace period	50	2,507	Almost Balanced
	30 years with 10 years grace period	66	3,251	ditto
Case 8	Loan Condition (Interest rate)			
	0.3 %	191	1,201	Black in 1998
	3 %	50	2,507	Almost Balanced
	6 %	−117	5,318	Always Red
Case 9	With Inflation (Grant) (Renewal Investment by 100% of Internal Reserve)			
	3%	58	3,451	Always Red
	5%	−149	7,096	ditto
Case10	With Inflation (Grant) (50% of Renewal Investment coverd by VM budgets			
	3%	154	904	Black in 2000
	5%	−52	958	Always Red

4.5 Strategy for Expansion of Collection Area

The present ratio (4.8%) of residents covered by the collection services shall be increased to 50% in 1995 based on the Beneficiary-Pay-Principle due to the weak financial situation of the Municipality. The implementation, however, will be very difficult. The collection experiment, therefore, was carried out in order to derive a strategy for the expansion of the collection area.

Based on the collection experiment, the strategy for expansion of the collection area is proposed as follows:

a. The expansion of collection area shall be conducted in a stepwise manner and the experiences obtained in the experiment shall be fully utilized. According to the requests and needs which may arise, proposed collection system shall be revised based on past experiences.

b. As shown in Fig. 5, the Study area is divided into the following areas and their collection service coverage ratios in 1995 are set up as follows;

- urbanized area 90%
- semi-urbanized area 50%
- less-urbanized area 25%

The reason is described as follows:

