MUNICIPALITY OF DAMASCUS
THE SYRIAN ARAB REPUBLIC

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF WASTE DISPOSAL EQUIPMENT IN CITY OF DAMASCUS IN THE SYRIAN ARAB REPUBLIC

FEBRUARY, 1996

JAPAN INTERNATIONAL COOPERATION AGENCY
YACHIYO ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the Syrian Arab Republic, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Waste Disposal Equipment in City of Damascus and entrusted the study to the Japan International Cooperation Agency (JICA).

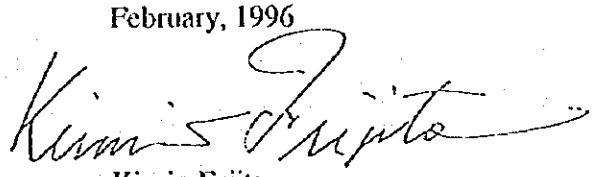
JICA sent to Syria a study team from November 5 to December 4, 1996.

The team held discussions with the officials concerned of the Government of Syria, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Syria in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Syrian Arab Republic for their close cooperation extended to the teams.

February, 1996



Kimio Fujita
President
Japan International Cooperation Agency

February, 1996

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of Waste Disposal Equipment in City of Damascus in the Syrian Arab Republic.

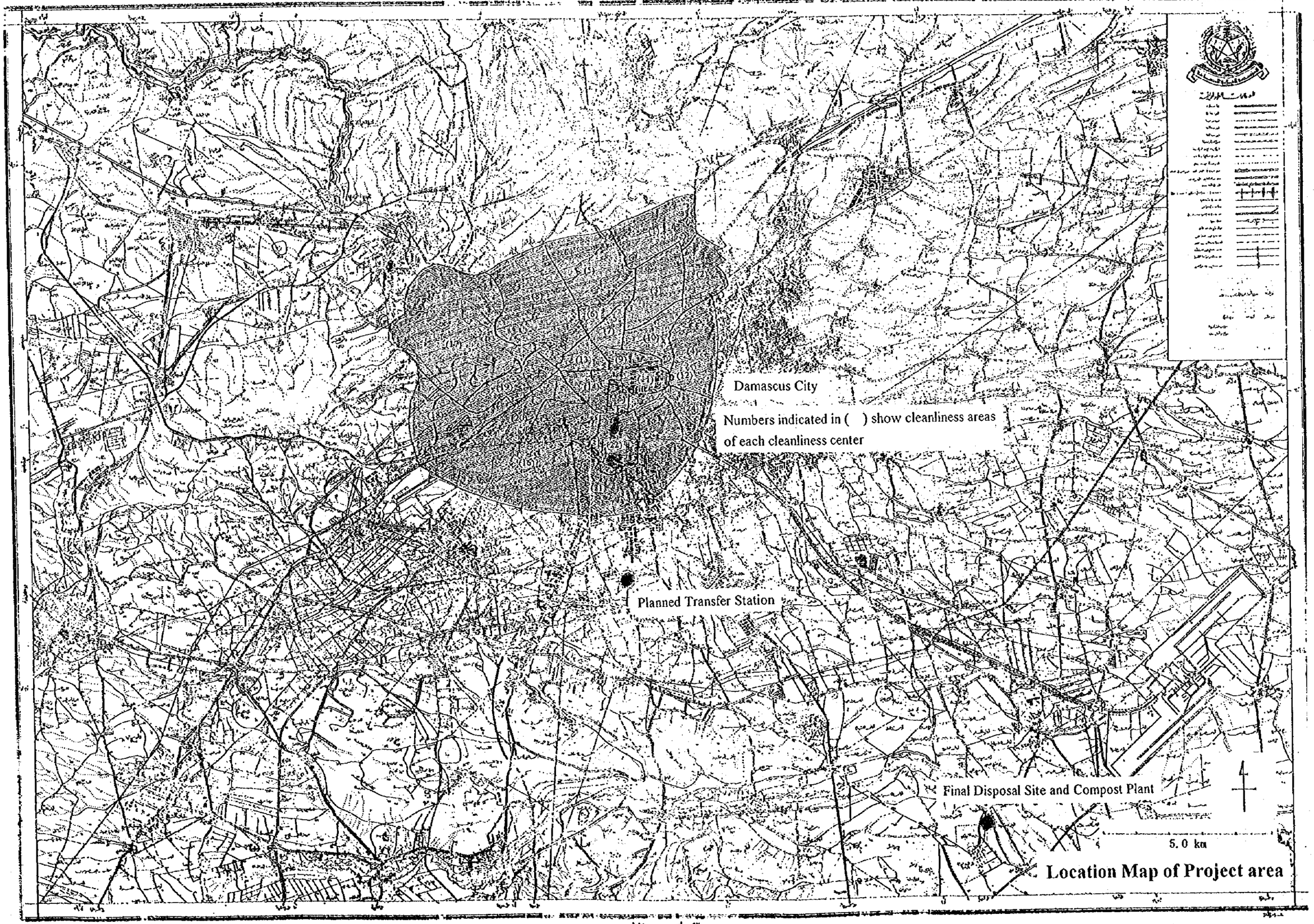
This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from October 23, 1995 to March 25, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Syria and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

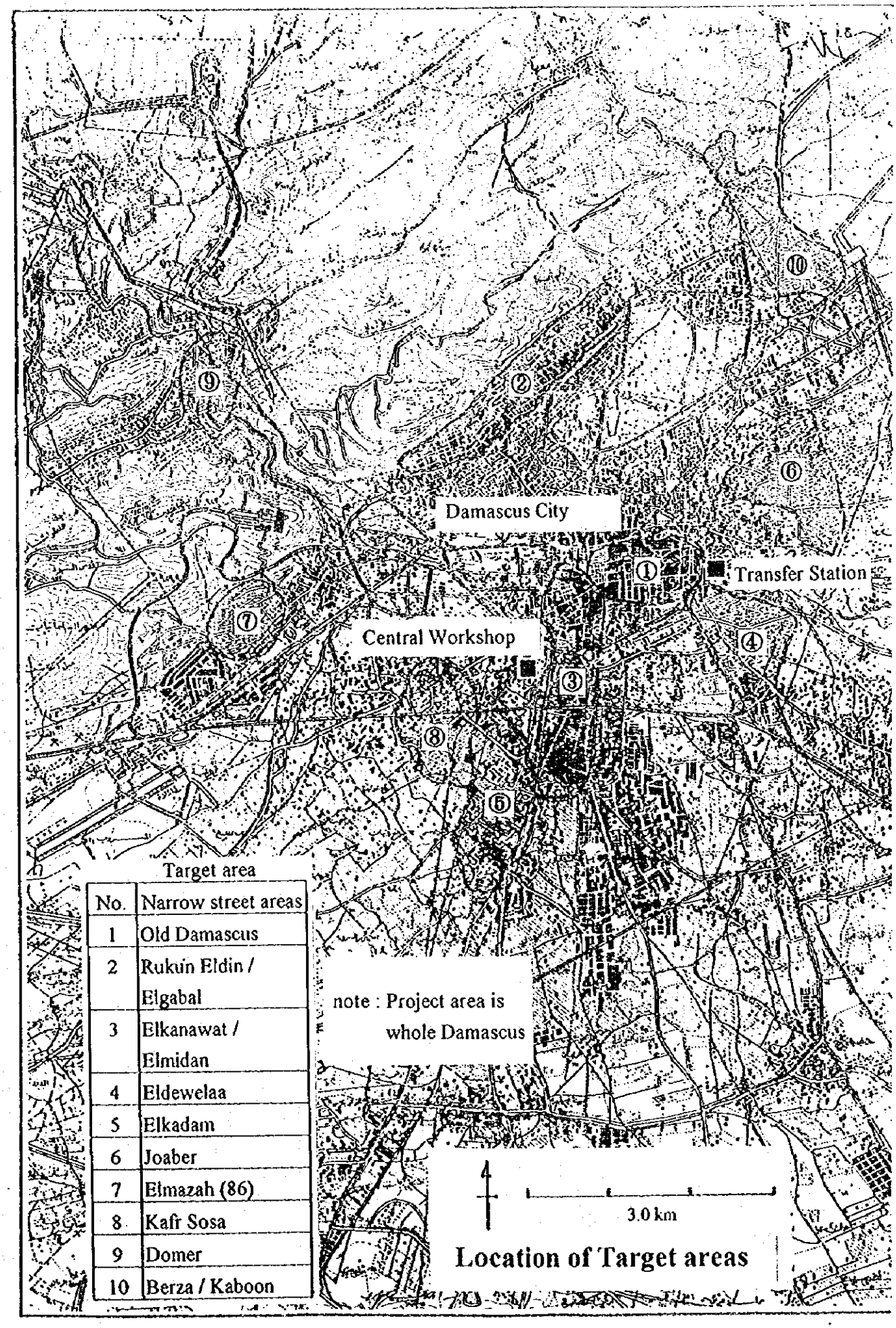
Very truly yours,

阿部 洋

Hiroshi Abe
Project manager,
Basic design study team on
the Project for Improvement of
Waste Disposal Equipment in
City of Damascus
Yachiyo Engineering Co., Ltd.



Location Map of Project area

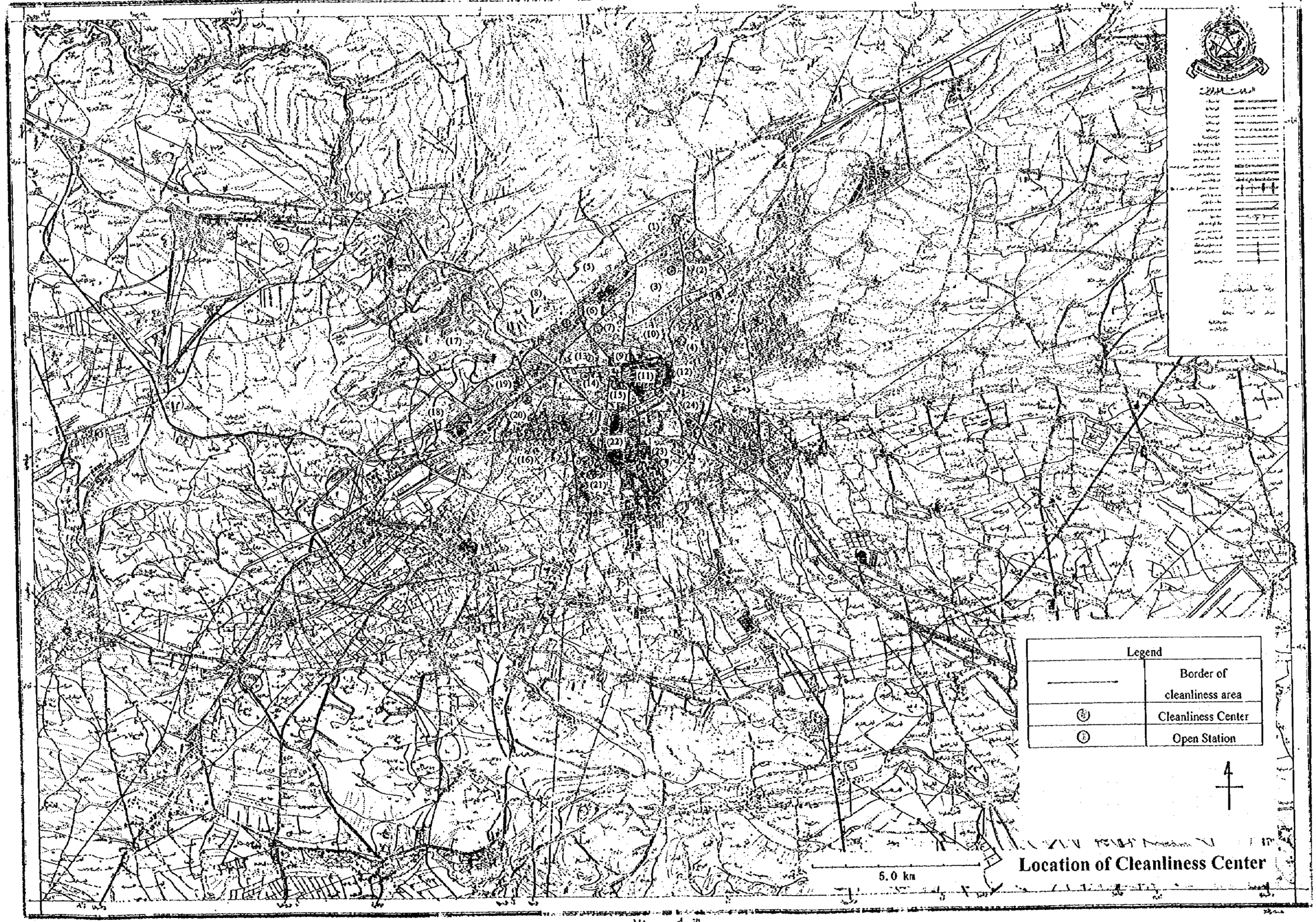


Target area

No.	Narrow street areas
1	Old Damascus
2	Rukun Eldin / Elgabal
3	Elkanawat / Elmidan
4	Eldewelaa
5	Elkadam
6	Joaber
7	Elmazah (86)
8	Kafr Sosa
9	Domer
10	Berza / Kaboon

Location of Target areas

دمشق وضواحيها



ABBREVIATIONS

OPEC	Organization of Petroleum Exporting Countries
EU	European Union
E/N	Exchange of Notes
GDP	Gross Domestic Product
GNP	Gross National Product
JICA	Japan International Cooperation Agency
O&M	Operation and Maintenance
OJT	On the Job Training
SL	Syrian Pound

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CHAPTER 1
BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

1-1 Background of the Project

Syrian Arab Republic (hereinafter referred to as Syria) is located on the Eastern coast of the Mediterranean, and it is a neighboring country of Turkey, Iraq, Jordan, Lebanon. It has an area of 185,000 km^2, and its population is 13.39 million (1993). The climate varies greatly depending on locations in the country. While the Mediterranean coast has more precipitation and the land is more fertile, the interior has little precipitation and the land is a semi-desert region. In addition to having an economy which is balanced in the sectors of agriculture, mining and manufacturing and service (the GDP composition ratio is 30%, 23% and 47%, respectively), it has a high standard of education, compared to the rest of the neighboring Arab countries. The GDP per capita has reached the level of $1,170 (1991). The population of the capital city, the Municipality of Damascus, is approximately 2.5 million, which is 18% of the population of the whole country.

Solid waste collection in Damascus is done in combining large sized compactor trucks and containers (0.5 $\sim$ 1.6 m^3). However, the collection vehicles are outdated, and the operation ratio of these vehicles is now 53%. Also, since in the city of Damascus there are areas called Old Damascus, hilly areas and randomly developed areas, in which 45% of the city population, 1.15 million people, are living, and because the streets of these areas are too narrow to accommodate large collection trucks, the discharged solid waste is collected by either hand carts or donkeys. The waste is temporarily deposited in containers which are placed on main roads or at solid waste collection centers (open station), then it is carried to transfer stations. However, since it is difficult to collect solid waste directly by large collection vehicles in narrow streets, there is a lot of solid waste scattered on the streets, and in some cases piled up in heaps.

Presently, the amount of solid waste discharged in the city of Damascus is 1,000 ton/day, and out of it approximately 870 ton is collected. It is predicted that the amount in the year 2,000 will increase to 1,236 ton/day. Because the collection vehicles will become further outdated, the solid waste collection is increasingly becoming a serious problem, and a solution is urgently sought.

Meanwhile, the solid waste, once transported to the transfer stations, is further transported to the Compost Plant and the Final Disposal Site, which are located at the place 35 km South East of the city. This transferring service is entrusted to a private company. Twenty percent of the transported solid waste is treated at the Compost Plant, and the rest is disposed of at the Final Disposal Site. At the Final Disposal Site, the practice of sanitary landfill using covering soil is not done due to lack of heavy equipment. Instead, open dumping is practiced. For this reason, the Final Disposal Site is permeated with an offensive smell, and fires spontaneously occur.

In the present seventh five-year national plan, one of target is set to improve the environment, together with to build a power station, and to develop the agricultural system aiming to be self-sufficiency of food. However, since the Department of Cleanliness in the Municipality of Damascus has only operation budget, it is not able to replace the outdated vehicles and equipment.

For this reason, the Government of Syria has requested the Government of Japan's provision of grant aid for the purposes of not only improving the environment of Old Damascus and hilly areas (the Target areas), by upgrading the vehicles and equipment for solid waste collection and street sweeping, but also to implement sanitary landfill providing necessary equipment, then for protecting the environment of the Municipality of Damascus as a whole.

1-2 Outline of the Request

The items requested by the Government of Syria are shown in Table 1-2-1.

