No.

Ministry of Local Government, Rural Development and Cooperatives
The People's Republic of Bangladesh

OUTLINE DESIGN STUDY
ON
THE PROGRAMME FOR
IMPROVEMENT OF SOLID WASTE MANAGEMENT
IN DHAKA CITY
TOWARD THE LOW CARBON SOCIETY
IN THE PEOPLE'S REPUBLIC OF BANGLADESH

FINAL REPORT

February 2009

Japan International Cooperation Agency (JICA)

Yachiyo Engineering Co., Ltd.

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PREFACE

In response to a request from the Government of Bangladesh, the Government of Japan decided to conduct an outline design study on the Programme for the Improvement of Solid Waste Management in Dhaka City toward the Low Carbon Society in the People's Republic of Bangladesh and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bangladesh study team from August 2008 to January 2009.

The team held discussions with the officials concerned of the Government of Bangladesh, 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 Bangladesh in order to discuss a draft outline 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 Bangladesh for their close cooperation extended to the teams.

February, 2009

Masafumi Kuroki
Vice-President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

February, 2009

We are pleased to submit to you the outline design study report on the Programme for the Improvement of Solid Waste Management in Dhaka City toward the Low Carbon Society in the People's Republic of Bangradesh.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from August, 2008 to January, 2009. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bangladesh 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,

Naoyuki Minami

Chief Consultant,
Outline Design Study Team
on the Programme for the Improvement of
Solid Waste Management in Dhaka City
toward the Low Carbon Society
in the People's Republic of Bangradesh

Yachiyo Engineering Co., Ltd.

SUMMARY

(1) Overview of the Country

Bangladesh is located in South Asia between north latitude 20°21″~26°38″and east longitude 88°01″~92°41″; it shares borders with India to the west and the north and with Myanmar to the southeast, while the southern side of the country faces onto the Bay of Bengal. The national land area is 144,000 km2 (1.8 times the size of Hokkaido) and the population is 144.4 million (according to the World Bank 2006). The national land of Bangladesh consists of the world's largest delta formed by the three great rivers of the Ganges, Brahmaputra and Megna, and alluvial plains with elevation of no more than 9 m comprise 80% of the country.

(2) Background of the Requested Project and Outline of Development

In Dhaka, due to the rapid increase of the population and economic development, the management of burgeoning quantities of solid waste is a considerable social problem. Dhaka City Corporation (DCC) is in charge of solid waste management, however, in order to realize appropriate solid waste management, there are problems such as weak implementation system, lack of planning, lack of equipment, and the low sanitation awareness among the citizens. Consequently, JICA implemented the development study, and established the Master Plan of Solid Waste Management of Dhaka City in 2005. After the establishment of the Master Plan, it was deemed necessary to support DCC officials in their efforts to gain the capacity and techniques to solve each problem in order to establish the solid waste management system in the City through the phased implementation of the Master Plan. Hence, JICA has been implementing the Programme for strengthening capacities for solid waste management in Dhaka City since February 2007.

In the current activities, capacity building for collection and transportation as part of the solid waste management of DCC is an important issue in order to improve the living environment of the citizens. Many collection trucks currently owned by Dhaka City have become too old to work and it is predicted that many trucks will no longer be in use around the years 2010 and 2011. Dhaka City is aware of the necessity of strengthening solid waste management and has therefore raised funds for the management and control of the necessary costs of solid waste management through collection of cleaning taxes from the citizens. However, since it still has little prospect of raising the funds required to purchase the replacement and incremental collection equipment according to the Master Plan, the Government of Bangladesh issued a request to the Government of Japan for the provision of General Project Grant Aid.

On the other hand, among the support for measures to counter climate change, the scheme of Programme Grant Aid for Environment and Climate Change was introduced in fiscal 2008 as a new grant aid scheme. Programme Grant Aid for Environment and Climate Change aims to support measures for the reduction of greenhouse gases (relief measures) and measures for responding to climate change problems (adaptation measures). The Ministry of Foreign Affairs adopted this project in June 2008 for implementation under this scheme. The Project for solid waste collection trucks, which was requested under General Project Grant Aid, is now being promoted with partial modification as a project for the conversion of solid waste management to a low carbon system geared to reducing greenhouse gases.

(3) Outline of the Study Findings and Contents of the Project

In response to the request, the Government of Japan decided to implement an Outline Design Study on the Programme for Improvement of Solid Waste Management in Dhaka City toward the Low Carbon Society in the People's Republic of Bangladesh, and consigned implementation of this to JICA. The Outline Design Study Team was dispatched to Bangladesh from August to December 2008, during which time it held discussions with officials in the Bangladeshi government and implemented field surveys. Following its return to Japan, the Study Team continued its work, later returned to Bangladesh to explain and discuss the Draft Summary of the Outline Design Study, and compiled the results of this into the report in hand.

The Project aims to strengthen the waste collection and transportation capacity of DCC, and to reduce emissions of greenhouse gases in waste collection and transportation in Dhaka City.

After the Outline Study Team returned to Japan, the basic components of the Project based on the site surveys and results of discussions with the Bangladeshi side were compiled as follows.

Outline of the Vehicles

No.	Component	Waste amount loaded (ton)	Vehicle payload (ton)	Container capacity (m^3)	**Number of vehicles**	Engine	Uses
1	Container carrier	3	4	6	**15**	CNG	Collection and transportation of general waste
2	Container carrier	5	6	10	**30**	CNG	
3	Detachable containter truck (hook haul)	7	8	14	**20**	Diesel	Collection and transportation of market waste
4	Compactor truck	2	2	3	**15**	Diesel	Collection and transportation of general waste
5	Compactor truck	5	5	8	**20**	Diesel	
	Total				**100**		

Outline of the Workshop Construction

Name	Structure Specification	Contents	Total Floor Are (m^2)		
			Building Unit	Building Quantities	Total
Workshop	Structure: Reinforced Concrete Rigid Frame Story: Single Wall: Brick Masonry Mortar Finish Painting Floor: Concrete hardener finish (Working Bay) Floor tiling (Offices) Sanitary Services: Plumbing Installation Septic Tank Electrical Installation Communication Installation Tools & Equipment	Working Bay: 8 Tool/ Parts Rooms Generator Room Offices: 4 Toilets Clerk Office	625	1	625
Total				1	625 m^2

Outline of the Technical Assistance

Goal	Output	Input			
		Expert	Assistant	Others	
DCC staff and citizens will be aware of global warming and greenhouse gas effect and will come to review their own behavior patterns.	Global warming and greenhouse gas effect will be recognized by DCC staff and citizens through campaign and seminar activities.	Environmental education expert 4.5 months	Environmental education assistant 4.5 months	Posters, newspaper PR, prizes, stickers, room rantal fee etc.	Transportation, copy, print
Emission of carbon dioxide will be reduced and collection of solid waste will be improved through proper operation and maintenance of collection vehicles.	Proper maintenance will be implemented through newly prepared maintenance manual. Newly introduced collection will be properly maintained with high operation ratio.	Mechanical expert 5.0 months	Mechanical assistant 5.0 months	—	
Emission of carbon dioxide will be reduced through promotion of utilization of CNG vehicles.	CNG promotion plan will be formulated. Construction plan of CNG station of DCC will be formulated.	CNG expert 5.0 months	—	—	

(4) Project Implementation Schedule and Cost Estimation

In the event where the Project is implemented under the Government of Japan's Grant Aid for Environment and Climate Change, the rough project cost is estimated as 1 billion 216 million yen (1 billion 215 million yen on the Japanese side and 1 million yen on the Bangladeshi side). The major scope of works on the Bangladeshi side will be preparation of the construction site, demolition and removal of obstructions, bearing of taxes, bearing of bank commission fees and so on, and the project implementation schedule from the tender to completion of works will be approximately 14 months.

(5) Verification of Project Validity

The responsible agency for the Project is Ministry of Local Government, Rural Development & Cooperatives (MLGRD&C), Local Government Department (LGD).

The Project implementing agency is the Dhaka City Corporation (DCC), the Solid Waste Management Department.

The primary related agencies on the Bangladeshi side are as follows:

- Ministry of Finance, External Economic Relations Department (ERD)
- Ministry of Local Government, Rural Development & Cooperatives (MLGRD&C), Local Government Department (LGD)
- Dhaka City Corporation (DCC)

The major effects anticipated as a result of Project implementation are as follows.

1) Direct Effects

Whereas current diesel vehicles emit 45.2 kg/day of CO2, the new diesel vehicles will emit 18.6 kg/day while CNG vehicles will emit 16.9 kg/day.

Whereas the current DCC waste collection amount is 1,619 tons/day (collection rate 58%), it will b e 2,121 tons/day (collection rate 67%) in 2012.

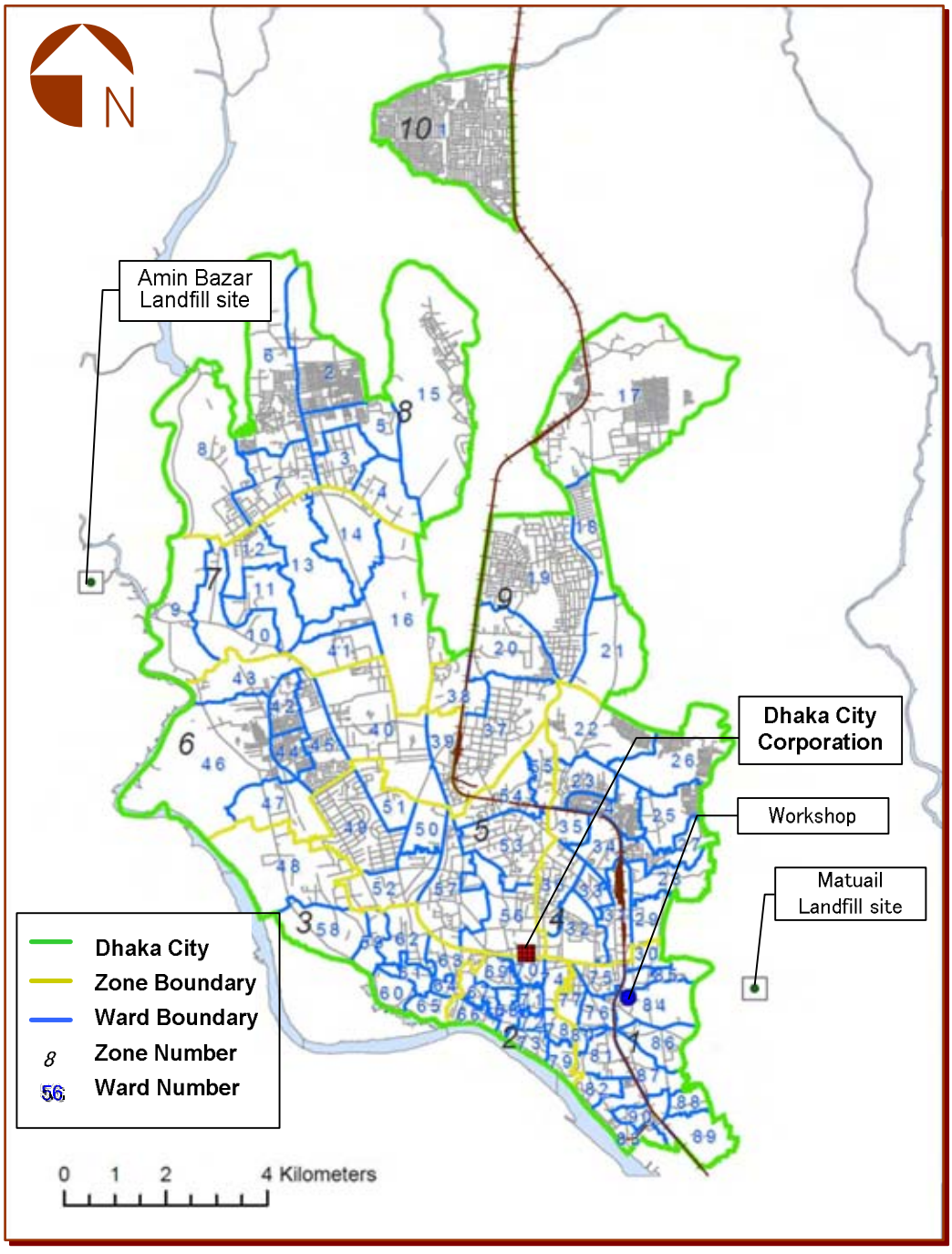
2) Indirect Effects

Improvement in the waste collection quantity will aid beautification of the city.
Moreover, risk of diseases from discarded waste will be reduced and the sanitary situation will be improved.

Thus, since the Project can be expected to realize sufficient beneficial effects and will not entail any problems in maintenance, the implementation of the Project under grant aid of the Government of Japan is judged to be appropriate.

Moreover, in order to realize the more efficient and effective implementation of the Project, it is necessary to establish the operation and maintenance setup, secure and appropriately assign personnel without delay, and secure an appropriate budget for operation and maintenance.

CONTENTS



LOCATION MAP OF STUDY SITES

Outline Design Study on the Programme for Improvement of Solid Waste Management in Dhaka City toward the Low Carbon Society in the People's Republic of Bangladesh

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ABBREVIATIONS

ADB	: Asian Development Bank
ADP	: Annual Development Programme
B/A	: Banking Arrangement
BMD	: Bangladesh Meteorological Department
BNBC	: Bangladesh National Building Code
CCC	: Chattagong City Corporation
DAC	: Development Assistance Committee
DCC	: Dhaka City Corporation
DFID	: Department for International Development
DPHE	: Department of Public Health Engineering
DPP	: Development Project Proposal
EC	: European Commission
E/N	: Exchange of Notes
ERD	: Economic Relations Division
EU	: European Union
GDP	: Gross Domestic Product
GOB	: Government of Bangladesh
IDB	: Islamic Development Bank
JBIC	: Japan Bank for International Cooperation
JICA	: Japan International Cooperation Agency
JICS	: Japan International Cooperation System
LGD	: Local Government Division
MLGRD&C	: Ministry of Local Government, Rural Development and Cooperatives
MoEF	: Ministry of Environment and Forest
MoP	: Ministry of Planning
NGO	: Non－Governmental Organization
PETROBANGLA	: Bangladesh Oil, Gas & Mineral Corporation
PRSP	: Poverty Reduction Strategy Paper
PWD	: Public Works Department
RPGCL	: Rupantarita Prakritik Gas Company Limited
SWMD	: Solid Waste Management Department
UNDP	: United Nations Development Programme
UP	: Union Parishad
VAT	: Value-Added Tax
WB	: World Bank
WFP	: World Food Programme

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Current Conditions and Issues in the Sector

1-1-1 Current Conditions and Issues

In Dhaka, due to the rapid increase of the population and economic development, the management of burgeoning quantities of solid waste is a considerable social problem. Dhaka City Corporation (DCC) is in charge of solid waste management, however, in order to realize appropriate solid waste management, there are problems such as weak implementation system, lack of planning, lack of equipment, and the low sanitation awareness among the citizens. Consequently, JICA implemented the development study, and established the Master Plan of Solid Waste Management of Dhaka City in 2005. After the establishment of the Master Plan, it was deemed necessary to support DCC officials in their efforts to gain the capacity and techniques to solve each problem in order to establish the solid waste management system in the City through the phased implementation of the Master Plan. Hence, JICA has been implementing the Project for strengthening capacities for solid waste management in Dhaka City since February 2007.

In the current activities, capacity building for collection and transportation as part of the solid waste management of DCC is an important issue in order to improve the living environment of the citizens. Many collection trucks currently owned by Dhaka City have become too old to work and it is predicted that many trucks will no longer be in use around the years 2010 and 2011. Dhaka City is aware of the necessity of strengthening solid waste management and has therefore raised funds for the management and control of the necessary costs of solid waste management through collection of cleaning taxes from the citizens. However, since it still has little prospect of raising the funds required to purchase the replacement and incremental collection equipment according to the Master Plan, the Government of Bangladesh issued a request to the Government of Japan for the provision of General Project Grant Aid.

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1-2 Natural Conditions

(1) Geographic Features

Bangladesh is located in South Asia between north latitude 20°21″~26°38″and east longitude 88°01″~92°41″; it shares borders with India to the west and the north and with Myanmar to the southeast, while the southern side of the country faces onto the Bay of Bengal. The national land area is 144,000 km2 (1.8 times the size of Hokkaido) and the population is 144.4 million (according to the World Bank 2006). The national land of Bangladesh consists of the world's largest delta formed by the three great rivers of the Ganges, Brahmaputra and Megna, and alluvial plains with elevation of no more than 9 m comprise 80% of the country.

(2) Meteorological Conditions

Bangladesh has a typical subtropical monsoon climate generally divided into the summer from March to May, the rainy season from June to October and the dry season from November to February. These areas are in a rainy zone with annual rainfall reaching 2,500~3,000 mm, and approximately 90% of this is concentrated into the rainy season. Moreover, cyclones frequently strike the country before and after the rainy season.