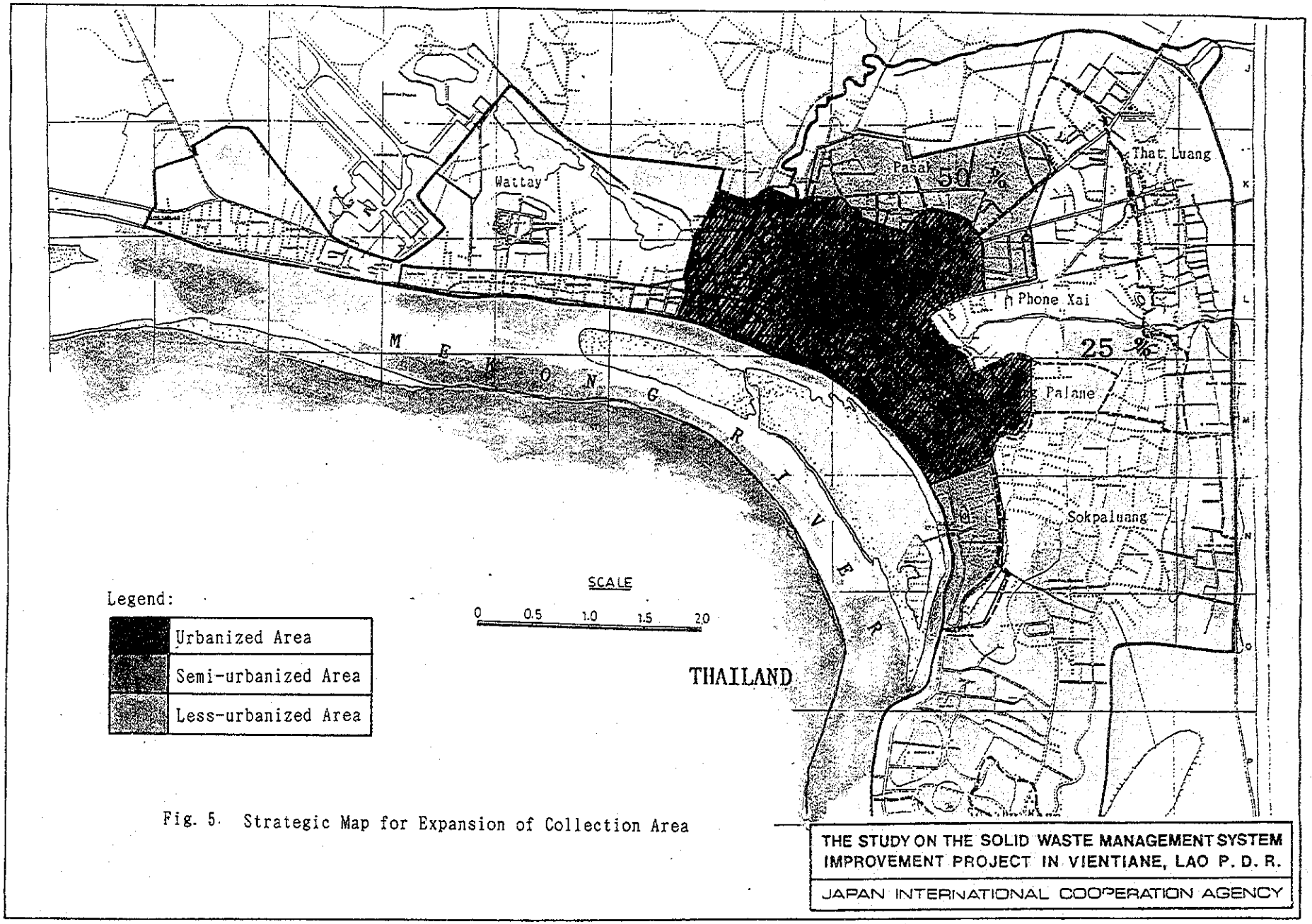

Fig. 5. Strategic Map for Expansion of Collection Area

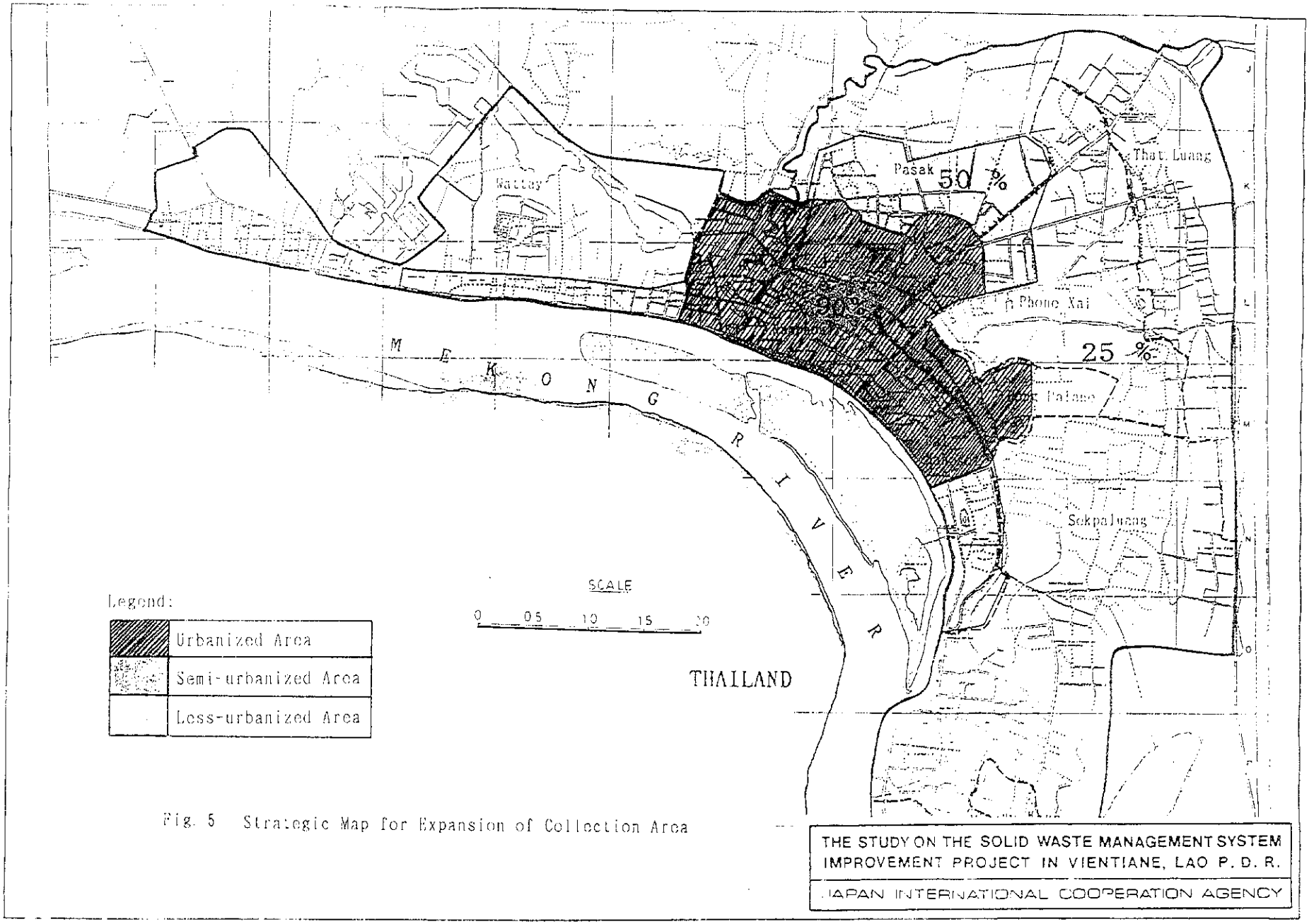

Fig. 5 Strategic Map for Expansion of Collection Area

i. Since the greater part of the urbanized area is already covered by collection services and the area consists of rather high income households and shops, it is possible to increase the ratio up to 90% by 1995.