Table 1-2-1 Items Requested by Syria

Equipment	Unit	No.
Collection and transport Equipment		
Garbage Compactor Truck (3 ton)	vehicle	23
Garbage Compactor Truck (2 ton)	vehicle	24
Tipper (Dump) Truck	vehicle	25
Road Cleaning Equipment		
Vacuum Car	vehicle	3
Water Tank Truck (3000 liter)	vehicle	3
Road Sweeper (large)	vehicle	5
Road Sweeper (small)	vehicle	5
Landfill Equipment		
Bulldozer	vehicle	1
Motor grater	vehicle	1
Hydraulic Excavator	vehicle	1
Wheel Loader	vehicle	1
Maintenance Vehicles		
Mobile Workshop	vehicle	2
Jeep	vehicle	3
Spare parts	set	1

CHAPTER 2
CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Objectives of the Project

Environmental protection and abolishment of pollution are one of the national target in the Syrian Arab Republic. This Project aims at the protection of environmental conditions and the development of adequate public health services to the inhabitants of the Municipality of Damascus by implementing rapid removal of the solid waste and sanitary landfill at the final disposal site.

In regard to the services of solid waste collection and street sweeping, the aim is not only to improve the service ratio of solid waste collection (presently 87%) and street sweeping services in the Target areas (Old Damascus and hilly area), but also to employ more efficient system to strengthen solid waste management of Damascus city since present method relies heavily on the manual work which is creating severe working condition. Also, in regard to the final disposal site, the goal is to implement sanitary landfill in order to protect the environment in surrounding area from offensive odors and harmful insects, and to prevent naturally occurring fires.

2-2 Basic Concept of the Project

The Municipality of Damascus is struggling with the protection and the improvement of the environmental conditions for its inhabitants, but due to the limited budget, it is difficult to fulfill the following tasks which are necessary to provide adequate solid waste management service to the city. This project is necessary to implement the following plans and to contribute improvement of environmental condition of the city.

1) Most of the existing vehicles are extremely old and its maintenance cost is high then the old vehicles must be replaced successively.

2) Implementation of the plan to renew old vehicles and equipment, using saving of maintenance cost through adequate abolishment of old vehicle.

3) Establishment of efficient collection system and grade up of collection service using small vehicle in the Target area which are the old Damascus and the hilly area with many narrow street. A great amount of solid wastes are found uncollected, since the collection is dependent heavily on the manual work and donkeys.

4) Implementing of sanitary landfill providing necessary heavy equipment to prevent offensive smell and harmful insects, and naturally occurring fires to avoid environmental pollution of surrounding area.

5) Upgrading of maintenance and inspection capability of solid waste management through providing maintenance vehicle and spare parts.

At present, the Municipality of Damascus is compelled to allocate much budget for the maintenance of outdated vehicles. Working conditions for humans and donkeys in the Target areas is very severe due to long distance of haulage and sweep road, and it is difficult to maintain steady employee and to recruit new workers due to long working hour and hard work. For these reasons the Municipality of Damascus shall replace old vehicles to reduce maintenance cost and change collection and sweeping system using small vehicles and mechanical sweeper in the Target areas to reduce hard manual work

Also there is only one outdated bulldozer to be renewed at the final disposal site while it is financially difficult for the city of Damascus to purchase equipment to implement sanitary landfill and to replace old equipment to cope with increase of population and solid waste amount.

Therefore, this Project has an urgency and appropriateness in these objectives, because, as explained in 1), 2), 3) and 4), without improving the present situation, it

is impossible to maintain present service level for the solid waste management and public health of city. And because the present situation is indeed creating a serious environmental problems at final disposal site.

Moreover, as described the above, there appears to be urgent and appropriate in the objectives of 5), because the Municipality of Damascus is not able to replace the outdated vehicles, then the city has no alternative but to utilize the existing vehicles and equipment as much as possible.

Considering the above, it is necessary to protect the environment for the residents and to improve the public health in the city by improving the solid waste collection service and its system for the sake of the whole of Damascus, so that the city would be able to cope with the increase of solid waste amount in the year 2000 through upgrading the vehicles and equipment required to collect the solid waste in the Target areas, including the old Damascus and the hilly area, by providing the heavy equipment for sanitary landfill; and by providing the maintenance vehicles and spare parts.

2-3 Basic Design

2-3-1 Design Concept

(1) Principles Concerning Natural Conditions

1) Temperature and Relative Humidity

The temperature in Target areas of this Project is 16.3°C on the average, the highest approximately 40°C and the lowest approximately -7°C. The humidity is also not very high, 50 to 60 %, and in matters of design there is no need to take either temperature or humidity into special consideration.

2) Rainfall Conditions

Average rainfall is recorded approximately 130 mm in a year, and snowfall also occurs; but there is no need for specially designed vehicles and equipment to accommodate problematic rain or snow conditions.

3) Narrow Streets and Hilly Districts

Since the solid waste collection vehicles and equipment, which will be procured under this Project, are intended to be used in narrow streets and hilly districts, the use of specifically designed small vehicles and equipment with high torque output and heavy duty clutch, as well as other measures, should be taken into consideration.

4) Working Conditions in the Final Disposal Site

For designing of landfill equipment to be procured under this Project, it is necessary to take some measures to protect the workers from methane gas, strong offensive odors and, so on, which are generated at the disposal site(s).

(2) Social Conditions

Eighty-five percent of the Syrian population is Muslim, and the holidays and working hours, etc., including Ramadan (a fasting month), are accordingly instituted. For this reason, it is necessary to design holidays and working hours, etc. taking careful consideration of this country's customs and common practices. Every Friday is a holiday for Syrians, and their statutory holidays, totaling 14 days a year, are shown in Table 2-3-1.

Also, in considering solid waste management for developing countries the role of scavengers is often questioned, but in Syria scavenging activity are not allowed by law.

Table 2-3-1 National Holidays

No.	Date	Name of Holiday
1	March 8	March's Revolution Day
2	March 11	Teacher's Day
3	March 21	Mother's Day
4	April 16	Al-Shaanain Monday
5	April 17	Independence Day
6	April 23	Festival Al-Fassh Day
7	May 1	World Labor Day
8	May 6	Remembrance of Independence's Martyrs
9	October 6	Remembrance of October's War
10	November 16	Remembrance of Renewal Nation
11	March 2 (Islamic calendar)	Festival Al-Fatter Day (Ramadan festival)
12	May 9 (Islamic calendar)	Festival Al-Addha Day (Al-Hajj Day)
13	May 30 (Islamic calendar)	Prophet's Immigration Day
14	October 8 (Islamic calendar)	Prophet Birth Day

note: Holidays based on the Islamic calendar are dates for 1995

(3) Use of Local Companies and Locally Purchased Materials

1) Employment of Local Companies

The vehicles and equipment to be procured under this Project are at heaviest 20t to 30t, and the local companies in Syria are capable of inland transportation.

2) Use of Local Product

The 0.5 m^3 containers to be used for the 3 ton compactor trucks are produced in Syria, and their quality is sufficient to be utilized for solid waste collection. Therefore, the production of the containers is to be done locally under the financial responsibility of Syria.

(4) Management and Maintenance Capability of Project Implementation Body

The facility of the present Department of Vehicles and Workshops, as well as the number of workers and the organization, etc. is sufficient and the Department's maintenance capabilities are proved by their record maintaining large Compactor trucks granted by the Government of the United States 16 years ago, and also by repairing and maintaining Japanese-made Compactor trucks procured 12 years ago (the operation rate is currently 53%). However, since they have used only outdated vehicles, their maintenance work, generally speaking, consists mainly of carrying out repairs of damaged vehicles.

For this reason, it seems necessary to provide OJT at the provision of new vehicles and equipment under this Project, to introduce a periodic inspection and maintenance (maintenance to prevent break down) which is well practiced in Japan. Also, in order to have effective management, it is desirable to provide training in Japan on preventative maintenance services and periodic inspection system .

(5) Design and Technical Level of Equipment

Basic concepts for the design and the technical level of the equipment to be procured under this Project, shall be as follows.

1) Vehicles and Equipment to be provided

The types of vehicles and equipment must be to aim at the improvement of the collection of solid waste (including street sweeping) in Target areas, the improvement of the maintenance capability, as well as the implementation of sanitary landfill considering improvement of the efficiency of the entire solid waste management including the collection and final disposal in the Municipality of Damascus.

2) Technical Level

Cautions should be taken that the specifications for the vehicles and equipment would not exceed the maintenance and management level of the Municipality of Damascus, and that, if possible, manually operated vehicles, which are easier to maintain and manage, must be procured. Also the vehicles and equipment to be procured should be uniformly designed under the same makers, so that consistency in maintenance know-how and in replacement parts can be maintained. Moreover, unnecessary series of maintenance and management operations, as well as any unnecessary increase in the number of workers, should be avoided. However, it is desirable to introduce a preventative maintenance system.

(6) Procurement of Vehicles and Equipment

Since anything other than 0.5 m^3 container for solid waste collection is not produced in Syria, all vehicles and equipment, except the containers, must be purchased from either Japan or from a third country. A choice for purchasing from either Japan or from a third country should be made with careful consideration to the maintenance aspects, keeping in mind the Syrian side desire to have Japanese-made vehicles and equipment. 0.5 m^3 containers shall be procured by Syrian side.

Considering about the collection vehicles, the street sweeping vehicles and the maintenance vehicles to be procured under this Project, the existing small and middle size Compactor trucks, are all Japanese-made. In the workshops there are maintenance lines for Japanese-made vehicles. Moreover, as there local dealers for Japanese vehicles, Japanese made is desirable. Because it was known that the agencies vehicle companies of third countries, who have service centers in Syria though providing adequate supplies of spare parts, are unable to supply small size vehicles and spare parts, and that some of these companies are producing only for their own countries and do not have any exporting experience, even if they have some models in their home countries. Therefore, taking into consideration the supply of spare parts and after-care of procured vehicles, it is suitable to purchase Japanese-made vehicles. It is interesting to note that in Syria the number of Japanese-made vehicles is rapidly increasing after the relaxation of the automobile import restrictions, and the dealers and service centers of the Japanese-made vehicles are well trained and qualified. Furthermore, the supply of vehicles, with a wide variety from light cars to large sized trucks, including small and middle sized trucks, and the supply of spare parts are adequately provided with maintenance and repair service.

On the other hand, with regard to the landfill equipment, most of the construction machine-makers who have a good reputation in Syria in stability of supply and quality of product, and who own dealerships or service centers in this country, are managed either under the capital investment of Japanese makers or in co-ownership with Japanese makers. Whether the equipment is supplied from a third country or from Japan, then, it is often the result that identical models are exported. Moreover, the maintenance know-how and the supply of spare parts happen to be more or less the same. Therefore, since the maintenance and management conditions with regard to the choice of the supplying country are all similar, the choice should be made rather from the price perspective. Also, since the 10 m^3 dump truck is large, compared to the collecting and transporting vehicles, and to the street sweeping vehicles, as well as to the maintenance vehicles mentioned above, its size and specifications are

obviously different from the others. It is not necessary to bring maker-uniformity with other vehicle and equipment, so it is necessary to choose a country which supplies as same as the construction machinery.

(7) Principles Regarding Construction Period

This Project will be implemented within a period of 11.5 months after E/N (exchange of Notes), namely approximately 2 months for detail design, approximately 1.5 months for contract procedure, approximately 6 months for manufacturing, and approximately 2 months for transporting and delivery.

2-3-2 Basic Design

(1) Designing of Vehicles and Equipment

1) Conditions for Designing

The type and quantity of the vehicles and equipment are to be determined based on the amount of the solid waste discharged in Target areas and in the Municipality of Damascus.

As the rate of the population growth in Target areas and in the Municipality of Damascus is 3.3% per year, and also the generation of the solid waste per capita will increase 1% annually, the amount of solid waste in the Target areas will be 576 ton/day in year as shown in Table 2-3-2.

Table 2-3-2 Levels of Solid Waste for Basic Design

	1995	1996	1997	1998	1999	2000
Whole Damascus						
Population Growth Rate 3.3% / Year	2,500,000	2,582,500	2,667,723	2,755,757	2,846,697	2,940,638
Per Capita Waste Produced (kg/person) Growth Rate 1% / Year	0.4	0.404	0.408	0.412	0.416	0.420
total Waste (tons) Growth Rate 1.043% / Year	1,000.0	1,043.3	1,088.5	1,135.7	1,184.9	1,236.3
Target Area						
Population Growth Rate 3.3% / Year	1,165,000	1,203,445	1,243,159	1,284,183	1,326,561	1,370,337
Per Capita Waste Produced (kg/person) Growth Rate 1% / Year	0.4	0.404	0.408	0.412	0.416	0.420
total Waste (tons) Growth Rate 1.043% / Year	466.0	486.0	507.3	529.2	552.2	576.1

2) Vehicles and Equipment for Collection and Transport

In order to set the basic specifications for the collection vehicles and equipment and then quantity, the following conditions must be incorporated considering the specifications of the existing vehicles and equipment of the Municipality of Damascus, and their quantity, as well as their working condition.

a) Collection of solid waste in Target areas shall be done mainly by small sized collection vehicles to reduce the workload of the severe manual operation, to meet difficulty of manpower recruitment, and to maintain continuous service.

b) To improve the solid waste collection ratio in Target areas to 100% of the amount of solid waste generated in these areas for the year 1997.

c) To replace appropriately existing outdated vehicles which have already passed the time of renewal, to reduce the present burden of the maintenance cost for the extraordinary repair jobs.

d) To reduce the maintenance cost by discarding the vehicles whose operable days per week are below 3 days when the new vehicles and equipment are procured under this Project in 1997.

e) To dispatch 2 small Dump trucks, in order to pick up extra-large solid waste.

f) To continue container collection by small size vehicles. There are some spaces to place 0.5 m^3 containers in the Target areas.

g) After the procurement of vehicles and equipment under the Project, the city of Damascus will be expected to replace existing vehicles in the target area, and to make plans to procure new vehicles to cover the shortage in the other areas of the city, through the efforts of the Municipality of Damascus.

With the above described principles, the arrangement of collection vehicles and equipment from year 1995 to the year 2000, corresponding to the amount of solid waste (see 2-3-2), is shown in Table 2-3-4. The basic specifications and quantity of the vehicles and equipment to be procured under this Project is shown in Table 2-3-3. The workable rates (operation rate) and the discarding plan of the existing vehicles and equipment are shown below in Table 2-3-5.

Table 2-3-3 Vehicles to be Procured

Type	Basic Specifications	Number
Garbage Compactor Truck	3 ton, 6 m^3	18
Garbage Compactor Truck	2 ton, 4 m^3	19
Tipper (Dump) Truck	3 ton, 6 m^3	20

Table2-3-4 Vehicles Distribution related to generated waste

For Whole Damascus

	Capacity (m^3)	Density (t/m^3)	Loading Efficiency	Load(t)	No. of Trip	Operation Efficiency	Load /day(t)	1995			1996			1997			1998			1999			2000		
								Unit	Operation Rate	Capacity(t)	Unit	Operation Rate	Capacity(t)	Unit	Operation Rate	Capacity(t)	Unit	Operation Rate	Capacity(t)	Unit	Operation Rate	Capacity(t)	Unit	Operation Rate	Capacity(t)
Old Big Compactor	16	0.5	0.9	7.2	1.5	0.857	9.26	79	0.47	343.7	79	0.41	299.8	34	0.7	220.3	29	0.64	171.8	29	0.54	144.9	16	0.5	74.0
New Big Compactor	16	0.5	0.9	7.2	2	0.857	12.34	10	0.98	120.9	10	1	123.4	10	1	123.4	10	1	123.4	10	1	123.4	10	1	123.4
Planned Big Compactor	16	0.5	0.9	7.2	2	0.857	12.34			0.0	8	1	98.7	8	1	98.7	8	1	98.7	8	1	98.7	8	1	98.7
Existing Middle Compactor	10	0.5	0.9	4.5	1.5	0.857	5.78	40	0.45	104.1	40	0.38	87.9	18	0.67	69.8	15	0.59	51.2	7	0.56	22.7	7	0.45	18.2
Existing Small Compactor	4	0.5	0.9	1.8	2	0.857	3.09	38	0.63	73.9	38	0.58	68.0	25	0.78	60.2	24	0.72	53.3	24	0.65	48.1	21	0.62	40.2
Existing Dump Truck	8	0.35	0.9	2.52	1	0.857	2.16	5	1	10.8	5	0.9	9.7	5	0.8	8.6	5	0.7	7.6	5	0.6	6.5	5	0.5	5.4
Existing hauled container Truck	4	0.35	0.9	1.26	4	0.857	4.32	3	1	13.0	3	0.9	11.7	3	0.8	10.4	3	0.7	9.1	3	0.6	7.8	3	0.5	6.5
Planned Compactor (3t)	6	0.5	0.9	2.7	3	0.857	6.94			0.0			0.0	18	1	125.0	18	1	125.0	18	1	125.0	18	1	125.0
Planned Compactor (2t)	4	0.5	0.9	1.8	4	0.857	6.17			0.0			0.0	19	1	117.2	19	1	117.2	19	1	117.2	19	1	117.2
Planned Dump Truck (3t)	6	0.35	0.9	1.89	4	0.857	6.48			0.0			0.0	20	1	129.6	20	1	129.6	20	1	129.6	20	1	129.6
Capacity of vehicles										666.3			699.2			963.1			886.8			823.9			738.2
Quantity for overtime work										200.7			200.7			125.4			248.9			361.0			498.0
Quantity of collected waste										867.0			899.9			1088.5			1135.7			1184.9			1236.3
Quantity of generated waste										1000.0			1043.3			1088.5			1135.7			1184.9			1236.3
Quantity of not collected waste										133.0			143.4			0.0			0.0			0.0			0.0