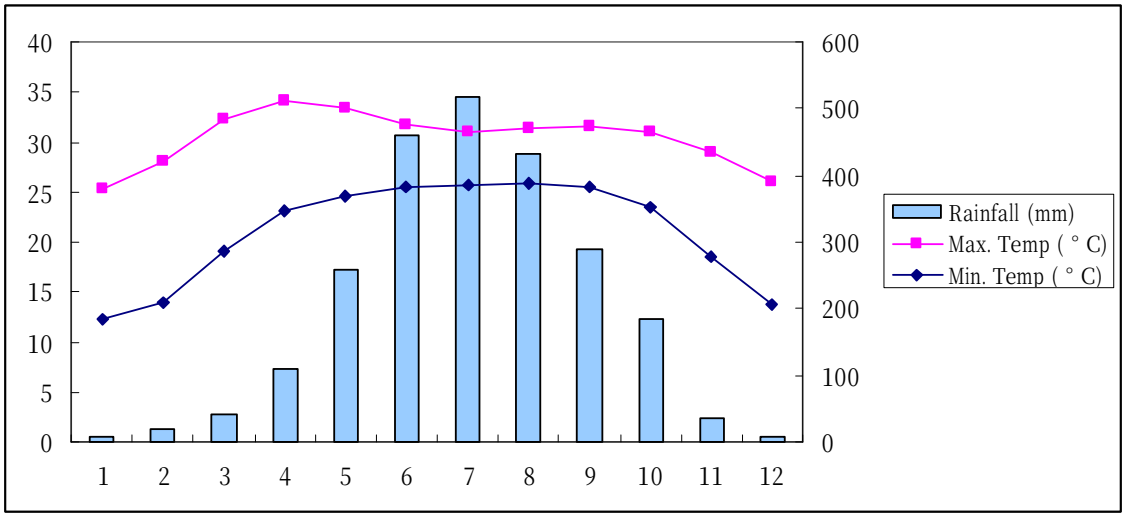

Figure 1-1 Bangladesh Maximum and Minimum Temperatures and Precipitation
(Source: Bangladesh Meteorological Department)

(3) Earthquakes

There are no official records of major earthquakes occurring in Bangladesh. The Project target area is in the center of the country where the seismic coefficient is 0.15.

1-3 Environmental Impact

The Project entails the procurement of solid waste collection vehicles and construction of a workshop.

The vehicles to be newly procured have better exhaust gas quality than existing vehicles.

Since the workshop will be constructed on the site of an existing workshop, no relocation of residents are required. Vehicle washing will be treated and there will basically be no use of asbestos, so there will be no negative impact on the environment.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Outline of the Project

2-1-1 Objectives and Targets

<Superior Objectives>

To implement sustainable waste management services in Dhaka City, to improve the sanitary environment in the city, to promote a recycling society and to contribute to reduction of greenhouse gas emissions.

<Project Objectives>

To strengthen the waste collection and transportation capacity of DCC

To reduce emissions of greenhouse gases in waste collection and transportation in Dhaka City

<Outputs of the Project>

Improvement in waste collection quantity and rate in Dhaka City

<Indicators of Project Achievement>

- ◊ Waste collection quantity
- ◊ Waste collection rate
- ◊ Reduction of emission of CO_2

2-1-2 Outline of the Project

(1) Contents of the Request to the Government of Japan

The contents of the original request are as follows:

Year and month of request: July 2007 (as general grant aid)

Requested amount: 1.45 billion yen

Contents of request: Procurement of 258 waste collection vehicles

Following that, during review of the assistance based on Programme Grant Aid for Environment and Climate Change, DCC issued a request for the procurement of 195 varying type of collection vehicles, road sweepers, pay-loaders, vehicle washing facility and capacity development.

(2) Plan of Inputs by the Bangladeshi Side

- ◊ Securing of land
- ◊ Demolition and removal of obstructions in the site
- ◊ Bearing of taxes
- ◊ Payment of bank commission fees

2-2 Outline Design of the Project

2-2-1 Design Concept

2-2-1-1 Basic Concept

(1) Selection Criteria

1) Current conditions and problems of collection vehicles

Currently DCC operates 297 collection vehicles which collect and transport approximately 1,619 tons/day of waste. Transportation quantities are falling due to an increase in broken down vehicles.

Out of the existing vehicles, the oldest dates back to 1989 and the newest was procured in 1999, however, there have been no recent renewals and the current vehicles including those more than 15 years old are running based on ongoing repairs.

In terms of the collection vehicle procurement scheme proposed under the Clean Dhaka Master Plan, the vehicles targeted by the Project represent the equipment required by 2012. Assuming that vehicles manufactured in or before 1997 will no longer be operating in 2012 (more than age of 15 years), the collection capacity of existing vehicles will drop to 577 ton/day by this time (assuming that the collection capacity of existing vehicles will be improved through increasing trip frequency and load capacity per trip and installing more containers, etc.).

2) Collection capacity targeted in the Project

According to the Clean Dhaka Master Plan, 2005, the generated amount of solid waste in 2012 will be 4,196 ton/day. Since waste collection in Zones 9 and 10 is consigned to the private sector, 532 ton/day can be deducted to leave 3,664 ton/day in the remaining zones. The discharged amount will be 86.3% of this or 3,162 ton/day, while the design collection and transportation amount is assumed to be 57.9% of 2,121 ton/day. DCC has applied for procurement of 27 5-ton container carriers under the Japan Debt Cancellation Fund (JDCF), and this should enable collection capacity to be increased by 432 ton/day (4 trips). After deducting the 577 ton/day collection capacity of existing vehicles in 2012 and the additional capacity of 432 ton/day based on the JDCF from the design collection amount in that year, this still means that additional collection capacity of 1,112 ton/day must be secured as a matter of urgency.

Table 2-1 Amount of Waste Collection in 2012

Contents	Amount (ton/day)
Total generation of solid waste	4,196
Generation excluding Zones 9 and 10 consigned to the private sector	3,664
Discharge of solid waste (excluding Zones 9 and 10)	3,162
Planned amount for collection and transportation	2,121
Amount of waste to be collected by the existing vehicles (after scrapping vehicles over 15 years and taking operation improvement into consideration)	577
Amount of waste to be collected with container carriers based on the JDCF	432
Amount of waste to be covered by this project	1,112

3) Collection vehicles selection criteria

The following conditions shall be taken into consideration for selection of collection vehicles in the Project:

◊ New collection vehicles are urgently required because of increasing amounts of waste and degraded existing vehicles, and the delivery and operation of new vehicles should be attained as soon as possible.
◊ Construction of a new CNG (Compressed Natural Gas) station is time-consuming since the necessary procedures take anything from a few months to over a year to complete.
◊ Observing the congested condition of existing CNG filling stations, since private sector CNG stations can only handle up to around 50 collection vehicles, operations will need to be conducted with this number of vehicles.
◊ It is difficult to secure warranty for compactor trucks with CNG engines as the manufacturers differ

for the chassis/engine, hydraulic mechanism of compactor and CNG section.

◊ CNG engines are disadvantageous for large trucks because of their lower horsepower.

◊ The fuel mileage of the existing vehicles is as low as 2.5~3 km/litter. New diesel engine trucks will improve the mileage nearly twofold by reducing emissions of CO_2 by about half. CO_2 emissions in CNG engines are generally be less than those in diesel engines by about 10%., and this will be equivalent to a 10% reduction of running distances.

◊ DCC is preparing for introduction of compactor trucks, performing collection experiments and compiling collection plans for several areas with compactor trucks. DCC has the capacity to maintain the mechanical parts of hydraulic systems.

◊ The 20-ton trailers that carry market waste urgently need to be replaced with efficient 7-ton detachable container trucks (hook haul). Moreover, these 7-ton containers need to also be installed at mini transfer stations in an effort to raise collection efficiency.

◊ Dump trucks with CNG engines will be difficult in terms of hydraulic equipment, operating parts, short wheel base and not enough space CNG tanks.

◊ The amount handled under this project will be 1,112 ton/day.

4) Setting the number of collection vehicles

Based on the above study, this component is set as procurement of 100 collection vehicles but not including construction of a CNG station. The total collection quantity is 1,112 ton/day.

Construction of a workshop is included in the component in order to maintain the vehicles in good condition, prevent unnecessary increase of CO_2 emissions, extend the service life of vehicles and reduce maintenance costs through providing space for periodical maintenance and minor repairs. The new workshop will be the central facility for the maintenance section of the Solid Waste Management Department, which was inaugurated in July 2008.

It is also necessary to conduct guidance on improving collection vehicle operations in line with the introduction of compactor trucks and detachable container trucks (hook haul), to raise public awareness through the introduction of new vehicles, and to provide technical support concerning vehicle maintenance centering on hydraulic equipment and electrical systems and CNG safety control, etc.

Table 2-2 List of Component Equipment

No.	Component	Waste amount loaded (ton)	Vehicle payload (ton)	Density of waste (t/m^3)	Container capacity (m^3)	Request by DCC in July 2008	Request by DCC in August 2008	**Preliminary Component**	Engine	Number of trips	Collection amount (ton)
	Open truck	1.5	1.5	0.7	2.1	20	20				
	Dump truck	3	3	0.7	4.3	70	20				
	Dump truck	7	7	0.7	10	10	5				
	Container carrier	10	11	0.5	20		10				
1	Container carrier	3	4	0.5	6	40	60	**15**	CNG	4.0	144
2	Container carrier	5	6	0.5	10	20	50	**30**	CNG	4.0	480
3	Detachable container truck (hook haul)	7	8	0.5	14			**20**	Diesel	2.5	280
4	Compactor truck	2	2	0.6	3	10	15	**15**	Diesel	2.0	48
5	Compactor truck	5	5	0.6	8	15	15	**20**	Diesel	2.0	160
	Total					185	195	**100**			1,112

5) Project components

Based on the above examination and the discussions with the Bangladeshi side, the Project components have been set as follows.

Table 2-3 List of Project Components

No.	Component	Waste amount loaded (ton)	Vehicle payload (ton)	Container capacity (m^3)	**Number of vehicles**	Engine	Uses
1	Container carrier	3	4	6	**15**	CNG	Collection and transportation of general waste
2	Container carrier	5	6	10	**30**	CNG	
3	Detachable container truck (hook haul)	7	8	14	**20**	Diesel	Collection and transportation of market waste
4	Compactor truck	2	2	3	**15**	Diesel	Collection and transportation of general waste
5	Compactor truck	5	5	8	**20**	Diesel	
	Total				**100**		
No.	Component				**Quantity**	Contents	
	Workshop construction				**1**	8 bays, 625m^2, including tools	
	Technical assistance				**1**	Environmental education, vehicle maintenance	

2-2-1-2 Concept regarding Natural Conditions

The design concept with respect to natural conditions concerning facilities construction in the Project shall be as follows.

(1) Meteorological Conditions

- Decline in work efficiency during the rainy season shall be given full consideration when setting the construction period.
- Considering that the area around the construction site will experience water accumulation and puddles during the rainy season, the works schedule shall be planned so that foundation works are certainly finished by July before the rainy season begins.
- Building roofs shall be designed as deck roofs with reinforced concrete slabs to offer better protection against cyclones. Lime terracing, which is the commonly adopted method in the local area, shall be adopted for the waterproofing of roofs.

(2) Wind Velocity

As a result of conducting analysis on probable wind velocity, wind velocity of 210 km/h (58.3 m/sec) shall be adopted as the design wind velocity based on the Bangladesh National Building Code (BNBC).

(3) Seismic load (horizontal force of inertia)

According to the BNBC, the country is divided into three seismic zones and the coefficient of the horizontal force of inertia is stipulated for each.

Zone 1 (north) 0.2
Zone 2 (center and east) 0.15
Zone 3 (south) 0.075

The Project area is located in Zone 2, where the coefficient is 0.15. However, the coefficient of shearing force shall be calculated according to the various conditions (building natural period, ground characteristics, etc.) stipulated in the BNBC standards.

2-2-1-3 Concept regarding Socioeconomic Conditions

The target construction site is located in an area containing public facilities, commercial facilities, housing and lakes, etc. All facilities are properly zoned, however, since the Project proposes to build a vehicle inspection and maintenance workshop, ample attention will need to be paid to the wastewater treatment plan. Moreover, since the washing of collection vehicles will take place adjacent to the workshop, attention will also be required concerning the treatment of washing water.

2-2-1-4 Concept regarding Construction Conditions and Local Contractors

(1) Basic Concept

All the required construction materials will be procured domestically. Assuming that reinforced concrete construction methods common to the local area, it is confirmed that building materials of stable quality can be procured in large quantities locally. Concerning cement, because manufacturing plants are located in the Dhaka area, it will be important to directly purchase from plants upon confirming quality control. Moreover, concerning reinforcing bars, local products and imports from third countries (India, etc.) are available on the local market. Concrete can be delivered in ready-mixed concrete trucks to the site.

(2) Fine Aggregate and Coarse Aggregate

In Dhaka, because it is difficult to obtain good quality aggregate (crushed stone and sand), burnt brick chips are crushed and used in place of crushed stone. These crushed chips are frequently used as coarse aggregate for concrete, however, compared to normal crushed stone aggregate, they are much weaker and upon comparing the results of compression strength testing of concrete made from such aggregate, concrete made from the crushed chips only has 76% the compression strength of crushed stone aggregate. Moreover, when execution accuracy and management capacity are also taken into account, the level declines even further. Also, due to impurities inside bricks themselves, these adversely affect concrete causing it to crack, peel and break. As a result, some buildings in Dhaka suffer from corroded and snapped reinforcing bars inside concrete. Accordingly, in the interests of securing quality, aggregate made from crushed bricks shall not be adopted in the Project; rather ordinary crushed stone aggregate shall be used.

The following table shows the results of strength testing conducted on concrete samples made from both types of aggregate.

Table 2-4 Example of Compression Test Results according to Used Aggregate

Type of sample	28-day strength (KN/m^2)	Comparison (a)/(b)
(a) Concrete made from crushed brick chips	19.0	76.0%
(b) Concrete made from crushed stone aggregate	25.0	

Data source: PWD (Public Works Department)

Good quality aggregate in Bangladesh can only be obtained in the Sylhet region in the north of the country, and a system is adopted whereby specialist transportation companies make deliveries of set

quantities to Dhaka, where a set quantity is always maintained. The building contractors in Dhaka are able to purchase good quality aggregate from this stock point.

(3) Concept regarding Transportation of Equipment and Geographical Characteristics

Arterial roads in Dhaka are in good condition and there are no problems regarding vehicle access of equipment to the construction site. Moreover, all equipment produced in Bangladesh can be procured in Dhaka. However, since central Dhaka suffers from severe traffic congestion, it is best to transportation equipment in early morning or late at night.

(4) Securing of Materials Storage Area

During the monsoon season from June to September, torrential downpours cause many areas to become submerged to depths of between 50~80 cm. Accordingly, it will be impossible to continue construction work during the rainy season, and care will be required to secure materials storage areas. In particular, attention will need to be paid to the cement and aggregate transportation plans, and an indoor storage area for construction materials shall be secured within existing facilities.

2-2-1-5 Concept regarding Utilization of Local Contractors

(1) Utilization of Local Construction Companies

For construction works, the basic principle shall be to utilized local contractors. Bangladesh is thought to possess a certain degree of construction technology because there are more than 1,000 construction operators in the country, there are many large-scale contractors in the capital Dhaka, and Dhaka has high-rise buildings. However, due to the construction boom in the metropolitan region, it is possible that the best companies will not show an interest in the small-scale facilities in this project. Accordingly, in the Project, assessment criteria targeting Class-A or higher contractors shall be prepared in order to ensure that the works are performed by a contractor with sufficient experience and technical prowess.

(2) Utilization of Local Labor

Engineers and craftsmen in Bangladesh are thought to possess a certain level of technology because numerous construction projects including road works, river works, bridge works and building works, etc. are implemented. Therefore, it should be possible to secure sufficiently skilled workers knowledgeable in construction through adopting assessment criteria targeting Class-A contractors or higher. Moreover, from the viewpoint of securing a certain execution quality and schedule control in the Project, local engineers who possess know-how of construction works and leadership skills shall be permanently dispatched to the works site to oversee the works.

(3) Utilization of Local Consultants

General consulting companies in Bangladesh are rare, however, there are numerous small-scale consultants and it is possible to secure engineers of a sufficient level necessary for supervising works sites. However, since quality control criteria have not been established, the Project concept shall be to realize a uniform level of quality through regularly dispatching Japanese consultants to provide thorough technical guidance.

2-2-1-6 Concept Regarding the Operation and Maintenance Capability of the Implementing Body

(1) Recruitment Criteria for New Mechanics

Before introducing the newly procured vehicles under the Project, current staff assignment shall be reviewed to make sure that refilling of posts that have been open for a long time is appropriate and to recruit mechanics based on confirmed recruitment standards.