ii. The collection experimental areas are located in the semi-urbanized area and the collection service ratio of the areas before the experiment was almost 0% and it was expanded to 30% by the only one month preparation works for the experiment. Therefore, although the present participation ratio in the experiment is 30%, it is possible to increase the ratio up to 50% by 1995 through the continuous efforts of DCTC and the urbanization of the area.

iii. By 1995, due to rapid urbanization, the less-urbanized area may become semi-urbanized area. Collection services can be expanded then up to 25%.

c. In case some difficulties concerning the application of the curb and bell collection system in an area arise due to limited passable roads, the introduction of handcarts for primary collection may be considered and the extra expenses from the introduction shall be shouldered by the beneficiaries.

d. By the year 1995, the proposed collection fee system shall be maintained and collection service ratio will be increased from 4.8% upto 50%. This target could be achieved by the expansion method proposed above. It seems, however, very difficult to increase the ratio from 50% to 100% by 2000 due to the existence of poor households. It shall be, therefore, necessary to examine the reduction of the proposed collection fee making up the deficit by means of the cross-subsidy through the introduction of a new tax system for the Municipality or the increase in the present land tax.

e. The introduction of a collection fee system in accordance with income level is not recommended by the Study Team, according to

the following reasons;

i. According to the UNDP M/P, the government employees share more than 60% in labour force in Vientiane Municipality and their income is less than 25,000 kips/month. The data of the World Bank on the income level in Vientiane shows the same figure.

The actual income of average households including government employees, however, is more than 55,000 kips/month/household according to the results of the CCS. This is because the average household has several jobs in addition to an official one like livestock farming, retailing, etc..

Consequently, if the collection fee is set in accordance with nominal income, the average collection fee should be much less than 1,000 kips/month/household and a sound SWM could not be achieved due to the lack of financial sources.

ii. Furthermore, it seems to be very difficult to know the actual income level.

iii. In addition, since the present fee collection system other than the one operated in the experiment has not functioned well, it is difficult to establish and operate a more complicated fee system than the present due to the lack of manpower both in terms of quantity and quality.

5. Implementation Plan and Recommendations

5.1 Implementation Plan

1) Project Implementation Body and Schedule

a. Project implementation body

Solid waste management is currently conducted by DCTC, Vientiane Municipality, which is responsible for collection/cleansing and disposal. For successful project implementation, however, an Urban Services Department should be established. Since the State Government is not directly responsible for the project implementation, Vientiane Municipality should provide the necessary funds and should supervise the implementation of the Project.

b. Implementation schedule

i. implementation conditions

Implementation conditions for the Phase I Improvement Project are as follows:

- Design Target Year : 1995
- Service Commencement Year : 1995
- Subject Area : entire Vientiane urban area

ii. preparatory period

The following must be conducted in 1993.

- acquisition of investment funds and preparation of repayment plan;
- confirmation of facility construction site;
- preparation of detailed design and specifications for facilities as well as equipment/material; and
- selection of contractor (tender, evaluation and contract)

iii. construction schedule

The Project is mainly divided into the equipment procurement work and facility construction work, and the following work periods are proposed:

- equipment/material procurement : 8 months after completion of contract
- maintenance shop construction : 12 months after commencement of construction work
- disposal site construction : 12 months after commencement of construction work

2) Financial Plan

a. Required fund/capital

The investment cost and annual expenditure have been estimated based upon the project cost making the additional assumptions:

i. The costs for engineering services and contingencies, which were not included in the financial analysis, shall be included in the financial plan.

ii. The investment and operation costs are estimated to increase at the rate of 3.0% per year, while a 5% annual increase in labour cost is assumed. The increase after 2000, however, will not be taken into consideration as the charging system will be revised and improved by then.

iii. Nominal interest rates of 6% for long term loans and 11.5% for short term loans will be adopted. The interest rate for deposits will be 9.5%.

b. Financial resources

The capital required for the implementation of the project will be appropriated from the VM budget, internal fund reserved by profit and depreciation, and grants. Long term foreign loan is not considered in this Feasibility Study Period due to insufficient foreign currency holdings and the urgency of the improvement of SWM. Long term foreign loans are, however, taken into consideration for the construction of the final disposal site in 1997. The loan condition is assumed to be 20 years repayment with 3 years grace period. Furthermore, the repayment of long term loan and its interest is assumed to be subsidized by VM budget.