Table2-3-4 Vehicles Distribution related to generated waste

For Target Areas

	Capacity(m³)	Density (t/m³)	Loading Efficiency	Load(t)	No. of Trip	Operation Efficiency	Load /day(t)	1995 Unit	1995 Operation Rate	1995 Capacity(t)	1996 Unit	1996 Operation Rate	1996 Capacity(t)	1997 Unit	1997 Operation Rate	1997 Capacity(t)	1998 Unit	1998 Operation Rate	1998 Capacity(t)	1999 Unit	1999 Operation Rate	1999 Capacity(t)	2000 Unit	2000 Operation Rate	2000 Capacity(t)
Old Big Compactor	16	0.5	0.9	7.2	1.5	0.857	9.26	36	0.47	156.6	36	0.41	136.6	8	0.7	51.8	8	0.64	47.4	8	0.54	40.0	8	0.5	37.0
New Big Compactor	16	0.5	0.9	7.2	2	0.857	12.34	4	0.98	48.4	4	1	49.4	1	1	12.3	1	1	12.3	1	1	12.3	1	1	12.3
Planned Big Compactor	16	0.5	0.9	7.2	2	0.857	12.34			0.0	4	1	49.4	1	1	12.3	1	1	12.3	1	1	12.3	1	1	12.3
Existing Middle Compactor	10	0.5	0.9	4.5	1.5	0.857	5.78	18	0.45	46.9	18	0.38	39.6	8	0.67	31.0	6	0.59	20.5	3	0.56	9.7	3	0.45	7.8
Existing Small Compactor	4	0.5	0.9	1.8	2	0.857	3.09	18	0.63	35.0	18	0.58	32.2	11	0.78	26.5	11	0.72	24.4	11	0.65	22.1	9	0.62	17.2
Existing Dump Truck	8	0.35	0.9	2.52	1	0.857	2.16	2	1	4.3	2	0.9	3.9			0.0			0.0			0.0			0.0
Existing hauled container Truck	4	0.35	0.9	1.26	4	0.857	4.32			0.0			0.0			0.0			0.0			0.0			0.0
Planned Compactor (3t)	6	0.5	0.9	2.7	3	0.857	6.94			0.0			0.0	18	1	125.0	18	1	125.0	18	1	125.0	18	1	125.0
Planned Compactor (2t)	4	0.5	0.9	1.8	4	0.857	6.17			0.0			0.0	19	1	117.2	19	1	117.2	19	1	117.2	19	1	117.2
Planned Dump Truck (3t)	6	0.35	0.9	1.89	4	0.857	6.48			0.0			0.0	20	1	129.6	20	1	129.6	20	1	129.6	20	1	129.6
Capacity of vehicles										291.1			311.0			505.8			488.7			468.2			458.5
Quantity for overtime work										108.9			108.9			1.5			40.5			84.0			117.6
Quantity of collected waste										400.0			419.9			507.3			488.7			468.2			458.5
Quantity of generated waste										466.0			486.2			507.3			529.2			552.2			576.1
Quantity of not collected waste										66.0			66.3			0.0			0.0			0.0			0.0

For Damascus except Target Areas

	Capacity(m³)	Density (t/m³)	Loading Efficiency	Load(t)	No. of Trip	Operation Efficiency	Load /day(t)	1995 Unit	1995 Operation Rate	1995 Capacity(t)	1996 Unit	1996 Operation Rate	1996 Capacity(t)	1997 Unit	1997 Operation Rate	1997 Capacity(t)	1998 Unit	1998 Operation Rate	1998 Capacity(t)	1999 Unit	1999 Operation Rate	1999 Capacity(t)	2000 Unit	2000 Operation Rate	2000 Capacity(t)
Old Big Compactor	16	0.5	0.9	7.2	1.5	0.857	9.26	43	0.47	187.1	43	0.41	163.2	26	0.7	168.5	21	0.64	124.4	21	0.54	105.0	8	0.5	37.0
New Big Compactor	16	0.5	0.9	7.2	2	0.857	12.34	6	0.98	72.6	6	1	74.0	9	1	111.1	9	1	111.1	9	1	111.1	9	1	111.1
Planned Big Compactor	16	0.5	0.9	7.2	2	0.857	12.34	0	0	0.0	4	1	49.4	7	1	86.4	7	1	86.4	7	1	86.4	7	1	86.4
Existing Middle Compactor	10	0.5	0.9	4.5	1.5	0.857	5.78	22	0.45	57.3	22	0.38	48.4	10	0.67	38.8	9	0.59	30.7	4	0.56	13.0	4	0.45	10.4
Existing Small Compactor	4	0.5	0.9	1.8	2	0.857	3.09	20	0.63	38.9	20	0.58	35.8	14	0.78	33.7	13	0.72	28.9	13	0.65	26.1	12	0.62	23.0
Existing Dump Truck	8	0.35	0.9	2.52	1	0.857	2.16	3	1	6.5	3	0.9	5.8	5	0.8	8.6	5	0.7	7.6	5	0.6	6.5	5	0.5	5.4
Existing hauled container Truck	4	0.35	0.9	1.26	4	0.857	4.32	3	1	13.0	3	0.9	11.7	3	0.8	10.4	3	0.7	9.1	3	0.6	7.8	3	0.5	6.5
Planned Compactor (3t)	6	0.5	0.9	2.7	3	0.857	6.94	0	0	0.0	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	1	0.0
Planned Compactor (2t)	4	0.5	0.9	1.8	4	0.857	6.17	0	0	0.0	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	1	0.0
Planned Dump Truck (3t)	6	0.35	0.9	1.89	4	0.857	6.48	0	0	0.0	0	0	0.0	0	1	0.0	0	1	0.0	0	1	0.0	0	1	0.0
Capacity of vehicles										375.2			288.2			457.4			398.1			355.7			279.7
Quantity for overtime work										91.8			91.8			123.9			208.4			277.1			380.4
Quantity of collected waste										467.0			480.0			581.3			606.5			632.7			279.7
Quantity of generated waste										534.0			557.1			581.3			606.5			632.7			660.2
Quantity of not collected waste										67.0			77.1			0.0			0.0			0.0			0.0

Table2-3-5 Operation Rate of Existing Vehicles (1 / 6)

Vehicle	Year						Remark
	1995	1996	1997	1998	1999	2000	
Old Big Compactor							
559	42.8	32.8					
560	42.8	32.8					
561	28.5	18.5					
562	0.0	0.0					
563	0.0	0.0					
564	71.4	61.4	51.4				
565	100.0	90.0	80.0	70.0	60.0	50.0	
566	0.0	0.0					
567	100.0	90.0	80.0	70.0	60.0	50.0	
568	0.0	0.0					
569	0.0	0.0					
570	0.0	0.0					
571	0.0	0.0					
572	85.7	75.7	65.7	55.7	45.7		
573	0.0	0.0					
574	71.4	61.4	51.4				
575	0.0	0.0					
576	71.4	61.4	51.4				
577	0.0	0.0					
578	0.0	0.0					
579	57.1	47.1					
580	100.0	90.0	80.0	70.0	60.0	50.0	
581	71.4	61.4	51.4				
582	100.0	90.0	80.0	70.0	60.0	50.0	
583	0.0	0.0					
585	57.1	47.1					
586	42.8	32.8					
587	0.0	0.0					
588	42.8	32.8					
589	0.0	0.0					
590	71.4	61.4	51.4				
591	0.0	0.0					
592	100.0	90.0	80.0	70.0	60.0	50.0	
593	42.8	32.8					
596	0.0	0.0					
597	100.0	90.0	80.0	70.0	60.0	50.0	
599	0.0	0.0					
600	0.0	0.0					
601	100.0	90.0	80.0	70.0	60.0	50.0	
602	100.0	90.0	80.0	70.0	60.0	50.0	
603	57.1	47.1					
604	85.7	75.7	65.7	55.7	45.7		
605	100.0	90.0	80.0	70.0	60.0	50.0	
606	100.0	90.0	80.0	70.0	60.0	50.0	
607	100.0	90.0	80.0	70.0	60.0	50.0	
610	28.5	18.5					
611	85.7	75.7	65.7	55.7	45.7		

Note:Operation Rates are shown in %. No rate means discarding.

Table2-3-5 Operation Rate of Existing Vehicles (2 / 6)

Vehicle	Year						Remark
	1995	1996	1997	1998	1999	2000	
612	100.0	90.0	80.0	70.0	60.0	50.0	
613	0.0	0.0					
614	85.7	75.7	65.7	55.7	45.7		
615	85.7	75.7	65.7	55.7	45.7		
616	0.0	0.0					
617	85.7	75.7	65.7	55.7	45.7		
618	85.7	75.7	65.7	55.7	45.7		
621	100.0	90.0	80.0	70.0	60.0	50.0	
622	85.7	75.7	65.7	55.7	45.7		
623	57.1	47.1					
625	85.7	75.7	65.7	55.7	45.7		
626	85.7	75.7	65.7	55.7	45.7		
627	42.8	32.8					
628	0.0	0.0					
629	57.1	47.1					
630	0.0	0.0					
631	100.0	90.0	80.0	70.0	60.0	50.0	
632	100.0	90.0	80.0	70.0	60.0	50.0	
633	0.0	0.0					
634	0.0	0.0					
635	85.7	75.7	65.7	55.7	45.7		
636	85.7	75.7	65.7	55.7	45.7		
637	0.0	0.0					
639	0.0	0.0					
640	0.0	0.0					
641	0.0	0.0					
642	0.0	0.0					
643	42.8	32.8					
644	0.0	0.0					
645	28.5	18.5					
646	85.7	75.7	65.7	55.7	45.7		
647	100.0	90.0	80.0	70.0	60.0	50.0	
Total No. of Vehicle	79.0	79.0	34.0	29.0	29.0	16.0	
Avrage operation Rate	47.4	41.2	70.3	63.6	53.6	50.0	

Note:Operation Rates are shown in %. No rate means discarding.

Table2-3-5 Operation Rate of Existing Vehicles (3 / 6)

Vehicle	Year 1995	1996	1997	1998	1999	2000	Remark
New Big Compactor							
648	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
649	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
650	85. 7	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
651	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
652	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
653	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
654	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
655	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
656	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
649	100. 0	100. 0	100. 0	100. 0	100. 0	100. 0	from 1991
Planned Big Compactor		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
		100. 0	100. 0	100. 0	100. 0	100. 0	from 1996
Total No. of Vehicle	10. 0	18. 0	18. 0	18. 0	18. 0	18. 0	
Avrage operation Rate	98. 6	100. 0	100. 0	100. 0	100. 0	100. 0	

Note:Operation Rates are shown in %. No rate means discarding.

Table2-3-5 Operation Rate of Existing Vehicles (4 / 6)

Vehicle	Year						Remark
	1995	1996	1997	1998	1999	2000	
Middle Compactor							
232	0.0	0.0					
233	14.2	3.2					
234	0.0	0.0					
235	0.0	0.0					
236	0.0	0.0					
237	100.0	89.0	78.0	67.0	56.0	45.0	
238	85.7	74.7	63.7	52.7			
239	85.7	74.7	63.7	52.7			
240	85.7	74.7	63.7	52.7			
241	71.4	60.4	49.4				
242	14.2	3.2					
243	85.7	74.7	63.7	52.7			
244	28.5	17.5					
245	85.7	74.7	63.7	52.7			
246	42.8	31.8					
247	0.0	0.0					
248	0.0	0.0					
249	100.0	89.0	78.0	67.0	56.0	45.0	
250	71.4	60.4	49.4				
251	0.0	0.0					
252	100.0	89.0	78.0	67.0	56.0	45.0	
253	28.5	17.5					
254	0.0	0.0					
255	100.0	89.0	78.0	67.0	56.0	45.0	
256	100.0	89.0	78.0	67.0	56.0	45.0	
257	0.0	0.0					
258	28.5	17.5					
259	85.7	74.7	63.7	52.7			
260	0.0	0.0					
261	71.4	60.4	49.4				
262	14.2	3.2					
263	0.0	0.0					
264	0.0	0.0					
265	100.0	89.0	78.0	67.0	56.0	45.0	
266	14.2	3.2					
267	85.7	74.7	63.7	52.7			
268	0.0	0.0					
269	0.0	0.0					
270	85.7	74.7	63.7	52.7			
271	100.0	89.0	78.0	67.0	56.0	45.0	
Total No. of Vehicle	40.0	40.0	18.0	15.0	7.0	7.0	
Avrage operation Rate	44.6	37.5	66.9	59.4	56.0	45.0	

Note:Operation Rates are shown in %. No rate means discarding.

Table2-3-5 Operation Rate of Existing Vehicles (5 / 6)

Vehicle	Year						Remark
	1995	1996	1997	1998	1999	2000	
Small Compactor							
96	100.0	93.0	86.0	79.0	72.0	65.0	
169	0.0	0.0					
247	0.0	0.0					
272	100.0	93.0	86.0	79.0	72.0	65.0	
273	85.7	78.7	71.7	64.7	57.7	50.7	
275	100.0	93.0	86.0	79.0	72.0	65.0	
276	71.4	64.4	57.4	50.4	43.4		
277	100.0	93.0	86.0	79.0	72.0	65.0	
278	14.2	7.2					
279	85.7	78.7	71.7	64.7	57.7	50.7	
280	71.4	64.4	57.4	50.4	43.4		
281	85.7	78.7	71.7	64.7	57.7	50.7	
282	100.0	93.0	86.0	79.0	72.0	65.0	
283	100.0	93.0	86.0	79.0	72.0	65.0	
284	57.1	50.1	43.1				
285	100.0	93.0	86.0	79.0	72.0	65.0	
286	0.0	0.0					
287	100.0	93.0	86.0	79.0	72.0	65.0	
288	0.0	0.0					
289	0.0	0.0					
290	85.7	78.7	71.7	64.7	57.7	50.7	
291	100.0	93.0	86.0	79.0	72.0	65.0	
292	0.0	0.0					
293	100.0	93.0	86.0	79.0	72.0	65.0	
294	100.0	93.0	86.0	79.0	72.0	65.0	
295	100.0	93.0	86.0	79.0	72.0	65.0	
296	71.4	64.4	57.4	50.4	43.4		
297	100.0	93.0	86.0	79.0	72.0	65.0	
298	0.0	0.0					
299	100.0	93.0	86.0	79.0	72.0	65.0	
300	100.0	93.0	86.0	79.0	72.0	65.0	
8610	0.0	0.0					
8611	42.8	35.8					
8612	0.0	0.0					
8613	85.7	78.7	71.7	64.7	57.7	50.7	
8614	100.0	93.0	86.0	79.0	72.0	65.0	
8615	28.5	21.5					
8616	0.0	0.0					
Total No. of Vehicle	38.0	38.0	25.0	24.0	24.0	21.0	
Avrage operation Rate	62.8	57.6	78.0	72.4	65.4	61.6	

Note:Operation Rates are shown in %. No rate means discarding.

Table2-3-5 Operation Rate of Existing Vehicles (6 / 6)

Vehicle	Year						Remark
	1995	1996	1997	1998	1999	2000	
Other vehicles							
Dump Truck -1	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Dump Truck -2	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Dump Truck -3	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Dump Truck -4	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Dump Truck -5	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Hauled Container Vehicle -	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Hauled Container Vehicle -	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Hauled Container Vehicle -	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	
Total No. of Vehicle	8. 0	8. 0	8. 0	8. 0	8. 0	8. 0	
Avrage operation Rate	100. 0	90. 0	80. 0	70. 0	60. 0	50. 0	

Note:Operation Rates are shown in %. No rate means discarding.

3) Vehicles and Equipment for Street Sweeping

Street sweeping in Target areas is being done under severe conditions of manual labor.

The number of the street sweepers at present and up to the year 2000 is estimated to change, as shown in Table 2-3-6. If street sweeping by manual labor with 2,000 workers, with no overtime, every day continues from 1995 to the year 2000, the shortage in the number of workers is estimated to change, as shown in Table 2-3-7.