Table 2-5 Currently Owned Vehicles and Workshop 1 Staff of DCC

Department	Number of vehicles	Maintenance staff	Employees	Part-time staff	Apprentices
Volvo department	32	7	3	0	4
Isuzu small truck department	33	10	3	1	6
Tata 608/709 open truck department	42	11	7	0	4
Tata 407/609 open truck department	84	12	6	0	6
A. Leyland container carrier department	92	11	6	1	4
Private car department	24	6	1	3	2
Tata 909/1613 container carrier department	32	9	4	0	5
Driver cabin plating department		10	1	1	8
Body plating department		29	18	4	7
Coating department		7	3	3	1
Battery department		3	0	3	0
Tire department		5	4	1	0
Garage department		5	2	1	2
Total	339	125	58	18	49

After the Project vehicles have been introduced, periodic inspections will be implemented at four work bays in the new workshop and two staff members will work on each vehicle. Accordingly, eight mechanics will be required. Therefore, it will be necessary to recruit an additional six mechanics in addition to the two existing ones.

(2) Driver Recruitment Criteria

New drivers shall be recruited upon confirming the recruitment criteria for them.

(3) New Workshop Operation

Vehicle maintenance work is currently implemented in six departments, i.e. open engine maintenance, body plating work, Volvo vehicle maintenance, Tata vehicle maintenance, Ashok Leyland vehicle maintenance and Isuzu vehicle maintenance. In the new workshop, periodic inspections on the newly procured vehicles will mainly be conducted using four work bays. It is necessary to acquire efficient work methods.

(4) Setting of Periodic Inspection Operating Criteria for Mechanics

Currently, appropriate vehicle periodic inspections are not being implemented. Accordingly, it is necessary to thoroughly enforce the shop entry control by engineers and periodic inspection by

mechanics of vehicles.

(5) Setting of Vehicle Operation and Maintenance Standards for Drivers

It is necessary to set and implement standards for before and after inspections targeting existing and newly recruited drivers.

2-2-1-7 Concept regarding the Grading of Facilities

(1) Program for Conversion to a Society with Lower CO_2 Emissions

The amount of CO_2 discharged from vehicles can be calculated according to the travel distance and fuel supply. Depending on the type of fuel used in vehicles, although the exhaust coefficient differs, emissions are generally calculated for 1 L of gasoline or diesel oil consumption or 1 Nm^3 of natural gas consumption.

Table 2-6 CO_2 Exhaust Coefficient

Fuel type	Gasoline	Diesel	Natural gas (city gas)
CO_2 exhaust coefficient	2.32kg-CO_2/L	2.62kg-CO_2/L	2.08kg-CO_2/Nm^3

Table 2-7 Carbon Dioxide Emission Comparison based on Fuel and Combustion Control Method

	Vehicle type	Fuel control device	Engine capacity (cc)	Horsepower (PS/rpm)	Fuel economy (km/L)	CO_2 emissions (g/km)
1	2 ton flat bottom truck (made in Japan)	CNG Electronic control	4,300	125/3,400	6.15 (when traveling in urban areas)	338.2
2	2 ton flat bottom truck (made in an advanced nation)	Diesel Mechanical fuel injection	4,300	110/3,100	6.8 (when traveling in urban areas)	385.2
3	2 ton compactor (made in Japan)	CNG Electronic control	4,300	125/3,400	3.76 (in work)	553.1
4	2 ton compactor (made in an advanced nation)	Diesel Mechanical fuel injection	4,300	110/3,100	4.0 (in work)	655.0

The above table shows that adopting the electronic control system with CNG fuel enables a CO_2 reduction of 12~15% compared to the mechanical fuel injection system. Moreover, since emissions of harmful CO and HC can also be cut, this can make a contribution to preventing global warming and air pollution. Meanwhile, in the case where the mechanical fuel injection system is adopted with CNG fuel, CO_2 can be reduced by around 9~12%, however, there is no effect in terms of eliminating harmful substances such as CO and HC.

When a diesel truck runs 100 km, it emits 38.52kg of CO_2. This becomes 33.82 kg in the case of a CG truck, thereby enabling a CO_2 reduction of 4.7 kg. This corresponds to a 40W fluorescent lamp being extinguished for 325 hours. Per capita CO_2 emissions for each member of the population in Japan are approximately 6 kg per day.

The diesel engine vehicles currently used for collecting solid waste were introduced in the 1990s and

their fuel efficiency is calculated as 2.0~3.0km/L. Therefore, if a new type of diesel engine vehicle is introduced, it can greatly contribute to reduce CO_2 emission for its fuel efficiency is 2 to 3 times better compared to that of current vehicles, although its CO_2 emissions are larger than those of CNG engines.

When the currently used diesel truck runs 50km, which is the average mileage per day, it consumes 20 L of diesel (50km÷2.5km/L) and emits about 45.20kg (20L×2.62kg-CO_2/L) of CO_2. Each of the trucks about to be introduced can reduce 26.45kg of CO_2 per day as its CO_2 emissions are calculated as 18,75kg when its fuel efficiency is 6.0km/L.

The price of natural gas is between 1/4~1/6 that of diesel and gasoline, and this price differential is likely to grow in future. CNG vehicles have fuel economy (running distance per 1 m^3) around 10% worse than diesel vehicles, however, the cheap fuel price allows them to save on running costs.

The following table shows fuel consumption of existing DCC vehicles according to maker.

Table 2-8 Fuel Consumption by Vehicle Type

No.	Type	Maker	Manufacturing country	Loading Capacity (ton)	Average fuel consumption (km/L)
1	Open truck	ISUZU NKR	Japan	1.5	3.0km/L
2	Open truck	TATA 407	India	1.5	3.5km/L
3	Open truck	TATA 608	India	3.0	3.0km/L
4	Open truck	TATA 1613	India	5.0	3.0km/L
5	Open truck	VOLVO	Sweden	5.0	3.0km/L
6	Container carrier	ASHOK LEYLAND	India	3.0	3.5km/L
7	Container carrier	TATA 909	India	3.0	3.0km/L
8	Container carrier	ASHOK LEYLAND	India	5.0	2.5km/L
9	Container carrier	VOLVO	Sweden	5.0	2.0km/L
Vehicles procured in the Project					
	Compactor truck	New diesel engine	Japan	2.0	6.8km/L

(2) Vehicle Output

The vehicles that are going to be introduced will experience frequent starts and stops when used for collecting solid waste. Besides, the load placed on engines and transmissions will be heavy from the weight of collected solid waste. Furthermore, the solid waste dump has a rough ground with an inclination of 10 degrees, so it has been decided that vehicles with more engine output than usual diesel trucks are required for this purpose.

Vehicles with high engine output can contribute to reducing PM (particulate matter) such as black smoke as they can reduce the load of engine and prevent imperfect combustion.

(3) Vehicle Bodies

Because separate waste collection is not implemented in Dhaka, containers get badly corroded because of the liquid exuded from various kinds of waste. Containers can be plated with metal and coated in DCC workshop, however, in the case of compactors, since compactor sections cannot be easily removed, it is important to use materials and coating that provide strong resistance against corrosion.

2-2-1-8 Concept regarding Construction and Procurement Methods and Works Schedule

The concept regarding construction and procurement methods and the works schedule shall be as follows.

◊ Generally make use of construction materials that are cheap and can be procured locally.

2-2-2 Equipment Procurement Plan

(1) Basic Concept

1) Low CO_2 emissions

Vehicles should basically have low CO_2 emissions.

As one of the action plans for a low carbon society, CNG vehicles are an effective way to reduce CO_2 emissions. Also, as an immediately effective measure, diesel vehicles with better fuel economy than the present vehicles should be used.

2) Modification to CNG engines

Since the process of converting a diesel engine to a CNG engine can cause damage as it involves modification of the piston, it is too dangerous to be conducted here in Bangladesh. Also, such modifying is outside of the engine warranty provided by the manufacturer. Furthermore, this modification can result in air pollution as the exhaust gas cannot be filtered. Therefore, modifying a diesel engine to a CNG engine by cutting off the upper part of piston cannot be permitted in Bangladesh.

However, there is a local automobile dealer that modifies engines by using a CNG conversion kit made in Europe and that his type of modification would be allowed by the manufacturers.

(2) Principal Conditions regarding Procured Vehicle Specifications

1) Vehicle output

The vehicles that are going to be introduced will experience frequent starts and stops when used for collecting solid waste. Besides, the load placed on engines and transmissions will be heavy from the weight of collected solid waste. Furthermore, the solid waste dump has a rough ground with an inclination of 10 degrees, so it has been decided that vehicles with more engine output than usual diesel trucks are required for this purpose.

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3) Weight to volume ratio of waste

The ratio of weight to volume of waste is set at 1:2. Therefore a compactor truck with a payload of 2 tons has a loading capacity of $4m^3$.

(3) Main Specifications of Collection Vehicles

Five types of solid waste vehicles will be procured in the Project and their main specifications are as

indicated in Table 2-10.

(4) Spare Parts

Since it is expected that there will be a sudden increase of maintenance and management costs following the introduction of vehicles under the Project, it has been decided to procure the spare parts expected to be needed for roughly two years after their introduction in order to ensure ongoing operation. Irregular consumables such as tires and batteries are not included as they can be purchased in Bangladesh.

Most of the spare parts are common, and compatible with other models. Accordingly, the likelihood of maker stocks disappearing even after vehicle model changes will be low and parts should be available for at least five years.

Table 2-9 Table List of Vehicle Spare Parts

Category	Name of Spare parts	Use	Quantity.
Periodic service parts	Engine oil filter	Engine oil	12
	Fuel filter	Fuel	6
	Air cleaner	Inner cleaner	2
		Outer cleaner	2
Engine parts	Fuel injection nozzle	Fuel injection	6
	Cylinder head gasket	Cylinder head overhaul	2
	Engine overhaul gasket kit	Engine overhaul	1
	Radiator hose	Upper hose	2
		Lower hose	2
Hydraulic parts	Hydraulic filter	Hydraulic oil	2
	High pressure hose	For mast cylinder	2
		For tilt cylinder	2
		For hydraulic pump	2
Brake parts	Wheel cylinder	Overhaul kit	12
		Assembly	8
	Wheel hub bearing	Front hub inner bearing	2
		Front hub outer bearing	2
		Rear hub inner bearing	2
		Rear hub outer bearing	2
	Brake shoe	Front shoe	8
		Rear shoe	8
Electric parts	Head light bulb	Halogen lift	4
	Fuse	Fuse 5A	10
		Fuse 10A	10
		Fuse 20A	10
		Fuse 100A	5

Table 2-10 Major Specifications of Collection Vehicles

Main unit	3-ton Container carrier	5-ton Container carrier	7-ton Detachable container truck (hook haul)	2-ton Compactor truck	5-ton Compactor truck
Driving handle position	Right handle drive	Right handle drive	Right handle drive	Right handle drive	Right handle drive
Engine location	Front engine	Front engine	Front engine	Front engine	Front engine
Engine type	4cycle, Water cooled, Diesel engine based CNG	4cycle, Water cooled, Diesel engine based CNG	4cycle, Water cooled, Diesel engine	4cycle, Water cooled, Diesel engine	4cycle, Water cooled, Diesel engine
Engine control type	Electric control unit type	Electric control unit type	Mechanical governor type	Mechanical governor type	Mechanical governor type
Fuel	CNG	CNG	Diesel	Diesel	Diesel
Displacement (cc)	4,500 – 7,000 cc	7,500 – 10,000 cc	7,500 – 8,500 cc	3,500 – 5,000 cc	6,500 – 8,500 cc
Max. Output (ISO gross) PS/rpm	More than 110 PS/rpm (3,000 rpm)	More than 200 PS/rpm (3,000 rpm)	More than 180 PS/rpm (3,000 rpm)	More than 100 PS/rpm (3,000 rpm)	More than 150 PS/rpm (3,000 rpm)
Transmission type	Mechanical type, 5 speed direct drive and 1 reverse	Mechanical type, 5 speed direct drive and 1 reverse	Mechanical type, 5 speed direct drive and 1 reverse	Mechanical type, 5 speed direct drive and 1 reverse	Mechanical type, 5 speed direct drive and 1 reverse
Chassis	Ladder type frame	Ladder type frame	Ladder type frame	Ladder type frame	Ladder type frame
Driving wheel	4x2 Rear drive	4x2 Rear drive	4x2 Rear drive	4x2 Rear drive	4x2 Rear drive
Body Unit					
Body type	Container carrier	Container carrier	Detachable container truck (hook haul)	Compactor truck	Compactor truck
Dump type	-	-	Rear gate discharge	Rear gate discharge	Rear gate discharge
Loading capacity	3tons	5tons	7tons	2tons	5tons
Container volume (m^3)	Approx. $6m^3$	Approx. $10m^3$	Approx. $14m^3$	Approx. $4m^3$	Approx. $10m^3$
Number of container to be specified in tender document	1 each	1 each	2 (10 sets) and 3 (10 sets)	1 each	1 each

2-2-3 Facilities Plan

2-2-3-1 Layout Plan

The target site contains ample land for facilities construction and is almost completely flat. In order to avoid intersection with vehicle traffic lines into the existing facilities and make the work bays more accessible to vehicles, ample space has been secured between them and the existing garages.

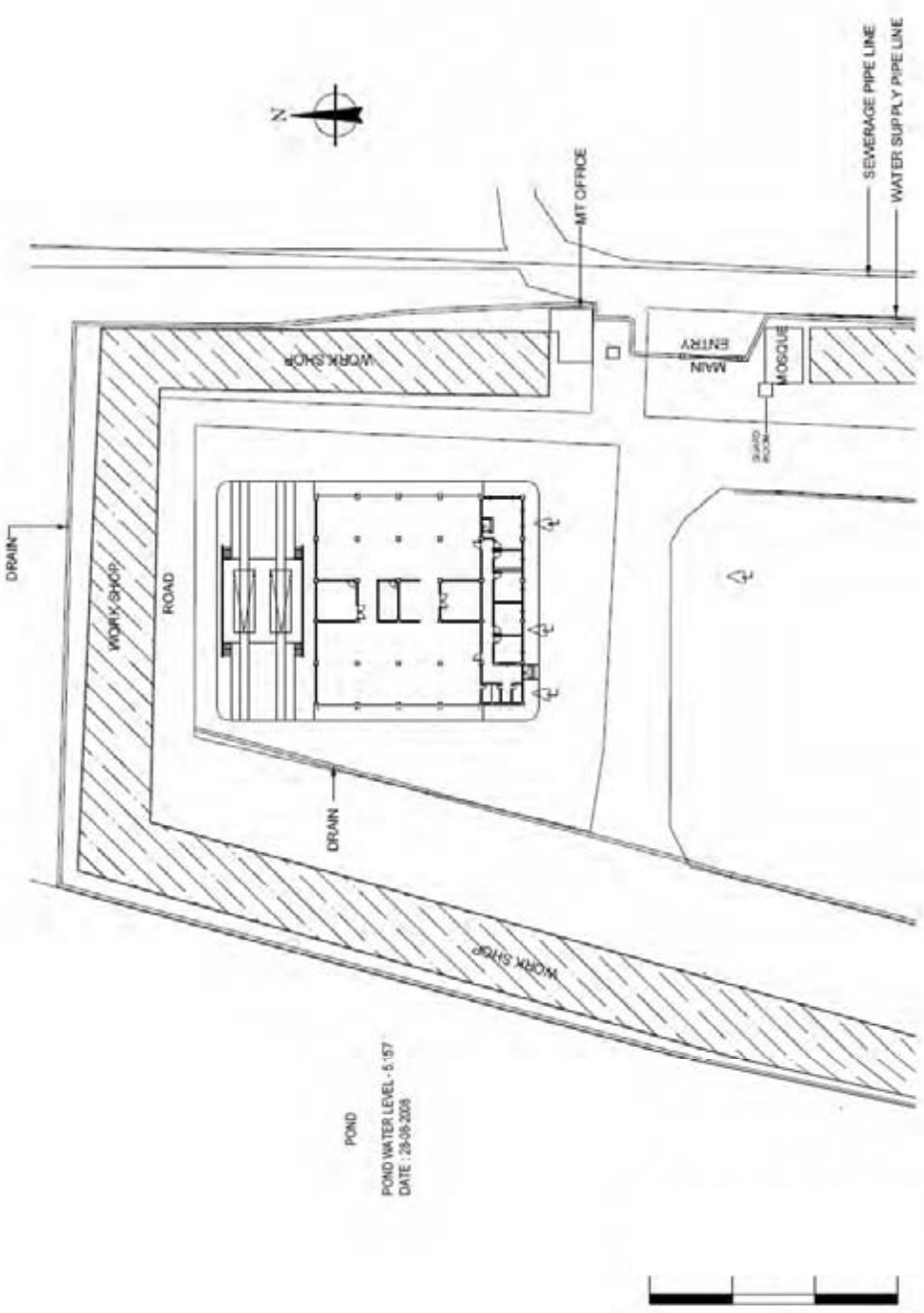


Figure 2-1 Workshop Layout Plan

2-2-3-2 Building Plan and Design

(1) Vehicle Maintenance Section

On the construction of a workshop in the Project, the number of working bays for inspections and maintenance of 100 newly introduced vehicles and existing vehicles was calculated as follows.

$$\text{The number of working bays} = \frac{\text{The working hours for periodic inspections and maintenance per year}}{\text{The working hours at workshop per year}}$$

$$= \frac{\text{(Average working hours)}\times\text{(The number of vehicles)}\times\text{(The number of maintenance conducted per year)}}{\text{(Working days per year)}\times\text{ (Working hours per day)}}$$

1) Setting of conditions (standard work time)

The time taken for periodic inspections has been doubled to 4 hours. The hours of periodic inspections conducted every 6 months and 12 months have been increased 2.5 times to 5 hours as the contents of works are expected to increase.