The appropriation of financial sources is as follows:

Table 16 Financial Resources for Investment

(unit : million Kips)

year	1994	1995	1996	Total
Project Budget of VM	-	81	83	164
Internal Fund Reserves	-	81	83	164
Grant	2,451	0	0	2,451
Total	2,451	162	166	2,779

If grants are difficult to acquire, foreign loans with the terms as soft as possible shall be considered.

The source of the SWM operation cost will be the collection fees and the ordinary budget of VM. The appropriation of finances from the 2 sources is shown in Table 17.

Table 17 Composition of Revenue

(unit : million Kips)

year	1995	1996	1997	Total
Fee Collection				
Basic Fee	241	311	380	932
Extra Fee	65	85	106	256
Special Fee	14	14	15	43
Tipping Fee	2	2	2	6
Sub-Total	322	412	503	1,237
VM Current Budget	129	133	137	399
Total	451	545	640	1,636

The fee tariff will be reviewed and increased in 1998. At the same time, it is necessary to examine the introduction of a new tax system for the municipality or the increase of the present land tax ratio, because it seems to be very difficult to increase the collection service ratio from 50% by 1995 to 100% by 2000 with the proposed collection fee system due to the existence of poor households.

c. Expenditures and revenues

The cash flow for 2000 is made based on the above-mentioned assumption and shown in Table 18. Cross-subsidy, however, is not taken into consideration.

Table 18 Balance Sheet and Cash Flow

Balance Sheet

Unit : million Kips

Year	1994	1995	1996	1997	1998	1999	2000
Revenue							
Fee collection							
Basic fee		241	311	380	539	623	706
Extra fee		65	85	106	126	146	167
Special fee		14	14	15	25	26	27
Tipping fee		2	2	2	3	3	3
Budget from VM		129	133	137	143	158	164
Others		0	13	33	56	94	126
Sub total(A)	0	451	558	672	893	1050	1193
Expense							
Personnel							
Expenditure		43	56	69	96	114	135
Maintenence		37	45	53	61	69	78
Fuel & Others		152	169	187	205	223	241
Depreciation		305	325	347	489	522	557
Interest		0	0	0	154	154	154
Sub total(B)	0	536	596	656	1006	1082	1164
Balance	0	-86	-38	16	-113	-32	29

Cash Flow

Unit : million Kips

Year	1994	1995	1996	1997	1998	1999	2000
Balance	0	-86	-38	16	-113	-32	29
Depreciation	0	305	325	347	489	522	557
Sub total(C)	0	219	287	363	376	489	586
Money Demand							
Investment	2451	161	166	2792	252	615	0
Loan							
Long Term	0	0	0	0	0	0	151
Short Term	0	0	0	0	0	0	0
Sub total	2451	161	166	2792	252	615	151
Money Supply							
Budget from VM							
for Investment	0	81	83	115	126	307	0
for Debt serv.	0	0	0	0	154	154	304
from Int.Fund	0	81	83	115	126	307	0
Foreign Aids	2451	0	0	0	0	0	0
Long Term Loan	0	0	0	2563	0	0	0
Short Loan	0	0	0	0	0	0	0
Sub total	2451	161	166	2792	406	769	304
Surplus of	0	138	204	248	404	336	740
Money							
Fund Reserves	0	138	342	590	994	1330	2069
Total of Debt	0	0	0	2563	2563	2563	2412

Note : Debt serv. includes repayment and interest for the long term loan for full scale disposal site(level 3)

The table clearly shows that the balance will be in black figures in 1997 and then in red in 1998 due to the interest rates of foreign loans made for the construction of a full scale final disposal site (level 3) in 1997. By 2000, however, the balance will be in black again.

A total debt of 2,412 million kips will be accumulated in 2000. Since the internal fund reserve in 2000 will be 2,069 million kips, self-finance can be established completely in 2005, if VM covers half of the new investment.