Table 2-3-7 Shortage of Workers (whole of Damascus)

	1995	1996	1997	1998	1999	2000
Necessary Work Force	2,000	2,000	2,000	2,000	2,000	2,000
Current Work Force	1,601	1,585	1,671	1,689	1,705	1,737
Shortage Work Force	399	415	329	311	295	263

Also, since the worker shortage in Target areas can be estimated based on the workers shortage in the whole city and the amount of solid waste to be collected, the shortage of street sweeper will be as shown in Table 2-3-8. In addition to that, a three shift system with overtime is presently used in order to cover the shortage of street sweepers.

Table 2-3-8 Shortage of Workers (in the Target Areas)

	1995	1996	1997	1998	1999	2000
Necessary Work Force	932	932	932	932	932	932
Current Work Force	746	738	778	787	794	809
Shortage Work Force	186	194	154	145	138	123

Table2-3-6 Workers Distribution related to Number of Vehicle

For Whole Damascus

	1995			1996			1997			1998			1999			2000		
	Unit	Operation Rate	No. of operated vehicle	Unit	Operation Rate	No. of operated vehicle	Unit	Operation Rate	No. of operated vehicle	Unit	Operation Rate	No. of operated vehicle	Unit	Operation Rate	No. of operated vehicle	Unit	Operation Rate	No. of operated vehicle
Old Big Compactor	79	0.47	37	79	0.41	32	34	0.7	24	29	0.64	19	29	0.54	16	16	0.5	8
New Big Compactor	10	0.98	10	10	1	10	10	1	10	10	1	10	10	1	10	10	1	10
Planned Big Compactor			0	8	1	8	8	1	8	8	1	8	8	1	8	8	1	8
Existing Middle Compactor	40	0.45	18	40	0.38	15	18	0.67	12	15	0.59	9	7	0.56	4	7	0.45	3
Existing Small Compactor	38	0.63	24	38	0.58	22	25	0.78	20	24	0.72	17	24	0.65	16	21	0.62	13
Existing Dump Truck	5	1	5	5	0.9	5	5	0.8	4	5	0.7	4	5	0.6	3	5	0.5	3
Existing hauled container Truck	3	1	3	3	0.9	3	3	0.8	2	3	0.7	2	3	0.6	2	3	0.5	2
Planned Compactor (3t)			0			0	18	1	18	18	1	18	18	1	18	18	1	18
Planned Compactor (2t)			0			0	19	1	19	19	1	19	19	1	19	19	1	19
Planned Dump Truck (3t)			0			0	20	1	20	20	1	20	20	1	20	20	1	20
No. of worker held by Department	1935			1935			1935			1935			1935			1935		
No. of assistant for Big and Middle Compacto	258			274			140			124			108			82		
No. of assistant for Small Compactor	76			76			124			122			122			116		
No. of available worker for road sweeping	1601			1585			1671			1689			1705			1737		

As the number of street sweepers is not sufficient if no overtime work is done, therefore mechanical sweepers shall be introduced to reduce manual sweeping. The basic specifications and the quantity of the vehicles and equipment for street sweeping to be procured is planned based on following considerations.

a) The workers will not be fired, and the work volume covered by overtime work due to a shortage of workers will be mechanized.

b) The roads to be swept mechanically are roads of 4 m or wider with fairly large pedestrian traffic in the Target area.

c) The shortage of the manual street sweepers is 123 persons in the year 2000 which is the smallest figure. It will be basic needs to be mechanized. Since it is estimated that one person working for eight hours sweeps both sides of a 0.5 km road. The length of a road to be mechanized in the areas will be 61.5 km (123 people × 0.5 km/person), and both sides of the road will be swept. (Sweeping length will be 123 km as the target for this mechanization.)

d) This Project will provide only for central area of the city (Old Damascus and part of El Kanawat/Elmidan, Elkadam) which has priority. Length of road in the area is 30 km (working length is 60 km).

e) Since street sweeping vehicles to be procured will be used in narrow streets, their measurements specifications must be same as those of 3 ton Compactor trucks, therefore the mechanical sweeper (Road sweeper) will have a capacity of $3m^3$, and the water tanker will have a capacity of 3,000 liters.

Following the above mentioned design principles and the design conditions, the vehicles and equipment described below in table 2-3-9

will be procured. Also, generally speaking, street sweeping is best done when utilizing a Road Sweeper in combination with a Water Tanker using pressurized water. In this Project by letting the Water Tanker drive ahead of the Road Sweeper, the working time of the Water Tanker is reduced, and the ratio of their operation times will be 1 : 0.5.

Table 2-3-9 Road Sweeping Vehicles to be Procured Under This Project

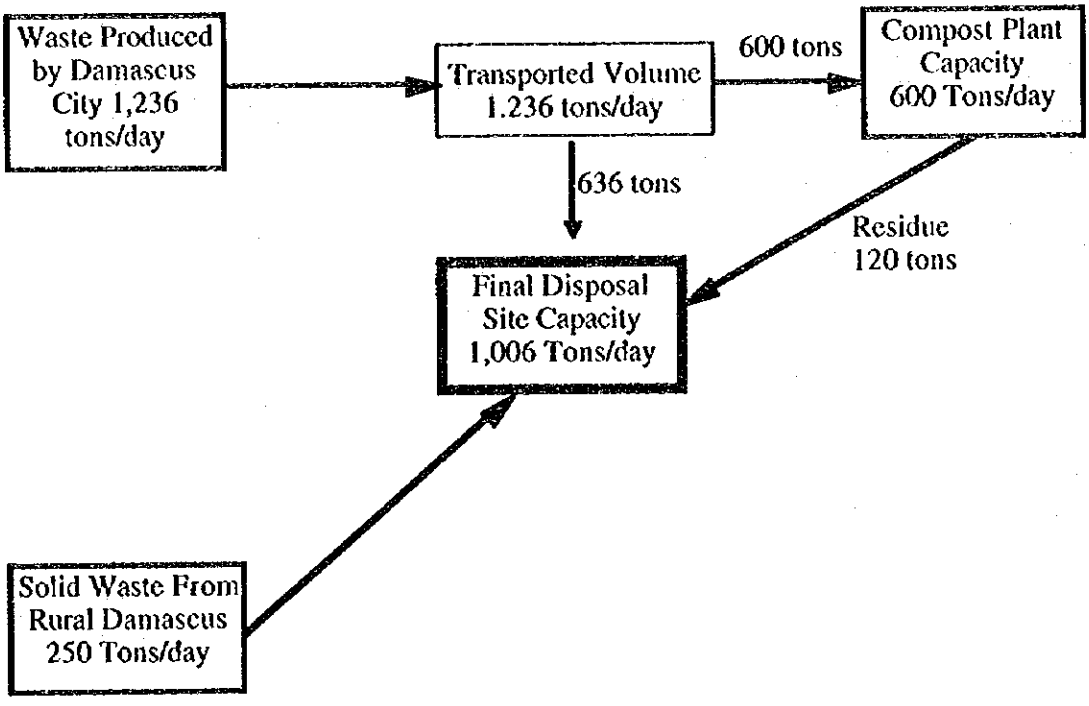
Type and Specification	No.	Effective Work Distance for 1 Unit	Hours of Operation for 1 Unit
Road Sweeper (3 m^3)	2	30 km	8.5 hours (30 km / 0.7 / 5 km/h)
Water Tank Truck (3,000 liters)	1	60 km	8.5 hours

4) Landfill Vehicles and Equipment

In the final disposal site of the Municipality of Damascus a portion of solid waste generated in the Damascus Rural Governorate and the residue discharged in the compost plant are also accepted. Therefore, these additional factors are taken into consideration, to determine the equipment for sanitary landfill to be procured for the year 2000 .

Also, it is estimated that since the working conditions of the compost plant is predicted to be improved up to 85% (600 tons/day), the acceptable amount of solid waste (treating amount) in the year 2000 will be as shown in Figure 2-3-1.

Figure 2-3-1 Amount of Treated Solid Waste in Final Disposal Site(s)
(Year 2,000)



The amount of 1,006 tons/day of solid waste, as shown in Figure 2-3-1, is the estimated amount when the final disposal site runs daily for 365 days a year. However, it is necessary to allow for one day per week as a holiday. Therefore, the designed quantity of solid waste must be 1,170 tons/day, which is the result of 1,006 tons divided by 0.857. The landfill equipment must, therefore, be designed according to the following conditions.

a) Sanitary landfill must be implemented, and a 0.5 m thick soil cover must be provided to every 2 m thick landfill of solid waste.

b) Only the equipment which is necessary for excavation of covering soil (35 % of soil to be excavated) will be provided. The remaining 65% will be excavated during constrictions of the Final Disposal site and is not included in this Project.

c) Since the soil consists conglomerate, sandstone, limestone and tuff, it is difficult to dig with only Excavator. Therefore, it is planned to introduce a Ripping breaker.

In order to dispose of 1,170 tons of solid waste per day, the following works, shown in the table below (Table 2-3-10), are necessary. These works are the conditions for designing the landfill equipment. The cross-section of landfill trench digging is shown in Figure 2-3-2.

Table 2-3-10 Landfill Equipment Design Requirements

Work	Volume	Note
Solid Waste to be disposed of	1,170 tons / day (1,670 m^3 / day)	
Covering Soil and Transportation of Covering Soil	543 m^3 / day	0.5m of covering soil for 2m of waste
Excavation	388 m^3 / day	543 / 1.4
Ripping work	248 m^3 / day	388 x 0.64

Based on the above mentioned design principles and the design conditions, the basic specifications and quantity needed for the landfill vehicles and equipment are as shown in Table 2-3-11. The calculation process for the quantity is shown on the following pages (Determination of the type and Number of Landfill Equipment).

Table 2-3-11 Landfill Equipment to be Procured

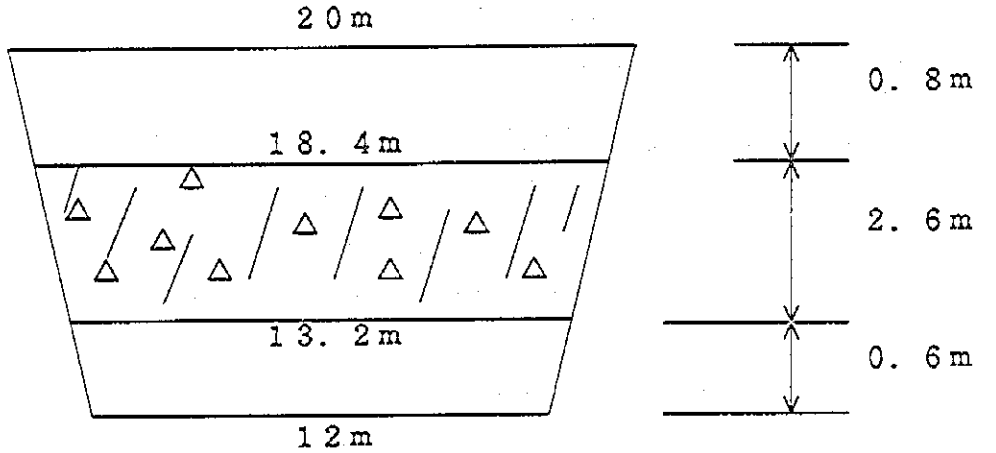
Type	Specification	No.	Hours of Operation for 1 Unit
Bulldozer 1	200 HP	1	pushing waste 6.0 h compressing dirt 3.0 h Total 9.0 h
Bulldozer 2	300 HP	1	pushing waste 4.0 h compressing dirt 1.5 h ripping 2.0 h Total 7.5 h
Hydraulic Excavator	0.7 m^3	1	excavation 8.0 h
Wheel Loader	1.5 m^3	1	loading 8.5 h
Tipper (dump) Truck	10 m^3	2	transporting 6.5 h as loading will take 8.5 h, 8.5 h of working time is required

Figure 2-3-2 Planned Section of Landfill Trench

Depth of Rocks layer at Final Disposal Site . according to Boring Test Result

Survey Point	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9	Average
min.depth	2	0	0	0	0	2.5	—	2.5	0	0.8
max.depth	4	4	3	4	4	4	—	3.5	4	3.4

Planned Section



Total Excavation quantity
= 64㎥/m

Excavation quantity for Rock
= 41㎥/m

note : The quantity of land fill will be the sum of the excavated portion, 64m^3/m and the piled-on portion 70m^3/m. Thus the capacity per unit area is 64+70 = 134m^3/m.

Determination of the Type and Number of Landfill Equipment

(based on processing 1170 tons/day in the year 2000)

1. Design Conditions (amount of work)

1) Volume of solid waste: 3,340 m^3/day

The volume of solid waste received at the final disposal site is 1,170 tons/day, and the specific gravity will be at 0.35 tons/m^3

1,170 tons/day ÷ 0.35t/m3 = 3340 m^3/day

2) Volume of solid waste after landfill compacting: 1670 m^3/day

The 3340 m^3/day of solid waste received is compacted by a ratio of 0.5:

3340 m^3/day × 0.5=1670 m^3/day

3) Volume of covering soil: 543 m^3/day

As 50 cm of covering soil will be required for 2m of solid waste, (ratio of thickness of soild waste to covering soil for spreading is 1 : 0.25)

1670 m^3/day × 0.25 ≅ 418 m^3/day

The ratio of compacting after spreading is taken to be 1.3 therefore,

418 m^3/day × 1.3 ≅ 543 m^3/day

4) Volume of covering soil to be excavated: 388 m^3/day

As 543 m^3/day of loose cover soil will be necessary, and the expansion ratio of the soil is taken to be 1.4, soil to be excavated is

543 m^3/day ÷ 1.4 ≈ 388 m^3/day

5) Volume of covering soil to be transported: 543 m^3/day

543 m^3/day (as in 3) above) must be loaded and transported.

6) Excavation by ripper-breaker: 248 m^3/day

The ground near the surface consists of conglomerate etc., boring data revealed that a ripper-breaker will be necessary for 64% of the excavations.

As the volume of soil required to be excavation is 388m^3/day, ripper -breaker excavation will be

388 m^3/day × 0.64 = 248 m^3/day

2. Determination of equipment capacity

The following calculations were conducted for each equipment.

1) Waste pushing rate for bulldozers (m^3/h)

$$Q = \frac{60 \times q \times f_1 \times E}{C_m}$$

where Q : volume pushed per hour

q : volume pushed per cycle
f_1 : soil volume ratio = 1/L
E : work efficiency
C_m : cycle time

i) q is calculated from blade width and height. A tractor with standard sized blade with trash rack was used for the calculation.

$q = 0.6 \times l \times h^2$

where

l : blade width (m)
h : blade height (m)

ii) L in f_1 = 1/L is the ratio of change of the excavated soil, and as the amount of excavated soil cannot be determined, L is taken to be 1.

iii) E, work efficiency is taken to be 0.7

iv) The cycle, C_m is calculated as follows:

$$C_m = \frac{l}{v_1} + \frac{l}{v_2} + t_g$$

where

C_m : cycle time (min)
l : average pushing distance (m)
v_1 : forward speed (m/min)
v_2 : reverse speed (m/min)
t_g : time required to change gears and accelerate (min)

and

l = 30m, v_1 = 50m/min (3 km/h)
v_2 = 50m/min, t_g = 0.3min.

2) Volume of soil pushed per hour by bulldozer (m^3/h)

The volume of soil pushed was calculated as above, however, using a blade without trash rack.

3) Volume of solid waste spread and covered (m^3/h)

The number of runs required to spread while pushing solid waste and soil are set as follows: for solid waste, 6 runs for every 30 cm, or 18 runs per 1 meter; and for soil, 12 runs per 50 cm.