2) The number of vehicles needing periodic inspections and maintenance

2012: 93 existing vehicles + 27 newly requested container carriers + 100 new vehicles introduced in the Project = 220 vehicles

3) The number of periodic inspections per year

The regulation is set at 6 services per year or one service every 2 months.

Periodic inspections at the DCC workshop are conducted every 2 to 3 months according to the frequency of operation and not according to mileage. Therefore, when the mileage per day is set at 32.5km (Note 1) and average operation ratio at 88.4% (Note 2), the monthly mileage is calculated as follows.

Mileage/day(a)	Days of operation	Ratio of operation(c)	Monthly mileage (a×b×c)
32.5 km	26 days	88.4%	746.98 km/month

If a vehicle's monthly mileage is about 750km, its mileage after 2 months becomes 1500km. Mechanics change the oil if it is dirty at this point. If they find that it is still useful, other units are checked. The oil is changed after 2 months when a vehicle's mileage reaches 3,000km. Usually the manufacturers recommend that engine oil for diesel automobiles be changed every 3,000~5,000km. Therefore, ongoing timing of periodic inspections has been appropriate.

For now, the number of periodic inspections per year used to calculate the number of working bay is 6 inspections per year or one inspection every two months, and not according to the mileage.

Note 1

Vehicle operation rate: refer to Progress report 2 on the Project for strengthening capacities for solid waste management in Dhaka City.

The number of operating vehicles per day in December, 2007	: 241
The number of operating vehicles per day in January 2008	: 254
The total number of operating vehicles	: 280
The rate of operation of vehicles in December 2007	: 86.1%
The rate of operation of vehicles in January 2008	: 90.7%
The average rate of operation of vehicles	: 88.4%

Note 2

Mileage of vehicles: refer to Progress report 2 on the Project for strengthening capacities for solid waste management in Dhaka City.

The operating condition of 5 vehicles per hour operated in ward 24, 76 and 81 during the 3 days between 29th and 31st of January has been examined. The shortest mileage per day was 17.2km, the longest 34,7km and the average mileage 25.95km among the 5 vehicles.

Vehicles examined are operated in the ward near landfill site within the radius of 4km, so vehicles operated in wards far from the landfill site, on the other hand, probable only be operated once a day, so the average mileage of vehicles should be around the same. Therefore, the average mileage of one vehicle per day can be calculated as 25.9km x 1.25 = 32.5km.

Table 2-11 Main check list and frequency of middle sized trucks

	3,000km 2 months	6,000km 4 months	9,000km 6 months	12,000km 8 months	15,000km 10months	18,000km 12months
Engine oil	Change	Change	Change	Change	Change	Change
Engine oil filter		Change		Change		Change
Air cleaner	Clean	Clean	Clean	Clean	Clean	Change
Fuel filter						Change
Mission oil			Check			Change
Differential oil			Check			Change
Grease up			Lubrication			Lubrication
Fastening check	Check	Check	Check	Check	Check	Check
Time	2 hours	4 hours	5 hours	4 hours	2 hours	5 hours

4) Working hours per day and working days per year

$$\text{The number of working bays} = \frac{\text{the working hour of one year for periodic inspection per year}}{\text{The working hour at the workshop per year}}$$

$$= \frac{(4 \text{ hours}) \times (220) \times (6 \text{ times})}{(264 \text{ days}) \times (6 \text{ hours})}$$

$$= 3.4 \text{bays} \quad \rightarrow 4 \text{ bays}$$

Therefore 4 working bays for periodic inspections and 4 working bays for light repairs, or 8 working bays in total will be applied.

One working bay is planned to be 5m in wide, 10m long and 5m high, which is big enough for the inspection and maintenance of a 7-ton detachable container truck (hook haul).

(2) Platforms

Since vehicle maintenance is improved when it is possible to conduct inspections and washing from underneath, platforms for two vehicles shall be installed. Moreover, a high-pressure washing machine

has been included for vehicle washing.

(3) Ventilation Equipment

Since the vehicle maintenance section has openings in the east-west directions and ample circulation of air can be anticipated, natural ventilation shall be adopted. In the offices, ceiling fans will be used to adjust ventilation.

(4) Electrical Equipment

In view of the electricity situation in Bangladesh, a generator (10kVA) shall be installed as a backup power supply in order to enable inspection and maintenance work to be continued during power interruptions. This backup power supply will permit operation of lighting, ceiling fans and water supply pumps, etc., however, use of power tools will not be included in the allowable capacity.

(5) Workshop Maintenance Equipment and Tools

Equipment and tools required for general periodic inspection and maintenance work shall be planned, and a storeroom shall be planned as management space for preventing loss of equipment, etc.

(6) Administration Section

1) Offices and data room

The vehicle maintenance section that was newly established in the Solid Waste Management Department in July 2008 needs office space, so four offices and one data room have been included in the design here.

2) Toilets

Men's and women's toilets for office staff and visitors shall be provided together with a separate toilet for mechanics in the vehicle maintenance section.

2-2-3-3 Building Structure and Foundation Plan

(1) Outline

- The building is a single-story workshop with the purpose of inspecting and maintaining solid waste transportation vehicles, and offices are included for use by the vehicle management section. Since heavy vehicles will frequently enter and leave the facility, structural consideration is required concerning the foundations and floor.
- Since the workshop is a vehicle maintenance facility, in accordance with the Bangladesh National Building Code, the level of importance of structure shall be I (I = 1.25).

(2) Applicable Codes and Standards

Basically the Bangladesh National Building Code (BNDC) shall be applied. ACI, ASTM, BSI, JIS, AIJ etc. will be used where appropriate.

(3) Structural Type of Building

When deciding the structural type of the workshop, comparative review was carried out on the reinforced concrete structure and the steel structure. Steel structures have an advantage in that they enable smooth work progress in line with plant manufacture and site assembly of prefabricated members, however, in Bangladesh, whereas welded connection of pillars and beams can be frequently seen, bolt joints are not common. If localized fractures occur in parts affected by welding heat, this can have an impact on the overall structure. Moreover, since steel structure work is almost all executed on site, the work and implementation schedule are easily affected by the weather. On the other hand, reinforced concrete structures possess good resistance to localized external forces on joints during high winds and so on. Moreover, in terms of cost, due to the recent price inflation in steel materials, reinforced concrete structures are slightly less expensive than steel structures, and either structure can be adopted to build the same purpose structure. In terms of execution too, since rigid frame structures are generally adopted in Bangladesh, local contractors have ample experience and there are numerous skilled workers. Therefore, the reinforced concrete structure shall be adopted as the structural type of the workshop.

(4) Used Materials

The materials are as follows according to Bangladesh National Building Code.

1) Concrete

Plain Concrete	: fc'=17 N/mm^2
Structure Concrete	: fc'=21 N/mm^2

2) Reinforcing bars

Thin Bar (D13 or under)	: 40grade fy=276 N/mm^2
Thick Bar (D16 or over)	: 60grade fy=415 N/mm^2

In addition, materials subject to stresses produced by wind or seismic forces combined with other loads may be proportioned for stresses 33 percent greater than those specified in BNBC.

(5) Design Loads

1) Dead loads (BNBC)

Dead loads are based on Table 6.2.2 of BNBC. Moreover, other standards shown in the application standard are applied correspondingly if necessary.

2) Live Loads

It is based on Table6.2.3, Table6.2.4 of BNBC.

Roof	: 1.5 kN/m^2
Work bay	: 5.0 kN/m^2
Office	: 2.5 kN/m^2
Toilet	: 2.0 kN/m^2
Others	: 4.0 kN/m^2 (entrance, corridor. store)

3) Wind loads (BNBC)

Wind loads are as follows.

$qz=Cc*Ci*Cz*Vb^2$

Where,

qz	: Sustained wind pressure at height z (kN/m^2)
Cc	: Velocity-to-pressure conversion coefficient $Cc=47.2*10^{-6}$
Ci	: Structure importance coefficient
Cz	: Combined height and exposure coefficient
Vb	: Basic wind speed (km/h, in Dhaka): 210 km/h

4) Seismic loads

Seismic loads are as follows.

$V=Z*I*(C/R)*W$

Where,

V	: Horizontal basic shear
Z	: Seismic zone coefficient
I	: Seismic importance coefficient
R	: Response modification coefficient for structural system
W	: Total seismic dead load
C	: Numerical coefficient given by the relation

Dhaka City belongs to ZONE 2 under the zone classification, and has a seismic zone coefficient of Z= 0.15.

5) Combination of loads

Combinations of loads are as follows.

- Dead load + Live load (long-term case)
- Dead load + Live load + Seismic load (short-term case)

(6) Structural Plan of Building

The structural plan of the workshop is described below.

- 5m x 5m spaces have been uniformly arranged in order to construct a simple but tough structural frame.
- The bricks used for partitions are relatively heavy, and large and small beams are arranged to receive the brick walls.
- All walls are made from brick masonry and the structural frame adopts a rigid frame structure in both the horizontal and vertical directions.
- Foundations comprise rigid underground beams in order to reduce the impact of uneven subsidence.

(7) Foundation Plan

Isolated foundations, continuous footing, mat foundations and double slab foundations are classed as spread foundations. In the case of the Project facilities, spread foundations and pile foundations shall be compared in terms of economy and ease of execution and the best type shall be selected according to the geological state of the Project site. Judging from the current geological conditions, mat foundations are the most effective.

(8) Building Plan

The following floor plan, elevation plan and sectional plan have been adopted.

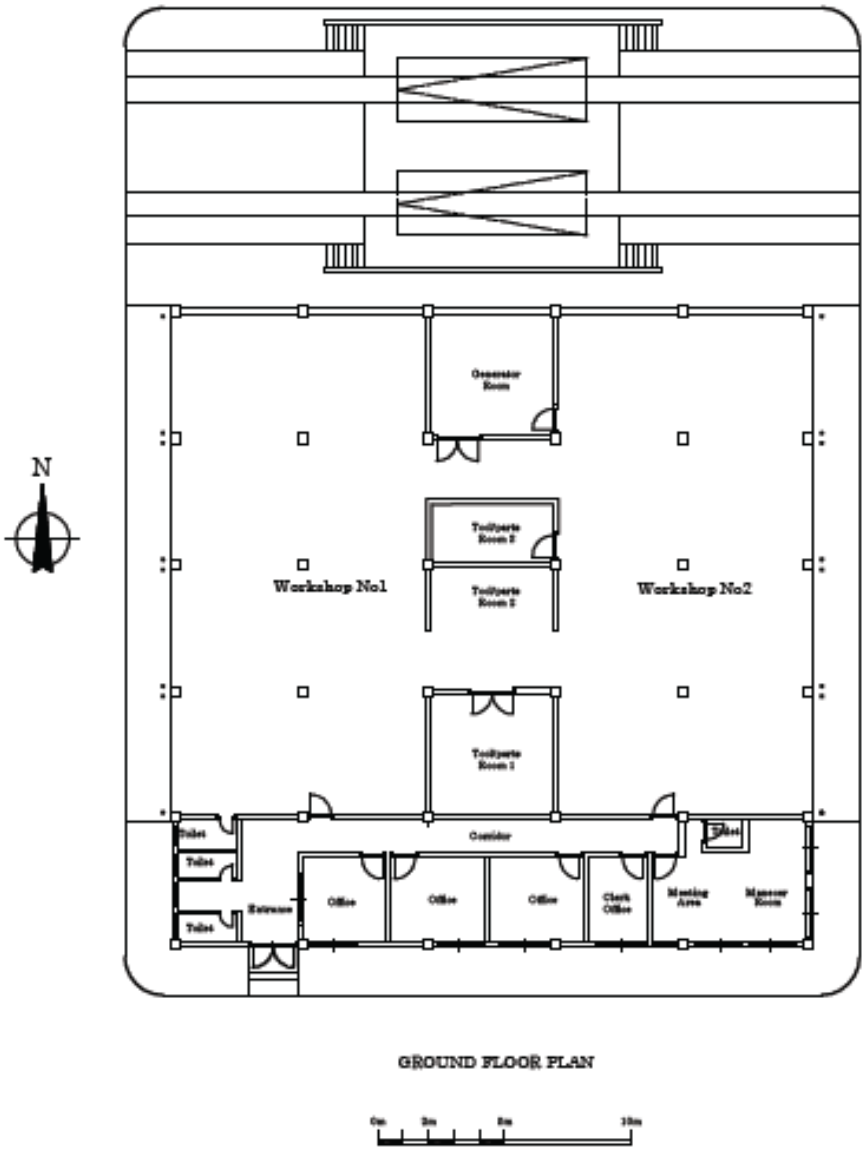


Figure 2-2 Workshop Floor Plan

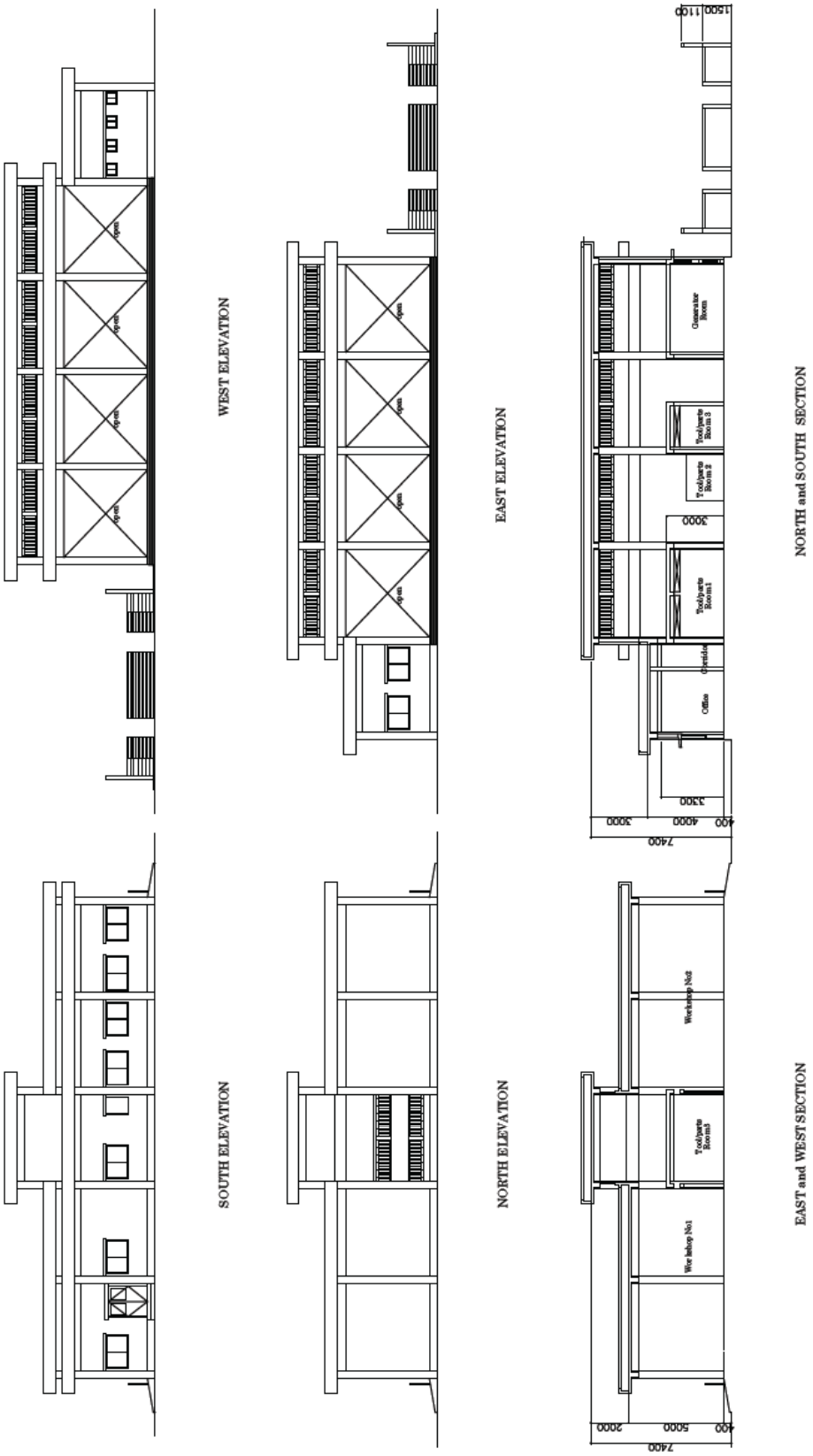


Figure 2-3 Workshop Elevation and Section Views

(9) Finishing

Since the workshop will be used for the dual purposes of vehicle maintenance and general office work, finishing specifications shall be set for each room according to the following table.