The allocation of VM budget is as follows:

Table 19 Allocation of VM Budget for SWM (in case of Grant)

(unit : million Kips)

year	1995	1996	1997	1998	1999	2000	Total
for investment*1	81	83	115	126	307	0	712
for public share	129	133	137	143	158	164	864
for repayment of loan						151	151
for interest of loan				154	154	154	462
Total (A)	210	210	252	423	619	469	2,189
VM budget (B)*2	5,550	6,003	6,492	7,021	7,592	8,211	
A/B x 100 (%)	3.8	3.6	3.9	6.0	8.2	5.7	

Note:

*1 : The investment for the purchase of collection vehicles is assumed to be subsidized by half from VM budget.

*2 : VM budget is assumed to increase in accordance with the increase ratio of the GRDP plus inflation ratio of 3%.

5.2 Recommendations

1) First Priority Project

The first priority project proposed is feasible and its implementation by the year 1995 is recommended.

2) Financial Source

Although the recurrent cost of the Vientiane SWM improvement project can be recovered, its initial investment cost has to be subsidized by the Central Government or financed by the donation of both bilateral and multilateral aid agencies. As such, Vientiane Municipality has to make every effort to acquire such assistance in order to successfully implement the project. As for the replacement of equipment, the procurement cost will be covered by the internal reserve.

3) Examination of the reduction of the proposed collection fee (1000 kips/household/month)

By the year 1995, the proposed collection fee system shall be maintained and collection service ratio will be increased from 4.8% upto 50%. This target could be achieved by the expansion method proposed by the Study. It seems, however, to be very difficult to increase the ratio from 50% to 100% by 2000 due to the existence of the poor households. It shall be, therefore, necessary to reduce the proposed collection fee making up the deficit by means of the cross-subsidy through the introduction of a new tax system for the Municipality or the increase in the present land tax. In addition, the Municipality is requested to provide the more strong financial support on SWM.

4) Stepwise Approach

In order to mitigate the financial burden, the proposed Basic Plan shall be implemented in a stepwise manner.

5) Setting-up Project Implementation Unit

In view of the large amount of work to be done for the implementation of the first phase projects, the Municipality should set up a project implementation unit which would be responsible for the systematic implementation of the project.

6) Continuance of Collection Experiment

Vientiane Municipality is requested to continue the collection experiment in order to improve their capability and to show the necessity of the project.

7) Urgent Replacement of Existing Dilapidated Vehicles

Vientiane Municipality is requested to take necessary measures for the continuation of the present collection service by the year 1995, such as the replacement of existing dilapidated vehicles.

8) Expansion of Curb and Bell Collection System

Curb and bell collection system being carried out by DCTC as a pilot project in the experimental areas should be expanded to all other residential and commercial areas as early as possible in order to make collection work more efficient.

9) Collection and Utilization of Data

Collection of relevant data is essential for the planning and evaluation of the existing situation and progress of solid waste management. Relevant data include waste amounts and composition which would change daily, seasonally and yearly. In this connection, weighbridge should be actively used.

10) Water Supply to the Surrounding Residences of the KM 18-DS.

The use of groundwater for drinking is not recommended because of the probable effect of leachate. It is, therefore, necessary to provide potable water to the surrounding area by the Municipality or Nampapa Lao.

11) Operation of KM 18-DS

The present KM 18-DS was improved and cleaned-up by the experiment on sanitary landfill operation and in order to maintain this, DCTC should prohibit the dumping at the entrance of the site and instruct the incoming vehicle to dump their waste inside as much as possible.

12) Execution of Public and Educational Campaigns

Strong emphasis should be put on public participation in SWM in order to make up the insufficient physical and financial resources of both service supplier (Vientiane Municipality) and service user (residents).

Vientiane Municipality is, therefore, requested to conduct public and educational campaigns in order to achieve public cooperation. For this purpose, tools prepared by the Study Team, i.e. a video tape, drawing boards and educational pamphlet, shall be efficiently used.

13) Encouragement of recycling activities

The recycling of domestic and commercial waste at the generation sources is well established. Wastes are segregated into waste for discharge, food waste to be used as domestic animal, mainly livestock feed, reusable materials for recycling, and self-disposable waste. The Vientiane Municipality should encourage these source separation and recycling activities.

14) Establishment of a Monitoring System

Once the Municipality decides to commit itself to achieving the Basic Plan targets, it will be important to establish a system which will monitor closely the progress of improvements within the Municipality. Data obtained from monitoring will be used to evaluate the Municipality's performance, a means to assess its progress. The establishment of a monitoring system is, therefore, recommended.

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