The calculation is as follows.

$$Q = \frac{W \times C \times D \times f_1 \times E}{P}$$

where

Q : volume spread per hour (m^3/h)
W : effective pushing width
V : pushing speed
D : spreading thickness (m) = 1 or 0.5m
E : work efficiency = 0.7
f_1 : soil volume ratio = 1/L = 1
P : number of runs = 18 or 12

4) Volume excavated by the hydraulic excavator (m^3/h)

$$Q = \frac{3600 \times q \times K \times f_1 \times E}{C_s}$$

where

Q : volume excavated per hour (m^3/h)
q : capacity of the bucket or dipper (m^3)
K : kind of bucket or dipper
f_1 : soil volume ratio = 1/L
E : work efficiency
C_s : cycle time (sec)

i) considering the local soil quality, K = 0.85

ii) L in f=1/L will be set at 1.3

iii) work efficiency will be set at E=0.7

iv) C_s cycle time for the 0.7m3 excavator to make a 180° turn is 23 sec (medium work difficulty)

5) Volume loaded per hour by wheel loader (m^3/h)

$$Q = \frac{3600 \times q \times K \times f_1 \times E}{C_s}$$

where

Q : volume excavated per hour (m^3/h)
q : capacity of the bucket (m^3)
K : kind of bucket
f_1 : soil volume ratio = 1/L
E : work efficiency
C_s : cycle time (sec)

I) considering the local soil quality, K = 0.85

ii) L in f=1/L will be set at 1 as the soil has already been loosened

iii) work efficiency will be set at E=0.6 as loading is done while gathering soil

iv) C_s cycle time for the wheel loader is calculated as follows

$$C_s = ml + t_1 + t_2$$

where

l	=	one way distance to carry soil (average 8m)
m	=	coefficient of mobility
t_1	=	time to quickly raise soil (sec)
t_2	=	time for gear changes, positioning, dump truck movement (sec)

where

l = 8m, m = 0.9 sec/m, t_1 = 20sec, t_2 = 15 sec

6) Hourly capacity of the bulldozer (ripper) in excavation assistance

$$Q = \frac{60 \times A \times l \times f \times E}{C_m}$$

where

Q	:	volume of soil scraped per hour (m^3/h)
A	:	ripping cross section area (m^2)
l	:	work distance per cycle
f	:	soil volume ratio = 1
E	:	work efficiency
C_m	:	cycle time (sec)

i) A is the ripping cross sectional area per cycle and is set at A=0.3m^2 here

ii) As fixed rocks are in the work area, work efficiency is set at 0.5.

iii) Cycle time C_m is calculated by the following formula,

$$C_m = 0.05l + 0.00 \text{ (min)}$$

l ≈ distance moved in one work cycle

where l = 30m

7) Cycle time per dump truck (min/cycle)

$$C_{mt} = \frac{C_{ms} \times n}{60\, E_s} + T_1 + T_2 + t_1 + t_2$$

where

C_{mt} : dump truck cycle time
C_{ms} : cycle time for loading equipment
n : number of loading per loading equipment = 7 (10 $m^3 \div 1.5\ m^3$)
C : capacity of 1 dump truck (m^3) = 15 m^3
q : bucket capacity of loading equipment (m^3)
K : bucket coefficient = 0.85
E_s : work efficiency of loading equipment
T_1, T_2 : transport and return times for dump truck (min) = (2min)
t_1 : time for dumping (min) = 1.0 min
t_2 : waiting time, etc. (min) = 0.5 min
(4 to 6 minutes are added if sheets need to be covered)

Capacity of one bulldozer per hour for soil (m3/h)

Type	min.	blade.l	blade.h	0.6.l.h^2 q	fl=1/L	E	l	v1	v2	tg	l/v1+l/v2+tg Cm	fl.E)/Cm Q
150HP	60	3.2	1.1	2.3232	1	0.7	30	50	50	0.3	1.5	65.05
200HP	60	3.6	1.2	3.1104	1	0.7	30	50	50	0.3	1.5	87.09
300HP	60	4	1.5	5.4	1	0.7	30	50	50	0.3	1.5	151.2
400HP	60	4.3	1.8	8.3592	1	0.7	30	50	50	0.3	1.5	234.1

Capacity of one Excavator per hour for soil (m3/h)

Type	sec.	q	K	fl=1/L	E	Cs	(sec.q.K fl.E)/Cs Q
0.7m3	3600	0.7	0.85	0.76923	0.7	23	50.15

Capacity of one Wheel loader per hour for soil (m3/h)

Type	sec.	q	K	fl=1/L	E	l	m	t1	t2	ml+t1+t2 Cs	(sec.q.K.fl.E)/Cs Q
1m3	3600	1	0.85	1	0.6	8	0.9	20	15	42.2	43.51
1.5m3	3600	1.5	0.85	1	0.6	8	0.9	20	15	42.2	65.26
2m3	3600	2	0.85	1	0.6	8	0.9	20	15	42.2	87.01

Capacity of one bulldozer per hour for solid waste (m3/h)

Type	min.	blade.l	blade.h	0.6.l.h^2 q	fl=1/L	E	l	v1	v2	tg	l/v1+l/v2+tg Cm	(min.q.fl.E)/Cm Q
150HP	60	3.2	2.1	8.4672	1	0.7	30	50	50	0.3	1.5	237.1
200HP	60	3.6	2.2	10.4544	1	0.7	30	50	50	0.3	1.5	292.7
300HP	60	4	2.5	15	1	0.7	30	50	50	0.3	1.5	420
400HP	60	4.3	2.8	20.2272	1	0.7	30	50	50	0.3	1.5	566.4

Capacity of one Bulldozer per hour for soil compaction (m3/h)

Type	W	V	D	fl=1/L	E	P	(WVDlIE)/P Q
150HP	2.8	5000	0.5	1	0.7	12	408.3
200HP	3.3	5000	0.5	1	0.7	12	481.3
300HP	3.7	5000	0.5	1	0.7	12	539.6
400HP	4	5000	0.5	1	0.7	12	583.3

Capacity of one Bulldozer per hour for solid waste compaction (m3/h)

Type	W	V	D	fl=1/L	E	P	(WVDlIE)/P Q
150HP	2.8	5000	1	1	0.7	18	544.4
200HP	3.3	5000	1	1	0.7	18	641.7
300HP	3.7	5000	1	1	0.7	18	719.4
400HP	4	5000	1	1	0.7	18	777.8

Capacity of one Bulldozer per hour for ripping (m3/h)

Type	t	A	l	f	E	0.05l+0.33 Cm	(tAlfE)/Cm Q
150HP	60	0.3	30	1	0.5	1.83	147.5
200HP	60	0.3	30	1	0.5	1.83	147.5
300HP	60	0.3	30	1	0.5	1.83	147.5
400HP	60	0.3	30	1	0.5	1.83	147.5

Cycle of one Dump truck (min./trip)

Type	Cms	n	sec	Es	T1	T2	t1	t2	Cmt
10m3	42.2	7	60	0.6	2	2	1	0.5	13.71

3. Calculation of Vehicles and Equipment Quantity

By the results of 1. Design Conditions and of 2. Vehicles and Equipment Capability, the following calculation is made in regard to the quantity of vehicles and equipment needed.

Type	Specification	No.	Hours of Operation for 1 Unit
Bulldozer 1	200 HP	1	pushing waste 6.0 h compressing dirt 6.0 h Total 9.0 h
Bulldozer 2	300 HP	1	pushing waste 4.0 h compressing dirt 1.5 h ripping 2.0 h Total 7.5 h
Hydraulic Excavator	0.7 m^3	1	excavation 8.0 h
Wheel Loader	1.5 m^3	1	loading 8.5 h
Tipper (dump) Truck	10 m^3	2	transporting 6.5 h as loading will take 8.5 h, 8.5 h of working time is required

Basis for Daily Hours of Operation Calculations for Equipment

Daily Volume

Solid waste to be processes	3340 m^3
Soil covering	543 m^3
Excavation	388 m^3
Soil loading	543 m^3
Soil transport	543 m^3
Ripping	248 m^3

1. Solid waste processing (bulldozer 200HP × 2)

pushing 290m3/h•bulldozer × 2 bulldozers × 6.0 h = 3480 m^3 > 3440 m^3

layering 640m3/h•bulldozer × 2 bulldozers × 3.0 h = 3440 m^3 > 3440 m^3

(6 times for thickness of 30cm) **work time: 9.0h**

2. Covering with soil (bulldozer 300HP × 1)

pushing 150m3/h•bulldozer × 1 bulldozers × 4.0 h = 600 m^3 > 543 m^3

layering 530m3/h•bulldozer × 1 bulldozers × 1.5 h = 795 m^3 > 543 m^3

(6 times for thickness of 30 cm) **work time: 5.5h *1**

3. Excavation (hydraulic excavator 0.7 m^3 × 1)

excavating 50m3/h•excavator × 1 excavator × 8.0 h = 400 m^3 > 388 m^3

work time: 8.0h

4. Excavation and loading (wheel loader 1.5 m^3 × 1)

loading 65m3/h•loader × 1 loader × 8.5 h = 552 m^3 > 543 m^3

work time: 8.55 h

5. Soil transport (dump truck 10 m^3 × 2)

The cycle time of a dump truck is 13.7 min/truck, or 4.3 loads per hour. One dump truck has a capacity of 10 m^3/load × 4.3 loads/hour or 43 m^3/hour.

However, to carry 552 m^3/day of soil, one dump truck would have to work

43 m^3/h × 13h = 559 m^3 > 552 m^3

13 hours a day.

Therefore, two dump trucks will be procured and the work time will be

43 m^3/h•truck × 2 trucks × 6.5h = 559 m^3.

work time: 6.5 h

6) Ripper (300HP bulldozer 0.3m^2 single ripper × 1)

ripping 145 m^3/h•ripper × 1 ripper × 2h = 290 m^3 > 248 m^3

work time: 2.0h *2

note: Adding *1 and *2 the work time of the 300HP bulldozer will become **7.5h.**

7) The number of Excavators needed for excavation

The Planed landfill consists of the excavated portion and piled-on portion (up to 3.5m including coverting soil). Therefore, the amount of landfill per one meter of trench is 134 m^3 (64m^3 in the trench and 70m^3 of covering, see fig. 2-3-2). And as the ratio of soil to garbage is 1:4, there will be 27m^3 of soil and 107m^3 of garbage per 1m of trench.

As the volume of garbage needed to be landfilled is 1,670m^3/day,

1.670m^3/day ÷ 107m^2/day = 16m/day

Therefore 16m of trench must be excavated every day. The total volume to be excavated is

64m^2 × 16 m/day = 1,024m^3/day.

This volume of 1,024m^3/day is the combination of the volume which must be dug in advance (during construction) and the volume to be dug in daily. There fore it is necessary to procure equipment to excavate 388m^3 of soil per day (35% of the total

excavation volume). The excavation which will be done during construction of the final disposal site (65% of the total excavation volume) will not be included in the Project.

5) Maintenance Vehicles and Equipment

Designing of the vehicles and equipment for maintenance operation must be conducted according to the following principles.

a) For the purpose of stabilizing solid waste management service, mobile repair equipment to promptly repair the present outdated vehicles when they break down on the road will be procured.

b) Service work must be provided to the communication vehicles and equipment which are involved in maintaining the flow of steady communication; in patrolling between the collection areas, the landfill site and the workshop and in assisting the mobile repair vehicles to provide simple repair jobs on the road.

c) The procured spare parts under this Project will be managed appropriately.

In the light of to the above principles, the following conditions must be taken into consideration with regard to design.

a) Presently, break-down of the collection vehicles and equipment occurs 10 to 12 times per week.

b) The collection sites, the workshops, the compost plant, and the final disposal site(s) are located at a great distance from each other; in particular, the compost plant and the final disposal site(s) are approximately 35 km from the city center.

c) In regard to the spare parts in general, only those which are needed until the first overhaul must be procured. In regard to the vehicles and equipment, such as collection vehicles and equipment, those which will be needed until the 50,000 km service shall be procured. Also, in regard to the landfill vehicles and equipment such as construction equipment, etc., only the parts needed until 5,000 working hours shall be procured. However, in regard to the mobile repair vehicles and the communication vehicles, their spare parts shall not be procured.

Following the above mentioned design principles and the design conditions, the maintenance vehicles and equipment must be procured, as described below in Table 2-3-12.

Table 2-3-12 Maintenance Vehicles and Equipment to be Procured Under This Project

Type	Specification	No.	Note
Mobile workshop		1 unit	
Inspection and Communication Car	4WD pickup double cab	1 unit	
Spare Parts		1 set	for vehicles other than mobile workshop and pickup

(2) General Specifications of Vehicles and Equipment

The vehicles and equipment to be procured in this project are as follows.

Equipment	Specification	No.
Collection and transport Equipment		
Garbage Compactor Truck	3 ton	18
Garbage Compactor Truck	2 ton	19
Tipper (Dump) Truck	3 ton	20
Road Cleaning Equipment		
Road Sweeper	$3m^3$	2
Water Tank Truck	3,000 liter	1
Landfill Equipment		
Bulldozer	200 HP	1
Bulldozer	300 HP	1
Wheel Loader	$1.5m^3$	1
Hydraulic Excavator	$0.7m^3$	1
Tipper (Dump) Truck	15 ton	2
Maintenance Vehicles		
Mobile Workshop		1
Pickup Truck	4WD double cab	1
Spare parts		1 lot

The general specifications of the equipment to be procured in the project are in table 2-3-13, and typical drawings are in figures 2-3-3, 4, 5 and 6.

Table 2-3-13 Specifications of Equipment to be Procured

Item	Specification	Note
I. Collection and transport Equipment		
1. Garbage Compactor Truck (3 ton)	6m³body volume	
(1) Main Specifications		
Type of vehicle	Compactor truck with 6m³ body volume for garbage collection	
Steering wheel	Left hand drive, forward control type	Traffic in Syria is on the right side of the road
Traction	4x2 rear traction	
Max. payload	Approx. 2,500kg	
Gross vehicle weight	Approx. 7,000kg	
(2) Dimensions		
Overall length	Approx. 6,300mm	
Overall width	Approx. 2,100mm	
Overall height	Approx. 2,400mm	
Wheel base	Approx. 3,400mm	
Minimum turning radius	Approx. 6,300mm	
Tires	Approx. 7.50-16-10 PR	
(3) Engine		
Type	Water cooled 4 cycle diesel engine	
Output	Approx. 120 HP	
(4) Attachments		
Body volume	Approx. 6 m³	
Container lift	Capable to lift 0.5 m³ steel container	
Hopper volume	Approx. 0.6 m³	
2. Garbage Compactor Truck (2 ton)	4m³body volume	
(1) Main Specifications		
Type of vehicle	Compactor truck with 4m³ body volume for garbage collection	
Steering wheel	Left hand drive, forward control type	Traffic in Syria is on the right side of the road

Traction Max. payload Gross vehicle weight (2) Dimensions Overall length Overall width Overall height Wheel base Minimum turning radius Tires (3) Engine Type Output (4) Attachments Body volume Hopper volume	4x2 rear traction Approx. 1,800kg Approx. 5,500kg Approx. 5,600mm Approx. 2,000mm Approx. 2,300mm Approx. 2,500mm Approx. 5,000mm Approx. 7.00-16-10 PR Water cooled 4 cycle diesel engine Approx. 110 HP Approx. 4 m^3 Approx. 0.6 m^3	
3. Tipper (Dump) Truck (3 ton) (1) Main Specifications Type of vehicle Steering wheel Traction Max. payload Gross vehicle weight (2) Dimensions Overall length Overall width Overall height Wheel base Minimum turning radius Tires (3) Engine Type Output	6m^3 body volume Hydraulic tipper truck with 6m^3 body volume for garbage collection Left hand drive, forward control type 4x2 rear traction Approx. 3,000kg Approx. 7,000kg Approx. 5,700mm Approx. 2,100mm Approx. 2,400mm Approx. 3,400mm Approx. 6,300mm Approx. 7.50-16-10 PR Water cooled 4 cycle diesel engine Approx. 120 HP	Traffic in Syria is on the right side of the road

(4) Attachments Body capacity	Approx. 6 m^3	
II. Road Cleaning Equipment		
1. Road Sweeper	3 m^3 capacity	
(1) Main Specifications Type of vehicle Steering wheel Traction Max. payload Gross vehicle weight	 3 m^3 road sweeper Right hand drive, forward control type 4x2 rear traction Approx. 1,600kg Approx. 5,500kg	 To sweep the right side of the road
(2) Dimensions Overall length Overall width Overall height Wheel base Minimum turning radius Tires	 Approx. 4,800mm Approx. 2,000mm Approx. 2,500mm Approx. 2,500mm Approx. 5,000mm Approx. 7.00-16-10 PR	
(3) Engine Type Output	 Water cooled 4 cycle diesel engine Approx. 110 HP	
(4) Attachments Hopper capacity Sweeping width Auxiliary engine Sweeping hood Water tank	Approx. 3 m^3 Approx. 2,000 mm Approx. 40 HP Approx. 1,500 mm wide Approx. 450 liters	hydraulic lifting and control type pump spray nozzle attached
2. Water Tank Truck (3000 liter)	3,000 liter capacity	
(1) Main Specifications Type of vehicle Steering wheel Traction Max. payload	 3,000 liter capacity water tank truck Left hand drive, forward control type 4x2 rear traction Approx. 3,000kg	 Traffic in Syria is on the right side of the road

Gross vehicle weight	Approx. 6,500kg	
(2) Dimensions		
Overall length	Approx. 6,300mm	
Overall width	Approx. 2,000mm	
Overall height	Approx. 2,200mm	
Wheel base	Approx. 3,300mm	
Minimum turning radius	Approx. 6,000mm	
Tires	Approx. 7.50-16-10 PR	
(3) Engine		
Type	Water cooled 4 cycle diesel engine	
Output	Approx. 120 HP	
(4) Attachments		
Body volume	Approx. 3,000 liters	Elliptical shaped tank constructed with steel plate by electric welding
Spray	Rear spray bar	