Table 2-12 Internal Finishing Specifications

Section	Room / Area	Floor	Skirting	Walls and columns	Ceiling
Vehicle maintenance and machine section	Work bays Equipment store Machine room	Concrete hardener finish	Steel troweled mortar & oil-proof painting	Steel troweled mortar & oil-proof painting	Steel troweled mortar & oil-proof painting
Administration section	Office Data room Entrance Corridor Toilets	Floor tiling	Skirting tiling		Ceiling boards & painting

Table 2-13 External Finishing Specifications

Area	Finish	Remarks
Roof and ventilation tower roof	Lime terracing waterproofing	With waterproofing
Parapet Eave ceiling Window roof External wall, columns	Steel troweled mortar and painting	

Table 2-14 Types of Fittings and Finishing Specifications

Section	Room / Area	Doors	Windows	Remarks
Vehicle maintenance and machine section	Work bay ventilating holes	-	Steel grille & painting	Long eaves
Vehicle maintenance and machine section	Work bay equipment store	Steel fittings & painting	-	
	Machine room		Steel grille & painting	
Administration section	Entrance	Steel fittings & painting & glass	-	
	Office Data room Toilets	Wood fittings & painting	Steel grille & painting Aluminum frames & glass	

2-2-4 Implementation Plan / Procurement Plan

2-2-4-1 Implementation and Procurement Policy

The Project will be implemented according to the scheme of the Government of Japan's Programme Grant Aid for Environment and Climate Change. Unlike general grant aid, since it is possible that local contractors will execute the works and that the waste collection vehicles will be procured by means of international tender, a Japanese procurement agent will be recruited to implement the tender work, contracting of local operators and fund management. Moreover, the local consultant and procurement agent will bind a contract for the implementation of detailed design and supervision of the facilities construction.

(1) Implementation Setup

Following the Exchange of Notes (E/N)・Grant Agreement (G/A) concerning the grant aid for the Project, the Government of Bangladesh will make agreement with the procurement agent including the services for management of the works supervision consultant and works contractor(s). The works supervision consultant and works contractor(s) will bind contracts with the procurement agent and implement their respective tasks.

1) Responsible Agency

The responsible agency for the Project is Ministry of Local Government, Rural Development & Cooperatives (MLGRD&C), Local Government Department (LGD).

2) Implementing Agency

The Project implementing agency is the Dhaka City Corporation (DCC), the Solid Waste Management Department. The Project will be implemented as a Programme Grant Aid for Environment and Climate Change undertaking based on the procurement agency agreement that is signed by DCC as the implementing agency on the Bangladeshi side and the Japanese procurement agent.

The primary related agencies on the Bangladeshi side are as follows:

- Ministry of Finance, External Economic Relations Department (ERD)
- Ministry of Local Government, Rural Development & Cooperatives (MLGRD&C), Local Government Department (LGD)
- Dhaka City Corporation (DCC)

Out of these agencies, the Ministry of Finance, External Economic Relations Department (ERD) is the agency of the Government of Bangladesh concluding the E/N・G/A with the Government of Japan, while the Ministry of Local Government, Rural Development & Cooperatives (MLGRD&C), Local Government Department (LGD) is the central agency with jurisdiction over DCC. Moreover, since DCC independently manages tender work and so on for related plans, it possesses adequate organizational and executive capacity as the contract partner of the procurement agent and smooth Project implementation can be anticipated. In addition, an inter-government conference comprising representatives from the main related government agencies on both sides will be established to discuss items requiring confirmation on the national level. Moreover, a working group will be set up between DCC, Japanese Embassy, JICA Bangladesh office and procurement agent in order to check on progress and discuss any technical points, etc. that may require confirmation.

The following figure shows the implementation setup for the Project.

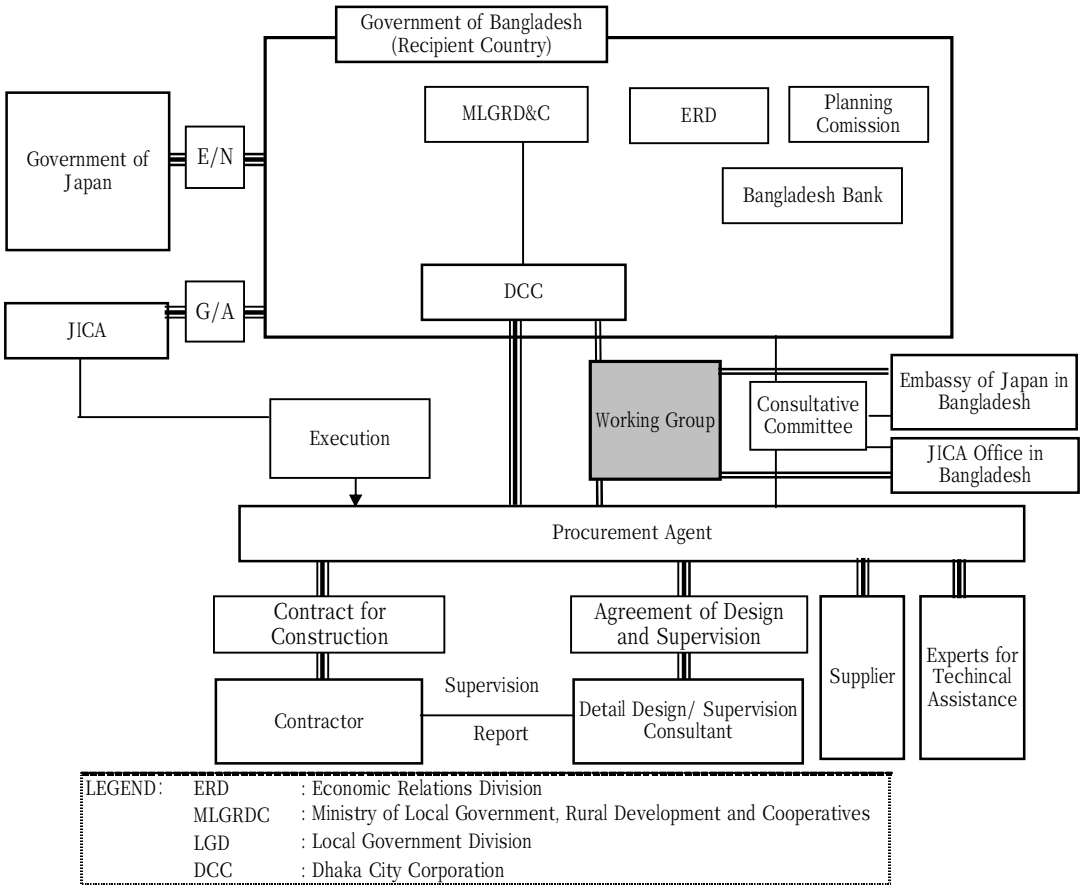


Figure 2-4 Project Implementation Setup

3) Procurement Agent

① Implementation Contents

The consultant that implemented the Outline Design Study will prepare the reference materials for preparing tender documents and supply them to the implementing agency on the Bangladeshi side. After that they will be handed over as the tender documents to the procurement agency, and the tender procedure and implementation works of the Project will begin. The procurement agent will be recommended by the Government of Japan to the Bangladeshi side and will conduct general supervision as the mandatory of the responsible agency to ensure that the components of the main works contract are appropriately and smoothly carried out.

Work during the implementation design period (tender procedures period) will comprise the agency agreement, bank arrangements, establishment of a local office, preparation of tender documents pertaining to the building contractor contract(s), distribution of tender documents, implementation of tender and assessment, and contracting work with building contractor(s) and supplier(s).

During the works supervision period, the resident manager dispatched from the Japanese procurement agent will conduct confirmation of the implementation contents (including payments and fund control and planning of use of residual funds), report on progress to both governments and maintain constant discussion, coordination and reporting with the Bangladeshi side.

② Implementation Setup

- Implementation design period (tender procedures period)

  Activities during this period will comprise the coordination of tender documents, confirmation of specifications and assessment of tenderers, however, since it is expected that there will be numerous tender lots due to the local construction situation, local assistant personnel will be recruited. Furthermore, since it will be necessary to respond to technical inquiries regarding the tender documents and evaluate the technical propriety of tender proposals, the Japanese consultant will offer assistance in technical areas.

- Works supervision period

  The procurement agent will conduct general supervision during the execution period, however, since the Project site is located in the capital city of Dhaka and there is a good chance that a high quality local consultant can be found, such a consultant will be utilized under the supervision of the Japanese consultant, while supervision by the procurement agent will be limited to the confirmation of important points.

4) Construction and Procurement Supervision Consultant

The consultant that is selected by the procurement agent as the technical consultant will act as the construction and procurement consultant. In addition to supervising the quality, progress and safety, etc. of works as well as the quality, functions, performance and quantities of procured equipment, this consultant will check for external damage of equipment caused during transportation. Moreover, in cases where the consultant finds abnormal situations, it will promptly compile a report and hold discussions with the related parties. Also, the construction and procurement supervision consultant will assess the work progress of contractor(s).

5) Building Contractor(s) and Supplier(s)

The supplier(s) selected via tender by the procurement agent will accurately gauge and promptly perform the contents of the work based on the contract made with the procurement agency.

(2) Facilities Construction

Construction operators in Bangladesh are thought to possess the technical capacity and financial strength to construct the Project workshop. Moreover, specifications and quality levels will be set so that all the necessary equipment can be procured locally rather than depending on imports. Accordingly, assuming that local contractors can handle the works specifications, the works contractor(s) will be selected through international tender also open to local companies, and the successful bidder will be utilized as the works contractor(s). Moreover, the works will be ordered as a single lot also covering the repair tools equipped in the workshop and the all-in contract method will be adopted.

(3) Equipment Procurement

The solid waste collection vehicles comprising detachable container trucks (hook haul), compactor trucks, CNG container carriers and so on to be procured in the Project will be introduced to Bangladesh for the first time. Accordingly, instructors from the suppliers (makers) will conduct OJT concerning differences with the orthodox engines (fuel electronic injection, etc.) and operating methods of existing vehicles primarily focusing on the initial operation and handling of CNG

container carriers, etc.

Concerning the tendering for equipment, general specifications shall be set so that a wide range of suppliers and makers can participate, however, required performance items shall be prescribed concerning durability, fuel economy, exhaust gas quality, sufficient horsepower to climb disposal site hills, potential for long-term maintenance and so on. Moreover, tender will comprise international competitive tender whereby announcements will be made in Bangladesh and Japan and the procurement agent will stage the tender meeting in Japan. Incidentally, since some vehicle makers do not make separate bodies according to different types of vehicles, the vehicle tender shall be divided into two lots, i.e. one for CNG engine container carriers and the other for diesel engine detachable container trucks (hook haul) and compactor trucks, in order to secure competition between procurement companies and makers.

2-2-4-2 Important Points to Consider in Construction and Procurement

(1) Mode of Ordering Public Works in Bangladesh

1) Tender and Contract Procedures

Bangladesh implements numerous public works projects including roads and bridges, etc. DCC alone orders more than 100 projects per year. Public works are first advertised in at least two national or local newspapers; tenderers are ranked according to their financial capacity and works record, etc., and operators acquire tender qualifications according to the scale of each works. Assessment is implemented following implementation of the tender, however, if the value of the works order is no more than 240 million BDT (approximately 360 million yen), approval is required from the mayor of Dhaka. For contracts worth between 240 million BDT and 500 million BDT (approximately 720 million yen), approval is required from the Minister, while for projects worth more than 500 million BDT, approval is required from the Purchase Committee (composed of five ministers and chaired by the Minister of Finance).

2) Type of Contract

Works contracts in Bangladesh mainly consist of BQ contracts, which are based on works quantities, and lump-sum contracts. Concerning the facilities construction in the Project, it is scheduled to adopt the batch contract method also covering the procurement of equipment, materials and tools.

2-2-4-3 Scope of Works

The scope of the works of the Japanese side and the implementing agency on the Bangladeshi side in the implementation of this Programme Grant Aid for Environment and Climate Change are as indicated in the following table.

Table 2-15 Scope of Works

	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct gates and fences in and around the sites		●
4	To construct the parking lot		●
5	To construct roads		
	1) Within the site	●	
	2) Outside the site		●
6	To construct the building	●	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. The distributing line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (from storm sewer and other to the site)		●
	b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site	N/A	N/A
	b. The gas supply system within the site	N/A	N/A
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8	To bear the following commissions to the Japanese bank for banking services based upon the B/A		
	1) Payment commission		●
9	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products to the recipient	●	
	2) To exempt or bear tax and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	●
10	To accord all concerned parties, whose service may be required in connection with the supply of the products and the services under the contract, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
11	To exempt or bear on behalf of all concerned parties from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the contract		●
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant		●
13	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment		●
14	OJT concerning the workshop tools and equipment	●	
15	Maintenance of the facilities and procured equipment		●

Note: B/A: Banking Arrangement

●：Indicates the responsible party.

2-2-4-4 Works Supervision Plan / Facilities Quality Control Plan

(1) Need for Construction Supervision

The facilities construction in the Project entails design and contents targeting local contractors. Since local contractors possess fairly high technical levels, Class-A contractors under the Bangladeshi ranking system shall be targeted in consideration of the scale and grade of the facilities. In order to ensure that uniform quality levels are achieved in the Project, it will be necessary to conduct thorough technical guidance using Japanese consultants in parts. In particular, it may be a good idea to assemble the local consultants and stage an orientation workshop to teach the works supervision points and methods, reasons for securing quality and method of filling out works supervision documents, and thereby thoroughly ensure uniformity of the works supervision methods.

(2) Implementation Setup

During the period of works execution, the consultant will conduct the necessary site guidance and technical guidance primarily comprising quality supervision, schedule supervision and safety control, etc. required for implementation of the Project. It will also report on the progress and contents of work to the procurement agent and agencies on the Government of Bangladesh side. Moreover, in cases where technical problems arise, it will hold discussions, conduct examination and propose solutions. Monthly meetings will be staged for DCC officials, procurement agent, consultants and contractors in order to confirm and coordinate progress. In particular, works supervision will be bolstered through conducting on-site checks of frames and reinforcing bar arrangements prior to the placing of concrete for structures.

(3) Facilities Quality Control

No special construction materials are adopted in the Project, and building plans have been compiled in accordance with local works methods. Control will be implemented according to the following items to ensure that the facilities under construction and the manufactured and supplied materials satisfy the quality levels and work progress that are required in the contract documents.

1) Checking of working drawings and specifications of the used materials for facilities construction

Working drawings will be presented for confirmation prior to the construction works. Moreover, specifications and purchase certificates will be presented for the supplied materials to make sure that quality is certainly secured.

2) Visiting of equipment manufacturing and production sites or checking of inspection results

Where necessary, the manufacturing or production plants of purchased construction materials will be visited to implement inspections, confirm the quality of raw materials and check product inspection certificates, etc.

3) Supervision and confirmation of performance and finish

On the construction site, technical supervision and on-the-spot inspections will be implemented and any defects will be thoroughly fixed. In performance inspections, final work performance will be checked against the contents of shop drawings.

4) Inspection records

Regarding the locally recruited consultants, instruction will be provided in control guidelines and they will be required to keep inspection records for each structural member and process in order to ensure that definite supervision is efficiently implemented.

Table 2-16 Quality Control Items and Plan

Type of Work	Management Item	Testing (Inspection) Method	Testing Frequency
Foundation works	Bearing strength	Plate bearing test	2 points of spread foundations
	Pile supporting layer (where necessary)	Comparison between excavated soil and boring data; measuring	For each pile
	Pile bearing test (where necessary)	Loading test	Test piles
Earth works	Compaction	Visual inspection	All foundation bases
	Incoming soil quality inspection (where necessary)	Particle size test	Quarry: 1 site
Formwork	Performance	Dimensional inspection and photographs	All members
	Materials inspection	Plate thickness, quality and deformation	All members
	Assembly inspection	Visual check (gaps, reinforcing material, spacers)	All members
	Bar arrangement inspection	Number of bars, diameter, spacing, joint length, fixed length, covering thickness	Before concrete placement, all points
Concrete works	Aggregate particle size	Sieve-analysis test	Once
	Test mixing	Blending, water-cement ratio, compressive strength, slump and salt content	Once
	Compressive strength	Compressive strength test	Once for each region
	Slump	Slump test	Once for each region
	Water quality test	Salt concentration	Once
Reinforcing bars	Tensile strength	Tensile strength test	Once for each size
	General quality	Mill sheet inspection	Once for each lot
Brick work	Brick quality	Plant inspection	Once
Doors and windows	Quality of doors and windows	Visual inspection; measuring	When carrying in
Vehicle inspection tools	General quality and quantities	Visual inspection, trial operation, etc.	When carrying in

2-2-4-5 Equipments Quality Control Plan

(1) Workshop Equipment

The vehicle serving equipment to be procured under the Project shall comprise simple operations and easy maintenance in order to limit the operating burden on mechanics and also reduce the chance of mistaken operations.

Since missed regular inspections and maintenance can lead to reduced functions and shortened service life of equipment, the control setup will need to be reconstructed to ensure that such work geared to keeping equipment always in the best condition is implemented as a matter of course. Accordingly, it is planned to implement OJT on the handing over and starting to use the equipment.

Items of equipment planned under the Project that will require particular inspection and maintenance are indicated below together with the methods of inspection and maintenance.

Table 2-17 Equipment Requiring Routine Maintenance and Inspection Methods

	Name of equipment	Quantity	How to maintain
1	Inflammable gas analyzer	1	Adjusting when checking leakage of inflammable gas
2	Diesel smoke tester	1	Supplying and adjusting diesel smoke detecting paper
3	Generator	1	Changing engine oil
4	High pressure car washer	2	Cleaning filters
5	Air compressor	1	Filling and changing compressor oil
6	High pressure grease pump	1	Cleaning grease nipples
7	Oil pump	1	Cleaning pump cylinder
8	Washing bench	1	Changing cleaning oil

(2) Solid Waste Collection Vehicles

The Programme Grant Aid for Environment and Climate Change undertaking has the goal of realizing a low carbon society in the solid waste management utility of Dhaka City, and within that the improvement of waste collection and transportation capacity and reduction of CO_2 emissions are important issues. Therefore, the vehicles to be procured in the Project must be types that contribute to reduction of greenhouse gas emissions and to improvement of the global environment. Also, in order to cut operation and maintenance costs and thus reduce the annual budget of DCC following introduction, CNG engine vehicles with low fuel cost and the latest diesel engine vehicles with good energy efficiency shall be adopted. Meanwhile, concerning the compactor trucks (2 tons and 5 tons) and large detachable container trucks (hook haul) (7 tons) to be procured, low-rotation high-torque engines are needed because the vehicles will need to operate in the loaded state. Accordingly, these vehicles shall be procured not as gasoline engine but as diesel engine models.

2-2-4-6 Procurement Plan

(1) Equipment Procurement Plan

1) Workshop tools, equipment

Following discussions with the manager and assistant engineers of DCC Workshop 1 and the mechanical engineers of DCC solid waste management department, the quantities and contents of necessary workshop tools were examined. The resulting items and quantities are as shown in the following table.

Table 2-18 Tools, Equipment to be supplied to the Workshop

No.	Equipment Name	Quantity	Uses
1	Inflammable gas analyzer	1	Inspecting for leakage of inflammable gas
2	Diesel smoke tester	1	Inspection of diesel engine smoke emissions
3	High-pressure car washer	2	Improvement of chassis washing and maintenance efficiency
4	Air compressor (70L)	2	Improvement of maintenance efficiency through using air pressure
5	Hydraulic press	1	Attachment and removal of pressure-fitted parts
6	Garage jack	4	Jacking up of large vehicle wheel sections
7	Garage jack	4	Jacking up of medium-size vehicle wheel sections
8	Truck lift jack	1	Lifting up of large vehicle chassis sections
9	Truck lift jack	1	Lifting up of medium-size vehicle chassis sections
10	Rigid rack	8	Safety maintenance for large vehicles
11	Rigid rack	8	Safety maintenance for medium-size vehicles
12	Air gun (with hose and reel)	4	Compressed air blow cleaning work
13	High pressure grease pump	1	Greasing up of chassis sections
14	Oil pump	1	Oil injection
15	Wheel dolly	4	Wheel hub attachment and removal in large vehicles
16	Parts washing bench	1	Parts washing
17	Impact wrench	4	Bolt tightening and loosening work
18	Tool set (with board)	2	Medium-size vehicle maintenance
19	Large vehicle maintenance tools set	2	Large vehicle maintenance
20	Hand tools set	8	Light work
21	Torque wrench	4	Measurement of bolt tightening specified values
22	Rapid battery charger	1	Battery charging
23	Arc welder	1	Electric welding
24	Gas cutter and welder	1	Acetylene cutting and welding
25	Bench drill machine	1	Steel cutting work
26	Rapid cutting machine	1	Steel cutting work
27	Work bench	2	General work
28	Bench grinder	2	Steel cutting work
29	Vice	2	Parts fixing
30	Large vehicle puller set	1	Large vehicle maintenance
31	Puller set	1	Medium-size vehicle maintenance
32	Tap dice set	1	Screw correction
33	Parts storage tray	16	Work environment improvement
34	Steel rack	2	Tools arrangement and storage
35	Engine crane	2	Engine maintenance work

2) Solid Waste Collection Vehicles

The vehicles to be procured should satisfy the following specifications.

Table 2-19 General Specifications of Solid Waste Collection Vehicles

Items	Details	General specification
1. Body	Ladder type	Truck body structures are classified as ladder type and mono-cock type. The structure is complicated, and a special manufacturing method is applied (parts and welding) emphasizing thus a comfortable ride. A ladder type vehicle body (chassis) will be applied for easy body installation and excellent maintenance.
2. Engine	CNG engine	CNG engine can reduce 20% of CO_2, 85% of NO_X and 100% of PM compared to diesel engine. Therefore CNG engine should be applied as much as possible. Diesel engine will be applied for vehicles in which CNG engine can't be installed.
	Diesel engine	Diesel engine is strong enough to stand combustion in high temperature and high pressure. Therefore it is suitable for waste collecting vehicles as it can produce high torque with low engine revolution. Therefore diesel engine is applied for vehicles in which CNG engine can't be installed such as compactor truck and detachable container truck (hook haul).
	Base engine for CNG engine	CNG engine needs base engine which can be modified into a CNG engine. Waste collecting vehicles needs durability and reliability. Usually gasoline engine lasts only for 10 years when it is used for waste collecting vehicles, while diesel engine lasts 15 years. Therefore diesel engine will be applied as the base engine for CNG engine.
	CNG fuel control system	ECU (Electric Computer Unit), which can control proper ratio of CNG and the amount of air intake, will be applied to prevent imperfect combustion in order to minimize CO and HC emission.
	Diesel mechanical fuel injection	Because of quality of diesel oil in the market of Bangladesh and easier maintenance, mechanical control system will be applied in this project.
	Output	To get enough engine output to prevent polluted gas emission caused by imperfect combustion, more than 70 PS output for 2 ton vehicles, 100 PS for 3 ton, 150 PS for 5 and 7 ton vehicles are required.
3. Transmission	Manual transmission	A drive train conveys the engine revolution to the drive side and includes manual and automatic transmissions. Due to the poor environment such as bad road and hilly surroundings, a manual transmission will be adopted for easy regulation of speed and driving, good inspection and low cost.
4. Differential	Banjo type differential	Since this is a type generally used in large-sized vehicles, it is not necessary to list the specifications.
5. Steering	Power steering	As a driving device used in the severely rugged environment such as long distances and poor roads, and for easy operation for the driver (small power and large work volume), power steering will be adopted. Right hand drive will be applied in accordance with traffic regulations in Bangladesh.
6. Suspension	Leaf spring	Suspensions are classified as leaf spring and air suspension types. Since the emphasis on air suspension is to provide a more comfortable ride by adjusting the vibration depending on the service capacity through compressed air, it has a complicated design and requires experience to maintain. Therefore, a leaf spring type will be applied because of its simple structure, high reliability, easy maintenance and reasonable cost.
7. Other specification of chassis		The overall length, height and width will be decided in accordance with traffic regulations in Bangladesh depending on service capacity.
8. Cabin, Body	Metal work	The body and chassis easily get corroded because of the liquid from various kinds of waste. Therefore steel panels for the body should be thicker than 3mm to protect the body from corrosion.

Items	Details	General specification
	Painting	The body and chassis easily get corroded because of the liquid from various kinds of waste. Therefore paints for body should be electrode position coating to protect the body from corrosion.
9. Engine, Capacity, Container	3ton container carrier	Engine: CNG engine Carrying capacity: 3ton Carrying volume: Approx. $6m^3$ Type of container: Closed type with lids
	5ton container carrier	Engine: CNG engine Carrying capacity: 5 ton Carrying volume: Approx. $10m^3$ Type of container: Closed type with lids
	7ton detachable container truck (hook haul)	Engine: Diesel engine Carrying capacity: 7ton Carrying volume: Approx. $14m^3$ Type of container: 20 of Open top type 30 of Closed type
	2 ton compactor truck	Engine: Diesel engine Carrying capacity: 2ton Carrying volume: Approx. $4m^3$
	5 ton compactor truck	Engine: Diesel engine Carrying capacity: 5ton Carrying volume: Approx. $10m^3$
10. Spare parts for equipments	Consuming spare parts	Sudden increase of maintenance and management cost is expected with the introduction of new vehicles. Therefore spare parts expected to be needed during the two years after their introduction are to be estimated and procured. Irregular consumables, such as tires and batteries, can be procured locally and, therefore, will not be included in the Project.
11. Spare parts for vehicles	Maintenance equipments	Such equipments will be applied so that, with proper maintenance, fuel efficiency can be improved and the running cost and the CO_2 emission of newly introduced vehicles can be decreased.

(2) Equipment Procurement Plan

The collection vehicles shall be procured from DAC (Development Assistance Committee) countries in order to secure high quality, endurance and longer life time.

On the other hand, the equipment required for construction of the Project facilities will be conducted based on the contract between the procurement agent and the works contractor. Construction of the facilities includes the building foundations, structures, plumbing and sewerage facilities, electrical facilities and tools and equipment required for vehicle maintenance, however, since this study has revealed that all the necessary equipment can be procured on the local market, no items shall be imported from Japan or third countries.

The following table indicated the procurement sources of equipment.

Table 2-20 Counry of Origine of Collection Vehicles

Item	Country of Origin			Remarks
	Bangladesh	Japan	3rd Country	
Collection vehicles		○		DAC[1] (Development Assistance Committee) including Japan and other countries
Ratio (%)		100%		Procurement from Japan and third countries

[1] It comprises 23 members: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States and the European Commission.

Table 2-21 Counry of Origine of Construction Equipment

Item	Country of Origin			Remarks
	Bangladesh	Japan	3rd Country	
[Materials]				
Portland cement	○			
Concrete aggregate	○			
Reinforcing bars	○		○	
Concrete blocks	○			
Timber and formwork	○			
General steel materials	○		○	
Steel fittings	○		○	
Paint	○		○	
Temporary installation materials	○			
Furniture	○			
[Construction machinery]				
Vehicles	○		○	
Dump truck	○		○	
Concrete mixer	○		○	
Concrete plant	○		○	

Table 2-22 Counry of Origine of Workshop Equipment

Item	Country of Origin			Remarks
	Bangladesh	Japan	3rd Country	
Vehicle maintenance equipment		○	○	

2-2-4-7 Initial Operation Guidance and Operation Guidance Plan

The solid waste collection vehicles to be introduced in the Project comprise items such as (1) CNG engine vehicles, (2) detachable container trucks (hook haul) and (3) compactor trucks, etc. that the DCC workshop has no prior experience of. Accordingly, since it will be necessary to conduct initial operation guidance for the vehicles and special instruments, guidance targeting DCC mechanics and drivers will be carried out according to the contents shown in the following table.

Table 2-23 Guidance Contents concerning Procured Vehicles and Equipment

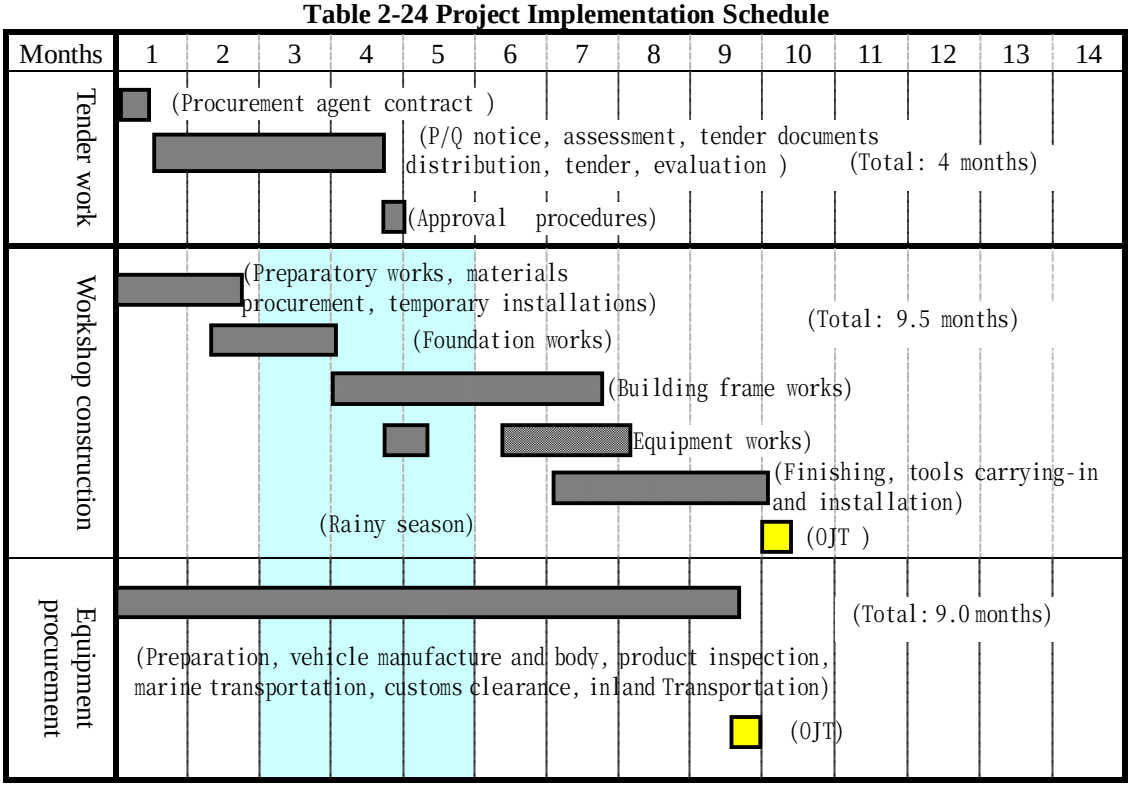
Item	Guidance items for drivers	Guidance items for mechanics
CNG engines	- Understand the special features of CNG engines. During operation, since engine output close to that of gasoline engines is generated, take care not to over-rev the engine (higher than the prescribed revolution speed). - Understand and implement routine inspection.	- Understand the combustion system of CNG engines. Since the same spark plug combustion method as gasoline engines is adopted, the engine inspection method differs from that for diesel engines. - Understand the method for handling high pressure gas devices. In particular, fully understand gas leakage inspections. - Understand routine inspection and periodic inspection methods.
Detachable container trucks (hook haul)	- Understand the proper way to mount and remove detachable containers. In particular, it is necessary to keep the container and vehicle parallel when mounting. - Understand the proper way to dump containers. - Understand routine inspection.	- Understand the proper way to mount and remove detachable containers. In particular, it is necessary to keep the container and vehicle parallel when mounting. - Understand the proper way to dump containers. - Understand the hydraulic equipment on the arm section. Moreover, understand the inspection method for the container section. - Understand routine inspection and periodic inspection methods.
Compactor trucks	- Understand the proper way to operate the compactor rotating section. Also understand operation of the emergency switch for preventing accidents. - Understand the procedure for discharging waste from the compactor. - Understand routine inspection.	- Understand the proper way to operate the compactor rotating section. Also understand operation of the emergency switch for preventing accidents. - Understand the procedure for discharging waste from the compactor. - Understand the hydraulic equipment and electrical wiring for operating the compactor and acquire sufficient understanding to conduct maintenance. - Understand routine inspection and periodic inspection methods.

2-2-4-8 Implementation Schedule

Since the foundation works and structure works will coincide with the rainy season, measures will need to be taken in order to minimize the reduction in work efficiency at this time.

The implementation schedule following the E/N・G/A is as follows.

Table 2-24 Project Implementation Schedule



2-3 Technical Assistance Plan

(1) Background to the Technical Assistance Plan

In introducing new vehicles such as the compactors, detachables and CNG trucks that DCC has never handled before, it will be essential to construct a comprehensive maintenance setup for all collection vehicles. For this reason, in addition to OJT by the makers, it will be necessary to implement technical assistance based on the specifications of Project vehicles, design policy and required know-how of the workshop. Moreover, in order to realize the Master Plan, a technical cooperation project supporting the plan is being implemented. The technical assistance planned in the Project will comply with and complement the existing plan. Moreover, concerning global warming countermeasures, since general awareness is low, the introduction of CNG vehicles will be utilized as an opportunity to raise awareness about global warming.

1) Need for Environmental Education

While international efforts are required in order to take global warming countermeasures and form the recycling-oriented society, reform of awareness and lifestyle patterns among individuals who implement such efforts is also indispensable. The Project entails hard global warming countermeasures in the form of procurement of CNG vehicles. However, improved awareness among drivers and managers aimed at avoiding sudden acceleration and idling, etc. is also essential.

In addition to DCC employees, citizens must also acquire better awareness and take steps on the individual level, however, DCC is not implementing any global warming awareness promotion activities for citizens. It will be required that background, contents and effects of the Project should be awared by citizens though PR activities in order to promote continuous and sustainable

implementation of countermeasures against global warming.

2) Maintenance Setup in Workshop-1

DCC has so far conducted solid waste collection utilizing open trucks and container carriers, etc. However, since compactor trucks and detachable container trucks (hook haul) will be procured in the Project, it will be necessary to build a workshop maintenance setup that corresponds to these new types of vehicles. Another problem is that existing workshop maintenance records do not contain travel distances and other information that is essential for maintenance. In order to secure the appropriate operation and maintenance of the Project, it will be essential to improve the maintenance system in Workshop-1.