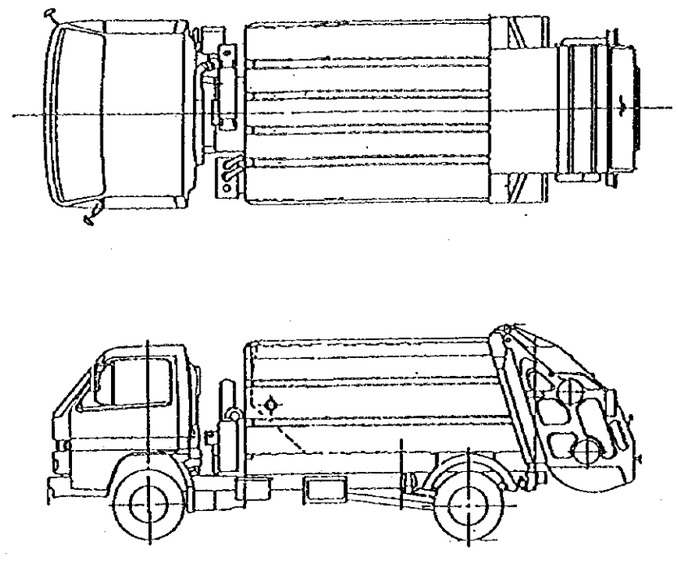
III. Landfill Equipment		
1. Bulldozer (200HP)	Approx. 200HP bulldozer	
(1) Main Specifications		
Overall length	Approx. 5,300mm	
Overall width	Approx. 2,600mm	
Overall height	Approx. 3,500mm	
Ground clearance	Approx. 350 mm	
(2) Bulldozer Blade	Straight tilt with trash rack	
(3) Weight	Approx. 20,000 kg	
(4) Engine		
Type	Water cooled 4 cycle diesel engine	
Output	Approx. 200 HP	
(5) Track		
Type	Sealed and lubricated track	
Width of shoe	Approx. 550 mm	
(6) Attachments		
Cab	ROPS canopy and steel cab with air conditioner	
Radiator guard		
Engine enclosure		
2. Bulldozer (300HP)	Approx. 300HP bulldozer	
(1) Main Specifications		
Overall length	Approx. 6,700mm	
Overall width	Approx. 2,600mm	
Overall height	Approx. 3,500mm	
Ground clearance	Approx. 500 mm	
(2) Bulldozer Blade	Straight tilt with trash rack	
(3) Weight	Approx. 30,000 kg	
(4) Engine		
Type	Water cooled 4 cycle diesel engine	
Output	Approx. 300 HP	
(5) Track		
Type	Sealed and lubricated track	

Width of shoe	Approx. 550 mm	
(6) Attachments Cab Radiator guard Engine enclosure Single ripper	ROPS canopy and steel cab with air conditioner	
3. Wheel Loader	1.5 m^3 wheel loader	
(1) Main Specifications Overall length Overall width Overall height Minimum turning radius Ground clearance	 Approx. 6,500mm Approx. 2,400mm Approx. 3,200mm Approx. 5,000mm Approx. 300mm	
(2) Bucket	1.5 m^3	
(3) Weight	Approx. 7,500 kg	
(4) Engine Type Output Max. travel speed	 Water cooled 4 cycle diesel engine Approx. 120 HP Approx. 30 km/h	
(5) Tires	Approx. 17-24-10PR	
(6) Attachments Cab	 Steel cab with air conditioner	
4. Hydraulic Excavator	0.7 m^3 excavator	
(1) Dimensions Shipping length Shipping width Shipping height Ground clearance Max. digging depth Max. reach at ground level Max. cutting height Max. loading height	 Approx. 9,300mm Approx. 2,800mm Approx. 2,900mm Approx. 400mm Approx. 6,500mm Approx. 9,500mm Approx. 9,400mm Approx. 6,500mm	
(2) Bucket	Bolt-on teeth backhoe type	

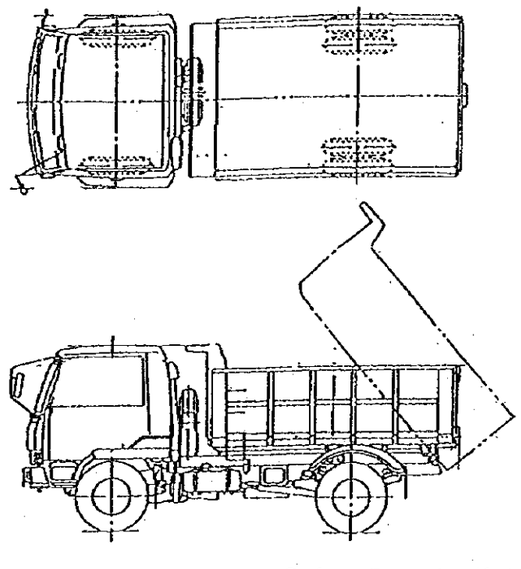
	excavation bucket 0.7 m^3	
(3) Weight	Approx. 20,000kg	
(4) Engine		
Type	Water cooled 4 cycle diesel engine	
Output	Approx. 130 HP	
(5) Track		
Type	Sealed and lubricated track	
Width of shoe	Approx. 600 mm	
(6) Attachments		
Cab	Steel cab with air conditioner	
5. Tipper (Dump) Truck (15 ton)	10m^3 body volume	
(1) Main Specifications		
Type of vehicle	Hydraulic tipper truck with 10m^3 body volume for transporting landfill soil	
Steering wheel	Left hand drive, forward control type	Traffic in Syria is on the right side of the road
Traction	6x4 rear traction	
Max. payload	Approx. 15,000kg	
Gross vehicle weight	Approx. 25,000kg	
(2) Dimensions		
Overall length	Approx. 7,500mm	
Overall width	Approx. 2,500mm	
Overall height	Approx. 3,200mm	
Wheel base	Approx. 4,500mm	
Minimum turning radius	Approx. 6,900mm	
Tires	Approx. 11.00-20-14 PR	
(3) Engine		
Type	Water cooled 4 cycle diesel engine	
Output	Approx. 300 HP	
(4) Attachments		
Body capacity	Approx. 10 m^3	
IV. Maintenance Vehicles		

1. Mobile Workshop		
(1) Main Specifications		
Type of vehicle	Mobile repair workshop van	
Steering wheel	Left hand drive, forward control type	Traffic in Syria is on the right side of the road
Traction	4x2 rear traction	
Gross vehicle weight	Approx. 9,000kg	
(2) Dimensions		
Overall length	Approx. 7,000mm	
Overall width	Approx. 2,100mm	
Overall height	Approx. 3,400mm	
Wheel base	Approx. 3,700mm	
Minimum turning radius	Approx. 6,500mm	
Tires	Approx. 9.00-20-14 PR	
(3) Engine		
Type	Water cooled 4 cycle diesel engine	
Output	Approx. 170 HP	
(4) Body Specifications		
Body length	Approx. 4,700 mm	
Body width	Approx. 2,200 mm	
Body height	Approx. 2,100 mm	
(5) Jib crane	Approx. 500 kg manual chain block fixed on floor	
(6) Main equipment		
Diesel engine driven generator welder set		
Air compressor		
Bench electric grinder		
Silicon quick charger with normal charger		
Electric drill	10 ton	
Hydraulic bench press		
Portable hydraulic jack		
Fire extinguisher		
Oxygen cylinder		
Acetylene cylinder		
Gas welder set		
Tool box		

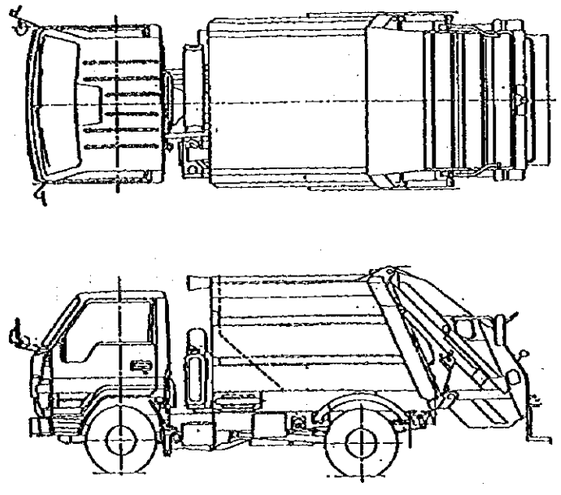
2. Pickup truck		
(1) Main Specifications		
Type of vehicle	Double cab 4WD pickup truck	
Steering wheel	Left hand drive, forward control type	Traffic in Syria is on the right side of the road
Traction	4x4 rear traction	
Gross vehicle weight	Approx. 2,500kg	
(2) Dimensions		
Overall length	Approx. 4,700mm	
Overall width	Approx. 1,700mm	
Overall height	Approx. 1,700mm	
Wheel base	Approx. 2,800mm	
(3) Engine		
Type	Water cooled 4 cycle gasoline engine	
Output	Not less than 100 HP	Displacement: not less than approx. 2,000 cc
(4) Others		
Seats	min. 5 seats	
Air conditioner		



Garbage Compactor Truck (3ton)



Garbage Dump Truck (3ton)

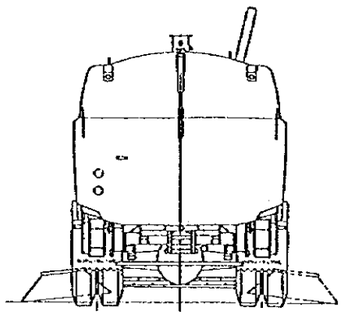


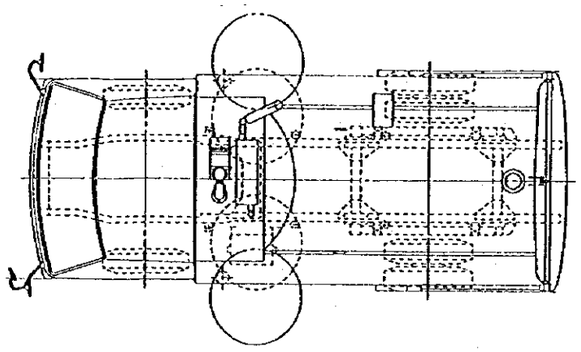
Garbage Compactor Truck (2ton)

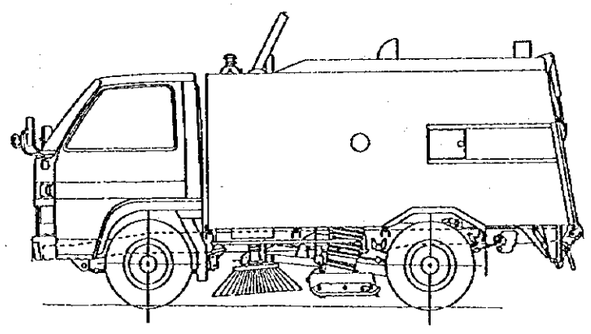
THE MUNICIPALITY OF DAMASCUS

Figure 2-3-3 Typical Drawings of Collection Vehicles	SCALE: —
	DRAWING NO.: DM-01

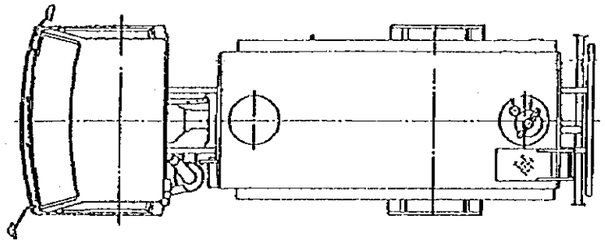
YACHIYO ENGINEERING CO. LTD.

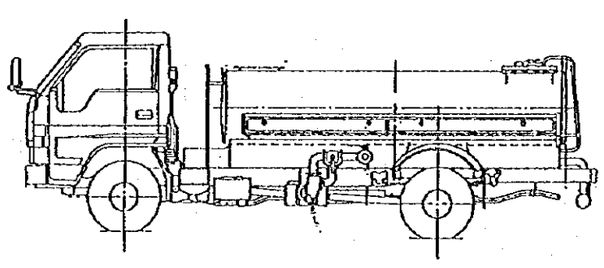




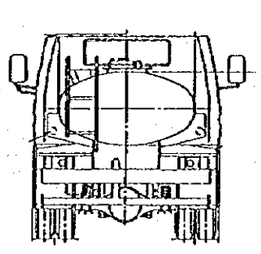


Road Sweeper ($3m^3$)

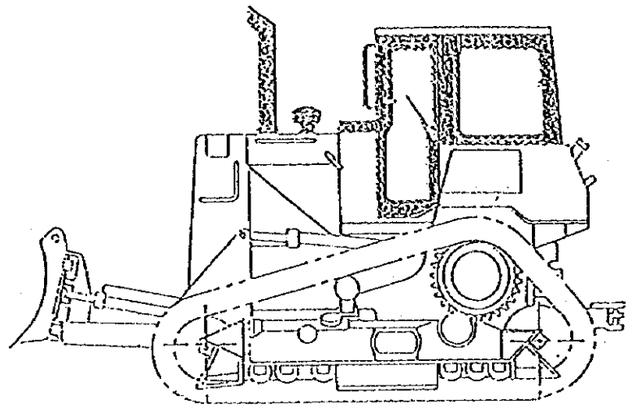




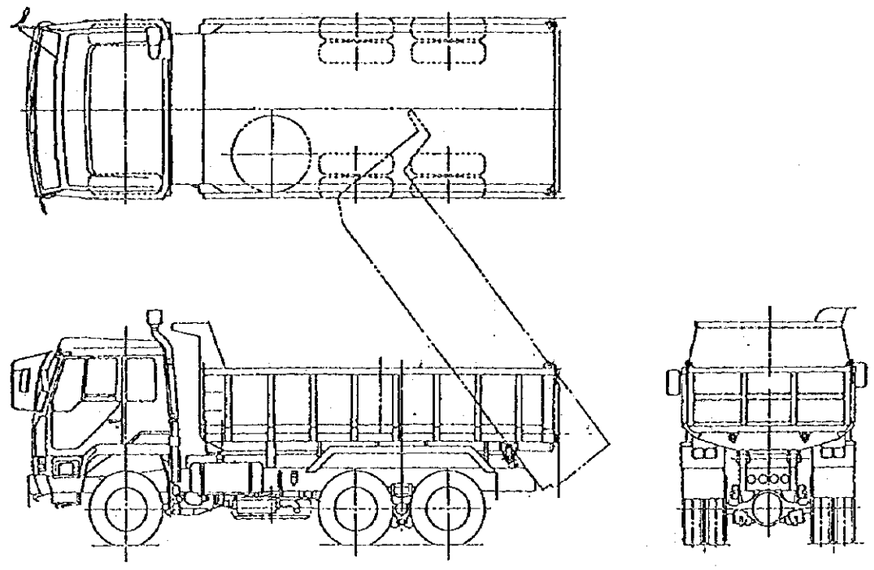
Water Tanker (3,000lit.)



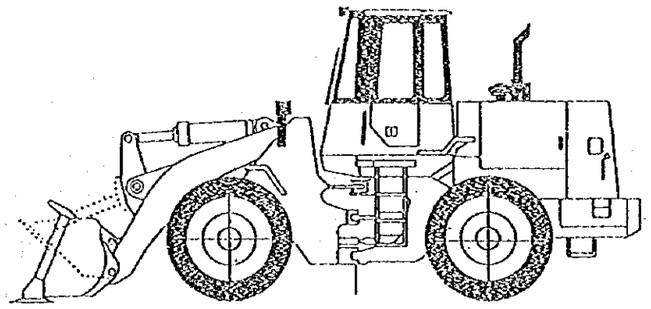
THE MUNICIPALITY OF DAMASCUS	
Figure 2-3-4 Typical Drawings of Road Sweeping Equipment	SCALE – DRAWING NO. DM-02
YACHIYO ENGINEERING CO. LTD.	