3) Awareness and Technical Level of Drivers and Mechanics

At DCC, mechanics implement the periodic inspection and maintenance of collection vehicles, however, problems exist in that oil changes are not thoroughly implemented. Furthermore, inspection before and after operation is not adequately carried out, so there is need to make personnel once more recognize the need for proper maintenance and inspection.

Meanwhile, the workshop mechanics do not possess maintenance qualifications but rather have acquired their skills based only on their vehicle maintenance experience so far. However, in order to conduct proper maintenance, it is necessary to learn about inspection methods and maintenance know-how based on proper theory. In particular, since compactor trucks entail far more complicated structure than existing collection vehicles, it will be essential to conduct maintenance based on correct know-how.

4) Setup for receiving CNG vehicles

CNG vehicles have already been introduced to DCC, however, this is the first time that the Solid Waste Management Department has had CNG collection vehicles. Accordingly, it will be essential to conduct safety education on CNG. Moreover, CNG gas refilling will need to be performed based on a contract with a private sector CNG station that is very congested. However, since solid waste treatment is a public service that cannot be suspended for even a day, depending totally on the private sector for CNG refilling threatens sustainability of services. Expanding use of CNG vehicles is compliant with the policy and social trend of Bangladesh, however, in the solid waste management sector, since no blueprint for extending CNG vehicles currently exists, it will be necessary to draw up a plan in future.

5) Division of Roles with the Technical Cooperation Project

Currently JICA is implementing the Project for Strengthening of Solid Waste Management in Dhaka City. This project aims to optimize and reorganize inefficient collection. However, it does not include improvement of maintenance manuals and the workshop management setup. Moreover, because the Master Plan does not include any contents concerning CNG vehicles, compactor trucks and detachable container trucks (hook haul), there is no redundancy.

(2) Goals of Technical Assistance

The Project, which is a co-benefit cooperation undertaking, aims to improve solid waste treatment and

transportation in DCC and at the same time to promote realization of a low carbon society in the solid waste management utility. Therefore, technical assistance shall be implemented in line with the following goals:

a) Present an opportunity for DCC employees and the citizens of Dhaka to realize the importance of global warming countermeasures and to review their own behavior patterns.

b) Appropriately operate and manage the equipment supplied in the Project to ensure that the solid waste management utility is efficiently implemented.

c) Compile measures for expanding use of CNG vehicles within the administration of the solid waste management utility.

Table 2-25 Target, Output and Input

Goal	Output	Input			
		Expert	Assistant	Others	
DCC staff and citizens will be aware of global warming and greenhouse gas effect and will come to review their own behavior patterns.	Global warming and greenhouse gas effect will be recognized by DCC staff and citizens through campaign and seminar activities.	Environmental education expert 4.5 months	Environmental education assistant 4.5 months	Posters, newspaper PR, prizes, stickers, room rantal fee etc.	Transportation, copy, print
Emission of carbon dioxide will be reduced and collection of solid waste will be improved through proper operation and maintenance of collection vehicles.	Proper maintenance will be implemented through newly prepared maintenance manual. Newly introduced collection will be properly maintained with high operation ratio.	Mechanical expert 5.0 months	Mechanical assistant 5.0 months	—	
Emission of carbon dioxide will be reduced through promotion of utilization of CNG vehicles.	CNG promotion plan will be formulated. Construction plan of CNG station of DCC will be formulated.	CNG expert 5.0 months	—	—	

(3) Outputs of Technical Assistance

The outputs of technical assistance are as follows:

a) Through implementing seminars and a public relations campaign concerning global warming, citizens will have a wide awareness of the Project and its objectives.

b) Vehicle maintenance manuals will be compiled, thus enabling appropriate maintenance to be implemented.

c) Newly procured vehicles will be properly maintained and operating rates kept at high levels.

d) Policy for DCC to expand use of CNG vehicles within the administration of the solid waste management utility will be compiled by 2010.

e) A draft plan for a CNG station belonging to DCC will be compiled by 2010.

(4) Velification Method for Achivement

The velification method for achievement of the outcome is shown as follows:

Table 2-26 Velification Method

Output	Indicator	Velification Method
Global warming and greenhouse gas effect will be recognized by DCC staff and citizens through campaign and seminar activities.	Degree of recognition on global warming and greenhouse gas effect by DCC staff and citizens.	Questionnaire survey for DCC staff and citizens in the selected areas before and after the environmental education
Proper maintenance will be implemented through newly prepared maintenance manual. Newly introduced collection will be properly maintained with high operation ratio.	Operation ratio of collection vehicles Number of mechanics implementing the maintenance manual	Operation ratio of collection vehicles will be surveyed by type and average. Number of mechanics implementing the maintenance manual will be surveyed at the end of phase-1 and phase-2.
CNG promotion plan will be formulated. Construction plan of CNG station of DCC will be formulated.	Formulation of CNG promotion plan Formulation of construction plan of CNG station of DCC	Progress of formulation of CNG promotion plan and CNG station construction plan will be monitored by the expert.
Objective	Indicator	Velification Method
Strengtening of capacity for collection of solid waste by DCC	Amount of waste collected per day Increase of collection rate	Amount of waste collected per day and increase of collection rate will be surveyed at the end of phase-1 and phase-2.
Reduction of emission of carbon dioxide in collection and transportation of solid waste in DCC	Quantity of reduced carbon dioxide	Amount of comsumed fuel, mileage and quantity of emitted carbon disxide will be surveyed.

(5) Technical Assistance Activities (Input Plan)

Three expert, i.e. an environmental education expert, mechanical expert and CNG expert, will be dispatched to implement the following technical cooperation. Moreover, the technical assistance will be implemented over two phases: Phase 1 between January and April 2009 following conclusion of the procurement agent agreement with the Bangladesh side, and Phase 2 between December 2009 and February 2010 following the arrival of equipment and completion of the workshop.

To maximize the outcome of the technical assistance, and also in order to materialize the objectives of the project, all the activities shall be done in a comprehensive manner as a package. Besides, all the inputs shall be made timely in accordance with the progress of procurement of equipment and construction of facilities.

1) Technical Assistance for Public Relations and Enlightenment

(a) Implementation of environmental education (guidance and enlightenment on reducing greenhouse gases)

Public relations (PR) activities will be carried out concerning Project implementation, the need for global warming countermeasures and assistance in cooperation with DCC after study of the present conditions. Towards this end, design with message of global warming and greenhouse gas effect for the new collection vehicles will be chosen from among the public.

(i) Preparation and Display of Posters

Prioritized areas will be selected from the wards where the new compactor trucks will be introduced in this project. Bengali posters with message of global warming and greenhouse gas effect will be prepared with DCC counterpart and the posters will be put up on highly visible walls etc in the selected areas.

(ii) Seminar on global warming

In order to aware importance of countermesures against global warming and the project, seminars will be held for DCC staff, personnel of local solid waste management offices and community leaders with

preparation of Bengali and English seminar materials in phase 1. In phase 2, the result and effect of the campaign and seminars will be monitored with comparison to the areas where the campaign was not carried out. Reflectiong the study of the monitoring, seminars will be held for personnel of local solid waste management offices and community leaders in the areas outside selected in phase 1.

(iii) Seminar to the Drivers

With respect to collection and transportation from the viewpoint of reducing greenhouse gases, seminars for collection vehicle drivers will be given in phase 1. The seminars will have the following contents:

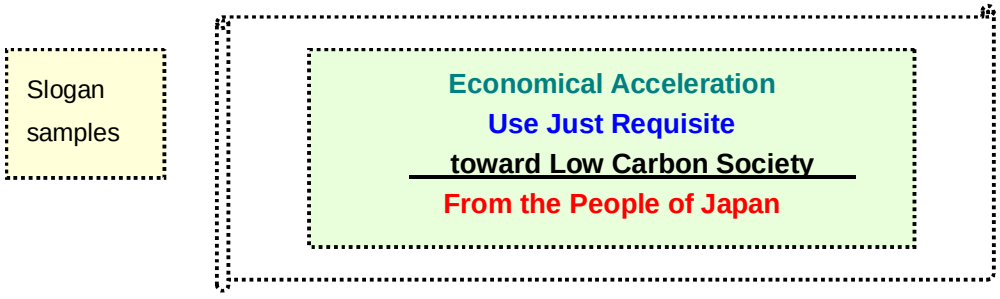
- ◊ Global warming and reduction of emission of greenhouse gas
- ◊ Education concerning greenhouse gas reduction activities that can be implemented by individuals (reduction of idling and sudden acceleration)
- ◊ Guidance on starting inspections, finishing inspections, periodic inspections, maintenance and vehicle and container cleaning

(iv) Sustainable PR Activities

The expert will share information on global warming and reduction of greenhouse effect gas with newly assigned persons in charge, and will prepare effective and strategic promotion plan for PR of this subject in order to continue the activities and efforts sustainably.

(b) Advertisement for collection and transportation designs and raising of awareness for greenhouse gas reduction

Stickers carrying catchphrases or illustrations about global warming prevention will be attached to the vehicles procured in the Project. A public contest will be held to obtain designs and base colors for the stickers. Advertisements will be placed in the major newspapers and citizens will be asked to submit their design ideas. The design selection contest will be open to citizens and municipal employees. The best designs will be selected by the committee organized for this sake with DCC. Commemorative prizes (trophies) will be awarded to three contestants submitting excellent designs. The winner for adopted design will get extra prize of practical use. “Eco bags” made with jute will be offered as promotional prizes. The experts will provide management in advertising for designs and planning and staging the contest.



(c) PR on collection vehicle bodies for greenhouse reduction and activities

The introduced collection vehicles (100 number) carrying stickers will be used to conduct a PR campaign for reduction of greenhouse gases and higher awareness of low carbon activities. In tandem with this campaign, newspaper advertisements (four major newspapers) will be conducted to promote greenhouse gas reduction activities and encourage better waste discharge habits on the individual level, at time of handing-over ceremony. Press releases of mass media (newspaper, radio and television) will

be promoted in order to enhance the effect of publicity. The experts and local consultants will assist formulation of the campaign plans and the campaign will be implemented by DCC with help from the local consultants.

2) Technical Support for Workshop Maintenance

(a) Issues

(i) Present Condition

The system and rules for maintenance for the collection vehicles are not established. Consciousness for maintenance of the drivers and the mechanics is not clear. For example, oil is not changed properly that may cause defects and short lifetime. Sometimes vehicles are continuously operated until they break down. In stock management of spare parts, records are taken but procurement would be made after it becomes requied and that might cause waste wating time. This leads to lower the operation rate and increase of maintenance and repair cost.

Also training and sharing of maintenance technique from the expert machanics to young and inexperienced mechanic is not properly carried out without adequate rules.

(ii) Countermeasures toward improvement

Preventional maintenance avoiding vehicle troubles from occurring shall be important. Therefore the following shall be implemented accoding to a rule:

◊ Daily checking by drivers
◊ Periodical inspection by mechanics
◊ Effective and planned stock management of spare parts
◊ Administration and control by supervisers

The methods of the above shall be trained by a module of the training course. The recording and reporting system of maintenance and inspection shall be established. Awareness for maintenance of the drivers and the mechanics shall be improved. The rules shall be established and the training course shall be conducted periodically. The capacity of the workshop shall be maintained and improved. Quality control shall be established preventing from moral degeneration and habituation.

(b) Establishment of the maintenance and periodic inspection system of the vehicles including compactor trucks and detachable container trucks (hook haul)

In order to realize the efficient maintenance of equipment, the experts in Phase 1 will assist the preparation of inspection (before operation and after operation) manual, periodic inspection manual, maintenance manual and special equipment manual. A maintenance information recording and reporting system will be guided by the expert including daily maintenance, operation and inventory of spare parts etc. using computers prepared by DCC. This data system will be utilized for planning and control of vehicle maintenance and inventory of spare parts.

(c) Training for mechanics and drivers on maintenance and routine inspections also covering compactor trucks and detachable container trucks (hook haul)

The experts will implement the following training.

Table 2-27 Maintenance and Routine Inspection Training

Target	Drivers	Mechanics
Timing	Phase 1 (Phase 2 : monitoring)	Phase 1 (Phase 2 : monitoring)
Policy	Before vehicles are introduced, offer guidance to drivers on inspection methods before and after operation.	Acquire inspection methods according to the periodic inspection manual.
Teaching materials	Inspection (before and after operation) manual (English and Bengalese)	Periodic inspection manual, periodic inspection record ledger (English and Bengalese)
Practical	- Fuel consumption and fuel management (show tainted oil and actual fuel consumption during idling to convey the importance of reducing fuel wastefulness). - Caution points in vehicle washing - Implementation of pre-operation inspections - Implementation of post-operation inspections	- Implementation of periodic inspections - Entering of periodic inspection record logs
Course work	- Lecture on engine and chassis structure - Lecture on energy saving driving - Lecture on pre-operation and post-operation inspections - Lecture on vehicle periodic inspections	- Lecture on engine and chassis structure - Lecture on basic maintenance work and work comparison using photographs - Lecture on pre-operation and post-operation inspections - Lecture on vehicle periodic inspections
Timing	Phase 2	Phase 2
Policy	Special equipment/CNG will be properly operated.	Special equipment/CNG will be properly mainteained.
Teaching materials	Special equipment/CNG manual (English and Bengalese)	
Contents	Maintenance and inspection manuals will be monitored and OJT will be implemented. Conduct guidance in appropriate methods of operating special equipment/CNG. In particular, help automotive electronics mechanics and hydraulic equipment mechanics understand the structure and operating systems of devices and become capable of conducting breakdown diagnoses and maintenance work.	

(d) Introduction and implementation of training with internal qualification for mechnics (also covering compactor trucks and detachable container trucks (hook haul))

Basic survey on each mechanic's experience and skill levels and collect information to provide the basis for training will be carried out. The experts will assist in introducing training with internal qualification geared to promoting the acquisition of correct know-how and theory by mechanics throughout Phase 1 and Phase 2. In particular, practical training methods will be examined and capable mechanics will be qualifid after proper attendance of the traing and final onsite checking. Important maintenance skills such as maintenance of brakes will be checked based on individual qualification because of safety and avoidance of serious accidents.

Table 2-28 Training with Internal Qualification for Mechanics

Target	Mechanics, supervisors
Timing	Phase 1, 2
Policy	Vehicles and equipment will be maintained properly through training with internal qualification system
Teaching materials	Training manual/material, qualification guideline (English and Bengalese)
Contents	Training with internal qualification system will be made. Unskilled mecanics will be trained to responsible mechanics who can carry out reliable maintenance work. Capability of skilled mechanics will be improved and will work as trainer in the training.

(d) Guidance on periodic inspections, maintenance and repairs using the introduced workshop equipment

The experts will conduct the following practical guidance. The status of OJT will be momitored observing comformity of the manuals. The experts will carry out follow-up guidance at appropriate times.

Table 2-29 Practical Guidance for Operation and Maintenance of Workshop Equipment/Tools

Target	Drivers, mechanics, supervisors
Timing	Phase 2
Policy	Following establishment of the maintenance system targeting pre-operation and post-operation inspections and periodic inspections, etc. in Phase 1, conduct guidance on the role of special equipment, structure and maintenance method of the newly introduced vehicles.
Teaching materials	List and Manual of Workshop Equipment and Tools (English and Bengalese)
Contents	Conduct guidance in appropriate methods of operating special equipment. In particular, help automotive electronics mechanics and hydraulic equipment mechanics understand the structure and operating systems of devices and become capable of conducting breakdown diagnoses and maintenance work.

3) CNG Station Plan Assistance and CNG Safety Management Guidance

(a) CNG station plan assistance

The experts will assist DCC in compiling a plan for expanding use of CNG vehicles in Phase 1. They will also help DCC compile a plan for constructing its own CNG station. In Phase 2, they will help selecting a specific and appropriate site for the CNG station and preparing the outline design of the necessary equipment. CNG stations will be constructed by DCC.

(b) Guidance in CNG safety and maintenance

The experts will conduct the following guidance.

Table 2-30 CNG Safety and Maintenance Guidance

Target	Drivers, mechanics, supervisors
Timing	Phase 2
Policy	Drivers will be taught about driving methods based on CNG engine characteristics. Moreover, mechanics will receive training in maintenance taking into account CNG vehicle safety.
Teaching materials	Special equipment/CNG manual (English and Bengalese)
Contents	Conduct guidance in appropriate operation methods of CNG equipment. In particular, help mechanics understand the structure and operating systems of CNG engines and become capable of conducting breakdown diagnoses and maintenance work.

(6) Technical Assistance Implementation Schedule

The following figure shows the implementation schedule.