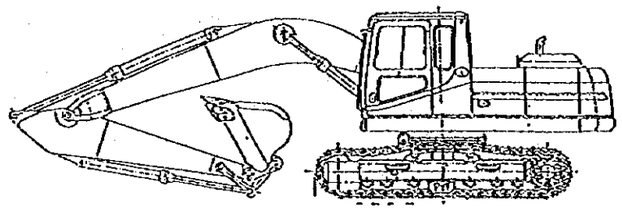
Bulldozer (200HP, 300HP)



Dump Truck (15ton)



Wheel Loader ($1.5m^3$)



Back Hoe ($0.7m^3$)

THE MUNICIPALITY OF DAMASCUS

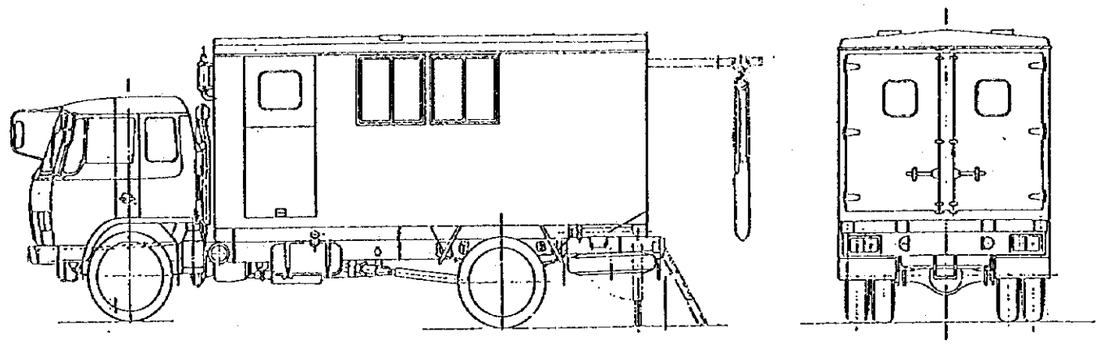
Figure 2-3-5

Typical Drawings of Landfill Equipment

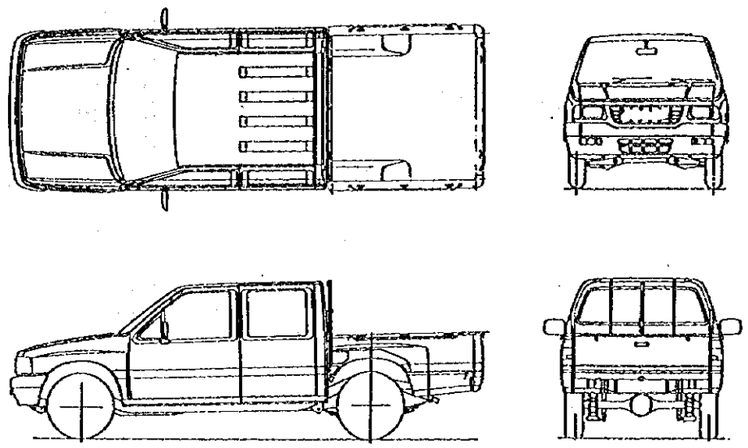
SCALE: —

DRAWING NO.: DM-03

YACHIYO ENGINEERING CO. LTD.



Mobile Workshop



Pick Up

THE MUNICIPALITY OF DAMASCUS	
Figure 2-3-6 Typical Drawings of Maintenance Equipment	SCALE — DRAWING NO. DM-04
YACHIYO ENGINEERING CO. LTD.	

CHAPTER 3
IMPLEMENTATION PLAN

CHAPTER 3 IMPLEMENTATION PLAN

3-1 Implementation Plan

3-1-1 Implementation Concept

This Project will be implemented within the framework of Japan's Grant Aid System, and will formally commence with the Exchange of the Notes (E/N) between both governments upon approval of the Project by the Government of Japan. The Government of Syria will then select the Consultant (a Japanese firm) to conduct the detail design work for the vehicles and equipment. With the completion of the detail design documents, the Contractor (a Japanese firm) which is the successful bidder, will conduct the assigned work and supply the vehicles and equipment. The basic principles and points to note to the implementation of the Project are explained below.

(1) Project Implemention Body

The body responsible for the implementation of the Project on the Syrian side will be the Department of Cleanliness, the Department of Solid Waste Compost Plant and Final Disposal Site, and the Department of Vehicles and Workshops in the Municipality of Damascus. It will be necessary for the Government of Syria to appoint a key person responsible for the implementation of the Project in order to maintain close communication and consultation with the Japanese Consultant and the Contractor to ensure the Project's successful progress.

This key person must insure that all the parties concerned of this Project fully understand the contents of this Project by explaining and answering their questions, and provide all possible assistance for the smooth progress of the Project.

(2) Consultant

The consultant (a Japanese firm) selected by the Government of Syria, will enter into a design and work supervision agreement with the Government of Syria to proceed to the equipment procurement stage of the Project. The consultant will prepare the detail design for the equipment to be procured under Japan's grant aid and will then supervise the procurement process. The Consultant will also prepare the tender documents and will conduct the tender process on behalf of the Government of Syria.

(3) Contractor

The Contractor, a Japanese firm, selected by open tender according to with the set procedure of Japan's Grant Aid System, will procure and supply the equipment. As the vehicles and heavy equipment will require the supply of spare parts and the provision of after-service in the case of breakdown following the completion of the Project, the Contractor should pay close attention to the need to establish communication links between the recipient side and the Contractor after the delivery of the equipment.

(4) Necessity to Dispatch Japanese Engineers

Since the Municipality of Damascus has no experience with sanitary landfill, it is necessary, to make guidance of the operation on sanitary landfill at the delivery of the equipment. It would seem that approximately two weeks would be sufficient for this guidance. The existing maintenance work mainly consists of repair work, because of the frequent breakdown of the many outdated vehicles, and preventive maintenance has not been carried out, it would, therefore, be desirable that the engineers from the manufacturing company provide some guidance and instructions, on the method of periodic checking and preventive maintenance at the delivery of equipment.

3-1-2 Implementation Conditions

(1) Conditions of the Procurement

1) Since the vehicles and equipment except containers are not produced in Syria, it is necessary that they be supplied by Japan or by a third country.

2) Transportation contractors in Syria seem to have sufficient experience and capability of inland transportation of the vehicles and equipment to be procured under this Project.

3) In regard to the procurement of vehicles , it is desirable to procure them from the same manufacturer to simplify the maintenance work, as much as possible.

(2) Points to Note on Laws

Vehicles manufactured according to the standards in Japan or in European and North American countries appear to fit to the traffic regulations in Syria.

Since Syria prohibits the import of materials from Israel, it is not possible to use any products made in Israel.

3-1-3 Scope of Works

The division of work between the Japanese side and the Syrian side is shown in Table 3-1-1.

Since containers which are suitable for Compactor Trucks (3 t) procured in this Project, are supplied in Syria, and the city of Damascus has an experience in this area, this item shall be arranged by the Syrian side.

Table 3-1-1 Scope of Work for Japanese and Syrian Side

Scope of Work	Japanese Side	Syrian Side
1. Procurement of garbage collection equipment (1) Procurement of vehicles (2) Procurement of containers	○	○
2. Procurement of street sweepers	○	
3. Procurement of landfill vehicles and equipment	○	
4. Procurement of maintenance equipment	○	
5. Transport	Ocean transportation	Inland transportation in syria

3-1-4 Consultant Supervision

In accordance with Japan's Grant Aid system, the Consultant will organize a project team to conduct the detail design and work supervision, taking all the basic design principals into consideration. At the work supervision stage, the Consultant will dispatch engineers to Syria when such dispatch is deemed necessary in light of the Project's progress to supervise the work and to witness the inspection. The Consultant will also dispatch an sanitary landfill engineer to Syria for a guidance of sanitary landfill method and operation

(1) Basic Principles Regarding Work Supervision

The Consultant will adopt the following principals to fulfill his responsibility to supervise and guide the Contractor in view of the punctual and safe completion of the Project-related work within the planned period. The scope of work for the Consultant is shown in Table 3-1-2

Table 3-1-2 Scope of Work for Japanese Consultant under the Project

1.	Pre-procurement stage	Detail Design Study Preparation of Tender Documents Execution of Tender on Behalf of Project Implementation Body Evaluation of Tenders Assistance for Contract
2.	Procurement stage	Work Supervision Inspection and Instruction Preparation of Reports

1) Schedule Control

a) The Consultant shall ensure that the Contractor always checks the progress of manufacture and delivery of the equipment against the original plan to ascertain the state of work progress

b) The Consultant shall control each work item on a monthly basis so that the Contractor adheres to the contracted work schedule.

2) Quality Control

a) The Consultant shall confirm that the specifications and quality of the equipment and materials meet those specified in the detailed design documents.

b) The Consultant shall witness the quality inspection and various performance tests in connection with the equipment to be procured at the completion of manufacturing work..

(2) Work Supervision System

The system to supervise the actual work of procurement process and the involvement of the related organizations are shown in Figure 3-1-1.

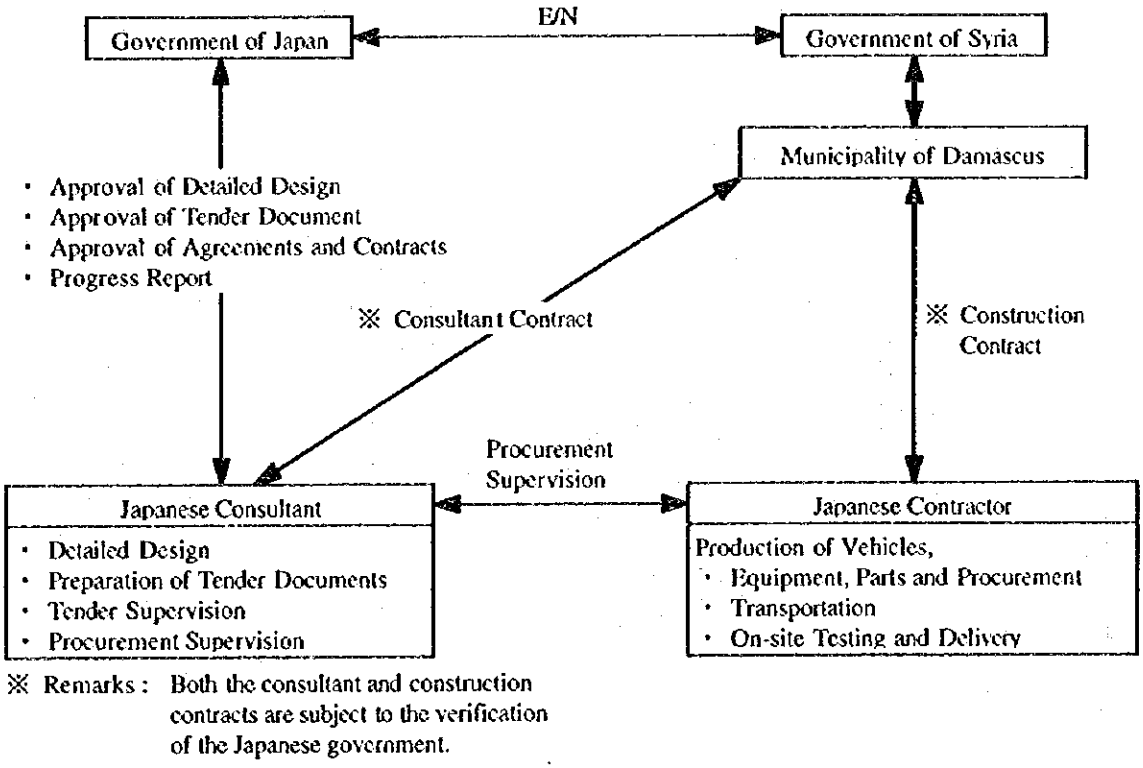


Figure 3-1-1 Project Implementation and Work Supervision System

3-1-5 Procurement Plan

The supply sources of the vehicles and equipment to be procured under this Project, have been decided as shown in Table 3-1-3 taking into consideration all the required standards, specifications, quality, production volume, stable supply prospect, delivery time and prices. Regarding to the spare parts of each equipment, their supply source will be same as the source of each vehicle and equipment.

Table 3-1-3 Material and Equipment Supply Sources

Vehicles and Equipment	Source Country		
	Syria	Japan	Third Country
Compactor Trucks (2 t)		○	
Compactor Trucks (3 t)		○	
Dump Truck (3 t)		○	
Road Sweepers (3 m3)		○	
Water Tanks (3,000 liters)		○	
Mobile Workshop		○	
Pick Ups		○	
Bulldozers (300HP)			○
Bulldozers (200HP)			○
Wheel Loaders (1.5 m3)			○
Excavator (0.7 m3)			○
Dump Trucks (15 t)			○

3-1-6 Implementation Schedule

In case that the Project is extended to the implementation stage with grant aid provided by the Government of Japan, the actual procurement will be conducted in three stages following the signing of E/N, i.e., (1) preparation of detail design documents; (2) tender process and signing of the contract, and (3) actual procurement.

(1) Detail Design

As soon as the E/N has been signed, the Japanese Consultant will conclude a consultant agreement with Syria side and will commence the detailed design work. Based on the Basic Design Study findings and the Detail Design Study findings, the tender documents (specifications and detail design drawings) will be prepared. At the beginning and end of the detail design stage, the Consultant will have thorough discussions with Syrian side and will then proceed to the tender process upon approval of the documents by both governments.

The detail design work is estimated to take 2 months.

(2) Tender and Contract

The Consultant will announce the tender, hold a tender explanation and distribute the tender documents to the prospective bidders on behalf of the Government of Syria. Upon receipt of the bid prices and application documents, the Consultant will promptly examine them to facilitate the contract between the Government of the Syria and a Japanese contractor. The tender will be witnessed by all applicants and representatives of related organizations. If the contents of the bid with the lowest price are assessed as being appropriate, the bid will be accepted and the bidder will conclude a contract with the Government of Syria.

The time required from tender announcement to signing of the procurement contract is expected to be 1.5 months.

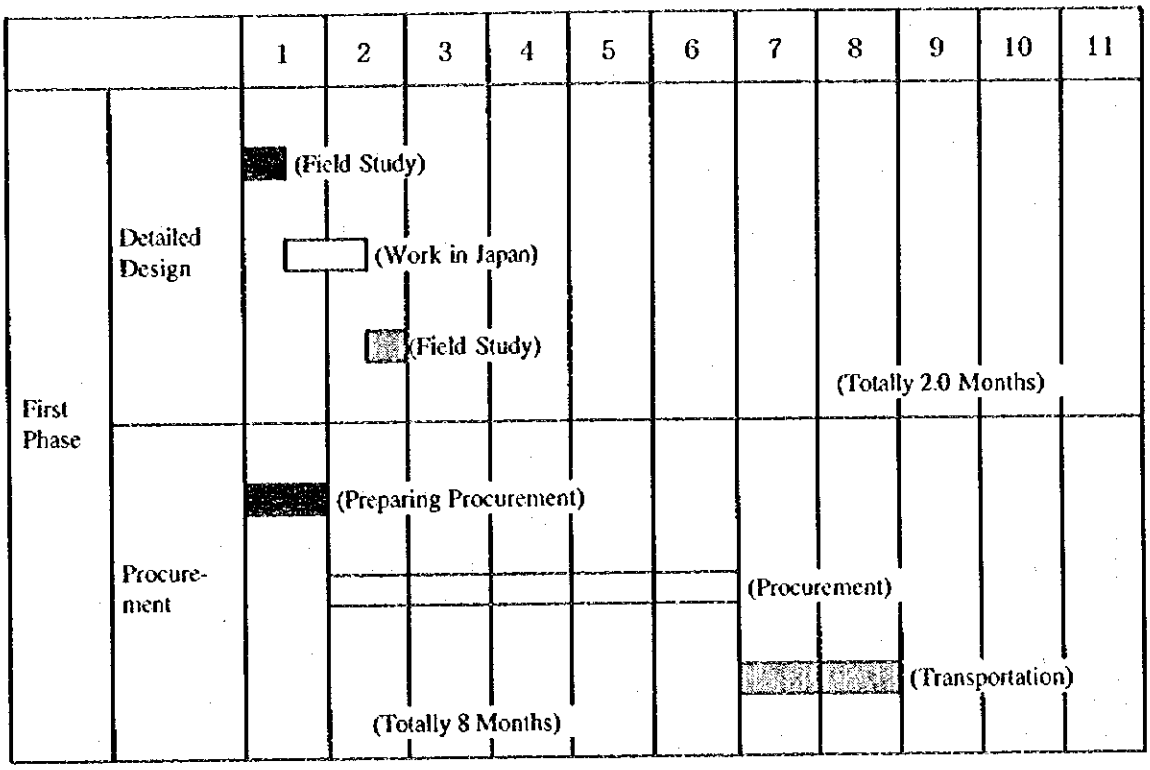
(3) Procurement of Equipment

Following the signing of the procurement contract, the Contractor will commence the procurement work upon receipt of verification from the Government of Japan. It is predicted that, considering of the size of this Project, this phase will require 8 months, if the procurement of the vehicles and equipment is smoothly carried out, and if works being responsible in Syrian side are accomplished on schedule.

The Consultant will conduct detailed arrangements prior to the commencement of the procurement work, and supervise the Contractor in regard to the manufacturing, transportation of equipment and work schedule, etc. The Consultant will also enforce schedule control, as well as quality control, in order to completes the entire work within the period stipulated in the E/N.

The Project implementation schedule is shown in Table 3-1-4.

Table 3-1-4 Project Implementation Schedule



3-1-7 Obligation of Recipient Country

The necessary measures to be taken by the Government of Syria are as follows.

1) To provide necessary data and information for this Project.
2) To ensure speedy unloading, customs clearance of the goods for this Project at the port and/or airport of disembarkation.
3) To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract(s), such facilities as may be necessary for their entry into the Syrian Arab Republic and stay therein for the performance of their work.
4) To meet the charge of customs duties, internal taxes and other fiscal levies which may be imposed in the Syrian Arab Republic with respect to the supply of the products and services under the verified contracts.
5) To bear commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Agreement.
6) To bear all the expenses, other than those to be borne by the Grant Aid necessary for the execution of this Project.
7) To assign exclusive counterpart engineers and technicians to this Project in order to transfer the operation and maintenance techniques for the Project.
8) To maintain and manage appropriately and effectively the vehicles and equipment procured under this Project by the Japan's Grant Aid.
9) To procure containers suitable to the Compactor Trucks (3 t), which are to be procured under this Project.
10) To transport in their country the vehicles and equipment to be procured under this Project.

3-2 Operation and Maintenance Plan

(1) Basic Principles

Since the existing collection vehicles of the Municipality of Damascus are more than 12 years old and are outdated, and the periodical maintenance work is only changing oil. Major maintenance work is repair of breakdown when the drivers inform and bring vehicles to the workshop for repair.

Therefore, preventative maintenance system is not introduced as practiced in Japan. Regular inspection and maintenance are legally required such as annual inspection

The purpose of regular inspection is not only to always maintain the vehicles in good condition, but also to prevent breakdown detecting signs of breakdown in the early stages to minimize damage. Therefore preventive maintenance system shall be introduced and practiced. At the time of vehicle and equipment delivered, the Manual on Inspection and Repair, and guidance on the preventative maintenance system shall be provided.

(2) Maintenance Operations

Guideline of vehicle maintenance in Japan is published by Ministry of Transportation and it describes contents according to the Outline of Legal inspection and maintenance work to be done in regular intervals of one month, three months, and one year. In this Project, it is recommended to follow to this guideline, however, there is a difference in the operation conditions of each equipment, periodic inspection shall be done based on running distance instead of working hour.

The contents of works required to maintaining vehicles and equipment to be procured under this Project is shown in below.

1) Vehicle

Necessary Maintenance Operations

No	Item	Mileage	Maintenance Operations
1	Minor Maintenance	Approx. every 3,000 km	Besides oil changes and lubrication, inspect and maintain the power-line system, oil-pressure device, electrical devices and wheels. Preventive inspection and maintenance is one of the most important operations.
2	Medium Maintenance	Approx. every 12,000 km	Although the occurrence of defacement, deformation, cracking and damaging of parts may differ depending on the type of work the vehicles are doing, a medium maintenance must be given every 12,000 km; that is, to adjust, repair or change parts of the engine, power transmitting systems, general parts of the wheels, and oil-pressure systems. These maintenance operations need to be done in repair workshops, because of the tools they require. Also, maintenance of oil-pressure mechanisms and painting of the body must be done simultaneously, when necessary.
3	Major Maintenance	Approx. every 36,000 km	This operation is the same as the Medium Maintenance, and provides particular attention to the maintenance of the linings of brakes, the clutch, the wheels, and especially the springs.

2) Construction Machinery

Construction machinery will be inspected at every 50 hours, 250 hours, as well as daily (approximately every 8 hours by hour-meter) inspection.

(3) Spare Parts Preparation Plan

1) Spare parts of the vehicles and equipment to be procured must be replaced according to the accumulated mileage. Spare parts shall be prepared both for preventative maintenance and spare parts needed for repair in case of unusual breakdown.

It is necessary to stock all of required items and quantity based on the schedule of the periodic maintenance plan.

2) In this Project, spare parts must be supplied for the first 50,000 km of driven distance for the collection and road sweeping vehicles and for the first 5,000 hours of operation of construction equipment.

Spare parts which will be needed further must be provided by the Syrian side. It is estimated that, the cost of these parts will be 5% of the vehicle cost annually.

3) Among the vehicles and equipment to be procured, the Compactor Trucks and the Dump Trucks (3 ton), will be operated mainly on steeply road and/or on narrow streets. Therefore, it is necessary to stock more parts related to the engines, the clutches, and the brakes considering working condition in the Target areas.

Since the engines of the Compactor Trucks will be used as the power source of compacting mechanism. The spare parts for the engines of

compactor trucks need to prepare considering this conditions. The requirement will be twice of the actual mileage

CHAPTER 4
PROJECT EVALUATION AND RECOMMENDATION

4. PROJECT EVALUATION AND RECOMMENDATIONS

4-1 Project Effects

Damascus, the capital of Syria, generates an average of 1,000 tons/day of solid waste, of which 870 tons are collected and dumped at the final disposal site. Most of the collection vehicles currently in use were procured in either 1980 or 1983 and their deterioration is underlined by the operation rate which is as low as 53%. As the Target areas for improved solid waste collection under the Project are Old Damascus characterised by many narrow streets, and the city's hillside and suburban areas where random development was made, large collection vehicles, the mainstay of the present fleet, find access difficult. The solid waste left outside each house to a nearby container in the area are collected and transported either manually or by donkey. The difficulty of implementing efficient collection work involving machinery has led to the piling up of uncollected solid waste at scattered empty sites, causing a great deterioration of the living environment. At the existing final disposal site, a shortage of equipment has made the adoption of sanitary landfill impossible and the simply dumped solid waste causes bad odour and a fire risk due to spontaneous combustion.

In view of the solid waste collection situation in Damascus described above, the Project intends the provision of new collection vehicles for solid waste collection and new equipment for road sweeping to improve the collection rate from the present 87% to 100% and to ensure a good living environment in the Target Areas (population of some 1,150,000, i.e. approximately 45% of the population of Damascus) Improvement of the collection work which currently involves much manual work in the Target Area will reduce such heavy manual work. The introduction of sanitary landfill at the final disposal site will prevent the scattering of solid waste, bad odour and fires, etc., thus improve the environment around the disposal site.

The introduction of new trucks under the Project will enable the phased renewal of the existing old vehicles and will reduce the maintenance cost which has been a burden on the municipal finance. The reduction of cost will allow the Authority to create a reserve for the phased renewal of old equipment on a self-help basis. The procurement of new maintenance equipment will enable the more efficient repair and maintenance of vehicles and equipment, including the existing old vehicles and equipment, and a more effective and reliable solid waste collection service.

As described earlier, the operation and maintenance of the vehicles/equipment to be procured under the Project will be conducted by the Department of Cleanliness, the Department of Solid Waste Compost Plant and Final Disposal Site and the Department of Vehicles and Workshops of the Municipality of Damascus. In regard to the personal requirement for new collection vehicles and road sweeping equipment will be filled without additional manpower. Due to the expected reduction of the current maintenance cost, maintenance cost of the new vehicles, will be ensured. The new recruitment of 6 operators necessary to operate the equipment at the disposal site can be made by transfer of available staff of the Department of Vehicles and workshops without causing any financial problems. The maintenance cost of the landfill equipment could be also covered by the above-mentioned reduction of the current maintenance cost.

Environmental issues to be examined in relation to the Project are the possible adverse impacts of the final disposal site on the surrounding area. However no private houses are located in the vicinity of the final disposal site and the introduction of sanitary landfilling will prevent fires, bad odour and harmful insects, which are currently developed in the disposal site. The Project is expected to improve the environment around the disposal site. In the case of the existing transfer station, an increase of the solid waste handling volume could lead to increased environmental impacts. But the provision of the new transfer station will minimise the adverse impacts.

All the above arguments suggest that the Project can be implemented without difficulty and without significant adverse effects once a decision is made by the Government of Japan to provide grant aid for the Project. The direct beneficiaries of the Project will be the 1.15 million people living in the Target Area in terms of solid waste collection and road cleansing and the 2.5 million citizens of Damascus in terms of final disposal. It is no exaggeration to assume that the entire city of Damascus will indirectly benefit from the Project in terms of improved hygiene and a healthy environment resulting from the solid waste collection, road cleansing and final disposal services.

4-2 Recommendations

The magnitude of the positive effects and strong contribution to the BHN of the citizens of Damascus by the Project confirm the appropriateness of providing Japanese grant aid for the Project. The Syrian side appears to have adequate ability to manage the Project. The further improvement or development of the following points will ensure the smooth and effective implementation of the Project.

(1) At present, the compost plant is operating at some 50% of its design capacity (700 tons/day). The more efficient use of this plant should be achieved by solving the problems relating to power supply and the inclusion of bulky waste in the compost materials.

(2) The increased solid waste collection made possible by the Project and expected increase of the solid waste in the future will make the handling capacity of the existing transfer station inadequate. It will, therefore, be necessary to complete the new transfer station as soon as possible. In developing the new transfer station, the adoption of a two-phase plan may be appropriate, the first phase is the construction of the transfer station and the second phase is the construction of a solid waste sorting facility. The implementation of the first phase, construction of the transfer station, should be urgently conducted.

(3) The deterioration of the present vehicles will certainly have progressed by the Project's target year of 2000. It is essential for the Minicipality of Damascus to proceed the renewal of the ageing fleet on a self-help basis. As funding should be available from the savings of the maintenance cost, which will be reduced by the Project, the Damascus Municipal Authority should ensure the pooling of such savings to creat a source of funding for new trucks.

(4) Because an ageing fleet is used for the solid waste collection service in Damascus, vehicle maintenance is primarily dominated by repair work and the practice of preventive maintenance is not hardly implemented. It is, therefore, necessary to establish a preventive maintenance system which incorporates regular checks, etc.

APPENDICES

APPENDIX 1.
Member List of the Survey Team

Members of the Basic Design Study Team

Name	Assignment	Current Position/Company
Yoshiaki NISHIKAWA	Leader	Deputy Director, First Basic Design Study Division, Grant Aid Study & Design Department, JICA
Shokichi SAKATA	Coordinator	First Basic Design Study Division, Grant Aid Study & Design Department, JICA
Shinsuke TAKEUCHI	Technical Councilor	Assistant Manager, Waste Management Affairs Department, Environmental Bureau, Kitakyushu City
Hiroshi ABE	Chief Consultant/ Maintenance & Operation Planner	Yachiyo Engineering Co., Ltd.
Katsuo OKAWARA	Collection & Transportation Planner	Yachiyo Engineering Co., Ltd.
Katsumi FUJII	Reclamation Planner	Yachiyo Engineering Co., Ltd.

Members of the Explanation Team for the Draft Basic Design

Name	Assignment	Current Position/Company
Shokichi SAKATA	Leader	First Basic Design Study Division, Grant Aid Study & Design Department, JICA
Shinsuke TAKEUCHI	Technical Councilor	Assistant Manager, Waste Management Affairs Department, Environmental Bureau, Kitakyushu City
Hiroshi ABE	Chief Consultant/ Maintenance & Operation Planner	Yachiyo Engineering Co., Ltd.
Katsuo OKAWARA	Collection & Transportation Planner	Yachiyo Engineering Co., Ltd.

APPENDIX 2.
Survey Schedule

1. Basic Design Study Team

No	Date	Day	Weather	Stay	Movement	Contents of Work
1	Nov 5	Sun	Fine	Paris	Tokyo 12:15 to Paris 16:55 (JL405)	Depart Japan (2 govt. members: Sakata, Takeuchi; 3 consultants: Abe, Okawara, Fujii)
2	Nov 6	Mon	Fine	Damascus	Paris 14:00 to Damascus 19:20 (AF8172)	Study Team arrives in Damascus
3	Nov 7	Tue	Fine	Damascus		• Courtesy call and meeting with Japanese Embassy and JICA Syria Office • Courtesy call and explanation of outline and goal of survey to S.P.C. (State Planning Commission) and Damascus Department of Cleanliness
4	Nov 8	Wed	Cloud	Damascus		• Courtesy call to Damascus Department of Cleanliness • Explanation of Inception Report and questionnaire
5	Nov 9	Thu	Cloud / Rain	Damascus	(Nishikawa) Tokyo to Rome	• Visit to the Final Disposal Site and Compost Plant and confirmation of conditions • Confirmation of conditions in the target area for collection improvement
6	Nov 10	Fri	Cloud	Damascus	(Nishikawa) Rome to Damascus	• Confirmation of conditions in the target area for collection improvement
7	Nov 11	Sat	Fine	Damascus		• Preparation of Minutes of Discussion (M/D) (Draft) • Confirmation of conditions in the target areas for collection improvement and collection sites
8	Nov 12	Sun	Fine	Damascus		• Discussion of M/D (Draft) • Confirmation of conditions in the target area for collection improvement and new
9	Nov 13	Mon	Fine	Damascus		• Signing of M/D • Reporting to S.P.C.
10	Nov 14	Tue	Fine	Damascus		• Report to Embassy of Japan and JICA Syria Office • Site survey
11	Nov 15	Wed	Fine	Damascus		• Organization of data • Site survey • Preparation for source unit and time and motion survey
12	Nov 16	Thu	Fine	Damascus	(Nishikawa) Damascus to Rome	• Site survey • Preparation for source unit and time and motion survey
13	Nov 17	Fri.	Fine	Damascus	(Nishikawa) Departs Rome	• Organization of data

No	Date	Day	Weather	Stay	Movement	Contents of Work
14	Nov 18	Sat	Fine	Damascus	(Nishikawa) Arrives Tokyo (Takeuchi) Damascus to Rome	• Preparation for source unit and time and motion survey • Survey of market prices
15	Nov 19	Sun	Fine	Damascus	(Takeuchi) Departs Rome	• Preparation for source unit and time and motion survey • Survey of market prices
16	Nov 20	Mon	Fine	Damascus	(Takeuchi) Arrives Tokyo	• Preparation for source unit and time and motion survey • Survey of market prices
17	Nov 21	Tue	Fine	Damascus	(Sakata) Departs Damascus	• Source unit survey • Survey of market prices • Preparation for time and motion survey
18	Nov 22	Wed	Fine	Damascus		• Source unit survey • Time and motion survey • Survey of market prices • Preparation for waste volume survey
19	Nov 23	Thu	Rain / Cloud	Damascus		• Source unit survey • Time and motion survey • Survey of market prices • Waste volume survey
20	Nov 24	Fri	Fine	Damascus		• Source unit survey • Time and motion survey • Survey of market prices • Waste volume survey
21	Nov 25	Sat	Fine	Damascus		• Source unit survey • Time and motion survey • Survey of market prices
22	Nov 26	Sun	Fine	Damascus		• Source unit survey • Time and motion survey • Survey of market prices • Preparation of field report
23	Nov 27	Mon	Fine	Damascus		• Source unit survey • Survey of market prices • Preparation of field report
24	Nov 28	Tue	Fine	Damascus		• Survey of market prices • Preparation of field report
25	Nov 29	Wed	Fine	Damascus		• Preparation of field report

No	Date	Day	Weather	Stay	Movement	Contents of Work
26	Nov 30	Thu	Fine	Damascus		• Report to Japanese Embassy and JICA Syria Office
27	Dec. 1	Fri.	Fine	Damascus		• Organization of data
28	Dec. 2	Sat.	Fine	Damascus		• Courtesy visit and report to concerned ministries on the Syrian side • Organization of data
29	Dec. 3	Sun	Fine	in Plane	Damascus 1:40 to Paris 5:50 (AF8173) Depart Paris 19:25 (JL406)	• Study team (Abe, Okawara, Fujii) depart Damascus
30	Dec. 4	Mon	Fine	Home	Arrive Tokyo 15:15	• Study team (Abe, Okawara, Fujii) arrive in Tokyo

2. Basic Design Explanation Team

No	Date	Day	Weather	Stay	Movement	Contents of Work
1	Jan. 16	Tue	Cloud	Frankfurt	Lv. Tokyo 14:00 (JL407) Ar. Frankfurt 18:15	DF/R Explanation Team (govt. members: Sakata, Takeuchi; consultants: Abe, Okawara) leaves Tokyo
2	Jan. 17	Wed	Cloud	Damascus	Lv. Frankfurt 11:20 (LH668) Ar. Damascus 19:00	Explanation Team arrives in Damascus
3	Jan. 18	Thur	Cloud	Damascus		Meeting with Japanese Embassy and JICA Syria Office Courtesy call and explanation of outline of Basic Design to S.P.C. (State Planning Commission) and Damascus Department of Cleanliness
4	Jan. 19	Fri	Cloud	Damascus		Team meeting
5	Jan. 20	Sat	Cloud	Damascus		Explanation of DF/R to the Department of Cleanliness Survey of final disposal site and compost plant
6	Jan. 21	Sun	Cloud	Damascus	Damascus to Damascus	Explanation of DF/R to the Department of Cleanliness and discussion of M/D (draft) Explanation of M/D (draft) to S.P.C.
7	Jan. 22	Mon	Cloud	Damascus		Explanation of M/D (draft) to the Department of Cleanliness
8	Jan. 23	Tue	Cloud	Damascus		Signing of M/D
9	Jan. 24	Wed	Cloud	Damascus		Reporting the results of explanation and discussions on DF/R to Japanese Embassy Reporting the results of explanation and discussions on DF/R to JICA Syria office
10	Jan. 25	Thur	Cloud	Frankfurt	Lv. Damascus 7:25 (LH669) Ar. Frankfurt 11:05	Explanation Team leaves Damascus
11	Jan. 26	Fri	Cloud	In flight	Lv. Frankfurt 20:50 (JL408)	
12	Jan. 27	Sat	Cloud	Home	Ar. Tokyo 16:05	DF/R Explanation Team (govt. members: Takeuchi; consultants: Abe, Okawara) arrive in Tokyo