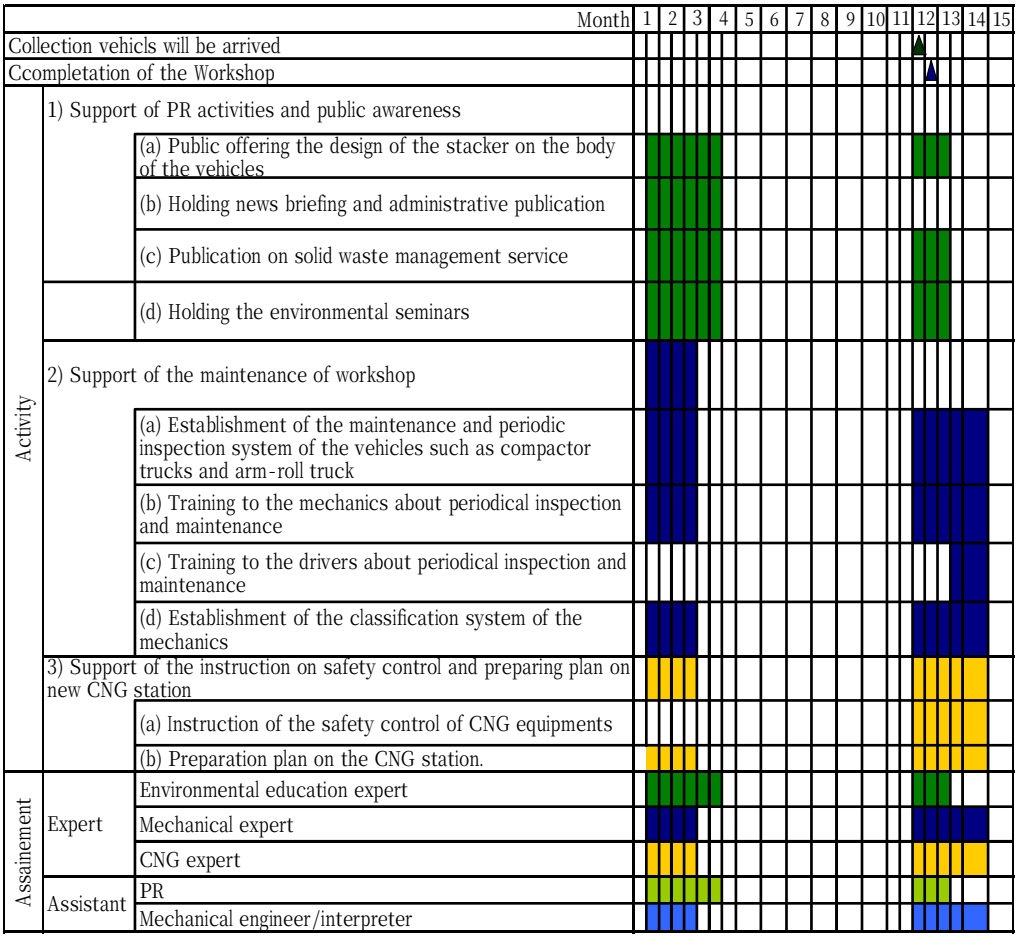


Figure 2-5 Technical Assistance Implementation Schedule

(7) Outputs

The experts will submit the following outputs to DCC, JICA and JICS.

Table 2-31 List of Outputs

	2009		2010	
	Phase 1		Phase 2	
	June	July	April	May
Environmental education expert	Low carbon society poster (plastic laminated) and seminar materials	Progress report	Final report (including monitoring)	
Mechanical expert	Pre-operation and post-operation inspection manual, periodic inspection manual, maintenance manual, special equipment/CNG manual, Progress report 1		Progress report 2 (emergency improvement plan)	Final report (including monitoring), final versions of the manuals
CNG expert	CNG promotion draft plan, CNG station basic concept, Progress Report 1		Progress report 2 (emergency improvement plan)	Final report (including monitoring), CNG promotion plan including the CNG station plan

(8) Responsibilities on DCC Side

DCC will assign the counterpart including a coordinator and four personel for the experts, and implement the improvement in cooperation with the experts.

Table 2-32 List of Counterpat and Responsibilities

Position	Coordinator	Environmental education expert	Mechanical expert	CNG expert
Counterpart	Coordinator: 1	Environmental education: 1	Mechanical Leader / Workshop: 1 Mechanic: 1 Drivers: 1	CNG planner: 1 CNG safety: 1
Assistant Counterpart		Several	Workshop: 1 Accountant: 1 Inventory control: 1 Mechanics: 1 Drivers: 1	
Responsibility of DCC	◊ Coordination ◊ Financial arrangement ◊ Preparation of venues ◊ Monitoring ◊ Sustainable improvement and implementation	◊ Preparation and display of posters and materials ◊ PR ◊ Implementation of seminar and training ◊ Preparation of rules ◊ Monitoring	◊ Preparation and implementation of maintenance manuals ◊ Preparation of rules and materials for training for the mechanics ◊ Maintenance of records and analysis ◊ Monitoring	◊ Formulation of CNG promotion plan and construction plan of CNG station ◊ Preparation of site for CNG station ◊ Preparation of rules ◊ Monitoring

The proposed organization for technical assistance is shown as follows:

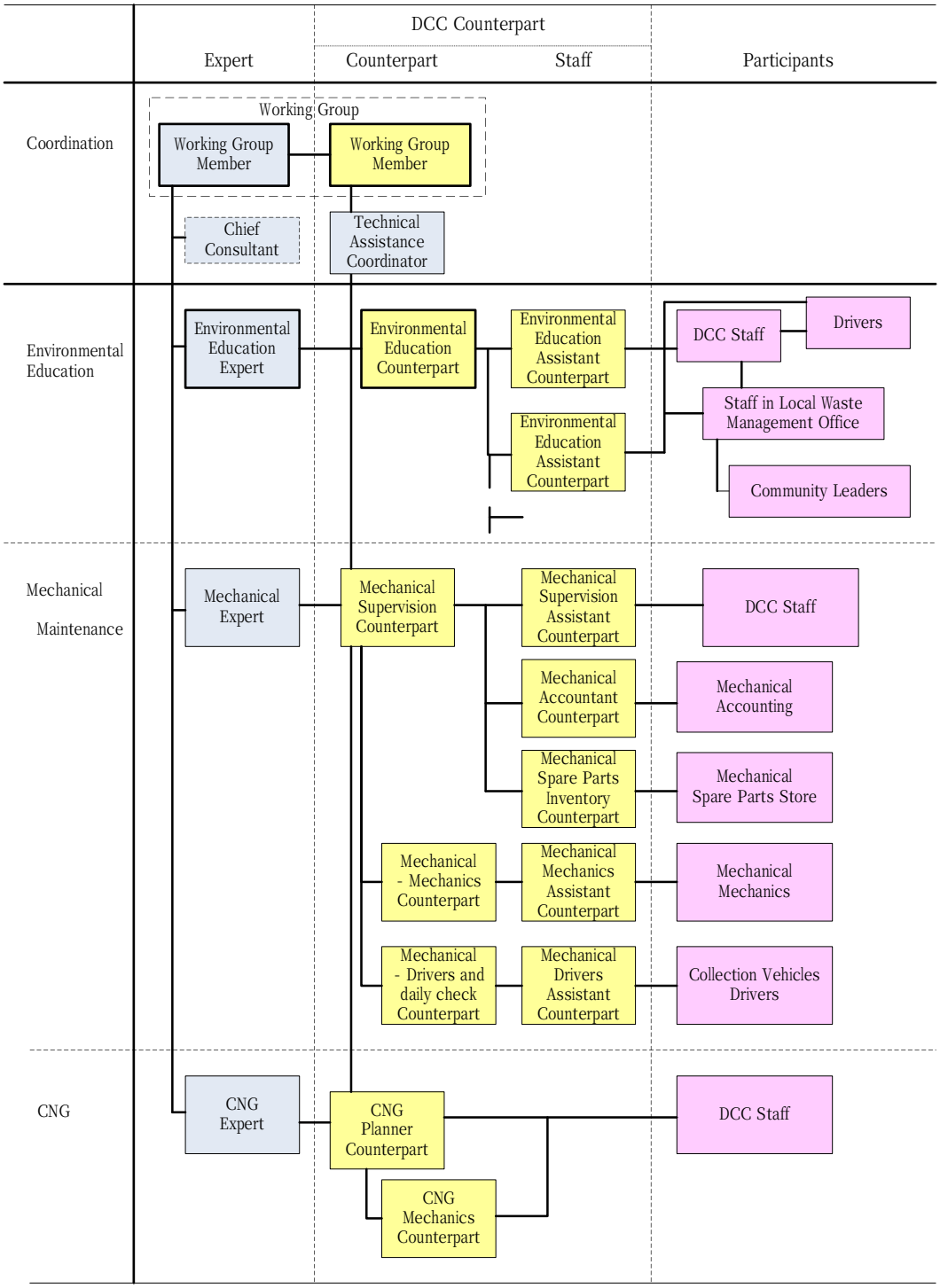


Figure 2-6 Proposed Organization of Technical Assistance

2-4 Obligations of the Recipient Country

Following the E/N・G/A, the Bangladeshi side will undertake the following works based on cooperation between the responsible agency and each implementing agency.

(1) General Items

◊ Opening an account with a Japanese bank and paying commissions arising from such payments.
◊ According Project officials (Japanese nationals and third country nationals) such conveniences as may be necessary for their safe entry into Bangladesh and stay therein.
◊ Exempting Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Bangladesh with respect to the supply of the equipments and services.
◊ Proper maintenance and use of the facilities and equipments procured and established under the Japanese Grant Aid.
◊ Payment of all expenses which are not covered by the Japanese Grant Aid but which are required for the Project.

(2) Items of Special Note

◊ Materials store yards and space for temporary installations shall be provided to the contractors free of charge.
◊ Site for the disposal of sediment and waste construction materials arising in the works shall be provided free of charge.
◊ Land clearance and permission for construction from related agencies shall be obtained.

2-5 Project Cost Estimation

2-5-1 Project Cost Estimation

The total cost of the Project entailing construction of facilities and procurement of solid waste collection vehicles is 1.2 billion yen. However, this amount does not indicate the aid limit given in the E/N・G/A.

2-5-2 Operation and Maintenance Cost

(1) Vehicles Operation and Maintenance Cost

The annual maintenance cost of the 100 collection vehicles to be procured in the Project is estimated as 49,814,000 yen as shown below.

Table 2-33 Annual Maintenance Cost of Collection Vehicles

Item		Amount (1000 Tk/year)	Remarks
Fuel cost	Light oil	5,985	68 Tk/L×4.97 L/day×322 days x 55 vehicles
	CNG	1,219	17 Tk/m^3×4.95 m^3/day×322 days ×45 vehicles
Periodic inspection and maintenance cost		9,260	Medium-sized vehicles 1,770, large-sized vehicles 7,490
Repair cost		33,350	Light maintenance 14,200, medium maintenance 16,900, heavy maintenance 2,250
Total		49,814	

(Classification of medium-sized and large-sized vehicles)

Medium-sized and large-sized vehicles were classified according to tire rim size, with 16 inches designated as medium-sized and 20 inches as large-sized vehicles.

Classification	Vehicle Type	Payload	Quantity	Tire size
Medium-sized vehicles	Container carrier	3	15	Rim diameter 16 inches
	Compactor truck	2	15	Rim diameter 16 inches
Large-sized vehicles	Container carrier	5	30	Rim diameter 20 inches
	Detachable container truck (hook haul)	7	20	Rim diameter 20 inches
	Compactor truck	5	20	Rim diameter 20 inches

1) Fuel cost

Assuming that vehicles travel 32.5 km per day, daily fuel cost is calculated as follows from the work mode. This figure is multiplied by the annual number of working days (360) and the operating rate (88.4%) to give the annual fuel cost. The fuel cost for newly introduced vehicles in 2009 is calculated as approximately BDT 9,570,000. In future, taking into account inflation in the cost of fuel, it is estimated that the fuel cost will rise by between 10~20%.

Table 2-34 Fuel Cost

Vehicle type	Payload (ton)	Number of vehicles	Travel distance (km/day) (a)	Work mode (km/L) (b)	Fuel cost (BDT) (c)	Daily fuel cost (BDT) (d)=a÷b×c× number of vehicles	Annual fuel cost (BDT) d×360×0.884 (operating rate)
CNG medium vehicles	3	15	32.5	7.0	17.0	1,183.9	382,006.4
CNG large vehicles	5	30	32.5	6.4	17.0	2,589.8	835,639.0
Diesel medium vehicles	2	15	32.5	7.0	68.0	4,735.7	1,528,025.6
Diesel large vehicles	5-7	40	32.5	6.4	68.0	13,812.5	4,456,741.3
						22,322.0	7,202,412.2

2) Periodic inspection and maintenance cost

The following table shows prices of parts and lubricants required for inspection and maintenance.

Table 2-35 Parts and Lubricants Price Sheet

Part name	Qty	Price (BDT)		Medium-sized vehicles		Large-sized vehicles	
		Medium-sized vehicles	Large-sized vehicles	Necessary quantity	Price (BDT)	Annual necessary number	Price (BDT)
Engine oil	L	600	600	60L	36,000	120L	72,000
Engine oil filter	Unit	1,500	3,000	2	3,000	2	6,000
Air cleaner	Unit	2,000	4,000	1	2,000	1	4,000
Fuel filter	Unit	1,000	2,000	1	1,000	1	2,000
Mission oil	L	500	500	15L	7,500	20L	10,000
Differential oil	L	500	500	15L	7,500	20L	10,000
Chassis grease up	kg	1,000	1,000	2kg	2,000	3kg	3,000
Total amount					**59,000**		**107,000**

Table 2-36 Annual Amount of Engine Oil required for Periodic Inspections (Newly Procured Vehicles)

	Formula	Annual oil amount (L)
Medium-sized vehicles	60 L×30 units	1,800 L
Large-sized vehicles	120 L×70 units	8,400 L
Total		10,200 L (51 drum can)

Table 2-37 Annual Total Cost of Periodic Inspections (Newly Procured Vehicles)

	Formula	Annual periodic maintenance cost (BDT)
Medium-sized vehicles	BDT 59,000 × 30	1,770,000
Large-sized vehicles	BDT 107,000 × 70	7,490,000
Total		9,260,000

3) Repair costs

Upon dividing maintenance contents into light maintenance, intermediate maintenance and heavy maintenance, annual costs for each item were calculated. The resulting amount was multiplied by the estimated frequency over 10 years to give a total maintenance cost over 10 years of BDT 333,500,000. Therefore, the rough annual vehicle maintenance cost is estimated as BDT 33,350,000.

Table 2-38 Parts and Lubricants Price Sheet

New vehicle	Carrying capacity	No.	Light maintenance			Medium maintenance					Heavy maintenance		
			Periodic service	Electric system repair	Tire repair	Brake repair	Chassis repair	Leaf spring repair	Clutch repair	Body repair	Engine overhaul	Mission overhaul	Differential overhaul
CNG	3	15	59,000	3,000	5,000	10,000	8,000	50,000	20,000	20,000	60,000	50,000	40,000
		total	885,000	45,000	75,000	150,000	120,000	750,000	300,000	300,000	900,000	750,000	600,000
	5	30	107,000	6,000	10,000	30,000	12,000	80,000	30,000	40,000	80,000	60,000	50,000
		total	3,210,000	180,000	300,000	900,000	360,000	2,400,000	900,000	1,200,000	2,400,000	1,800,000	1,500,000
Diesel	2	15	59,000	3,000	5,000	10,000	8,000	50,000	20,000	20,000	60,000	50,000	40,000
		total	885,000	45,000	75,000	150,000	120,000	750,000	300,000	300,000	900,000	750,000	600,000
	5 - 7	40	107,000	6,000	10,000	30,000	12,000	80,000	30,000	40,000	80,000	60,000	50,000
		total	4,280,000	240,000	400,000	1,200,000	480,000	3,200,000	1,200,000	1,600,000	3,200,000	2,400,000	2,000,000
Total cost per year			9,260,000	510,000	850,000	2,400,000	1,080,000	7,100,000	2,700,000	3,400,000	7,400,000	5,700,000	4,700,000
The number of service for 10 years			10	30	40	20	15	10	5	6	1	1	2
Total cost for 10 years			92,600,000	15,300,000	34,000,000	48,000,000	16,200,000	71,000,000	13,500,000	20,400,000	7,400,000	5,700,000	9,400,000
												Total cost for 10 years	333,500,000
												The average cost per	33,350,000

(2) Facilities Operation and Maintenance Cost

The workshop annual maintenance cost is estimated at approximately BDT 601,000.

Table 2-39 Workshop Annual Maintenance Cost

Item	Amount (BDT 1000 /year)	Remarks
Electricity tariff	115.2	Tk. 4.00/ kwh (including meter usage)
City water tariff	34.5	Tk. 5.75/ m^3
Septic tank maintenance	24.0	
Paint, and fittings repair cost, etc.	428.0	BDT 2,140,000 over 5 years (12% of direct facilities work costs)
Total	601.7	

(3) Vehicles and Facilities Operation and Maintenance Costs

The annual operation and maintenance cost of the new vehicle workshop is BDT 50,415,700, which is equivalent to 2.8% of the Solid Waste Management Department budget of BDT 1,796 million (2008). Even taking future increase and the 194 vehicles expected to be scrapped by 2012 into account, this is not a problem. The workshop currently employs 58 mechanics and 49 apprentices. In line with the introduction of new vehicles, it is planned for the five mechanics currently implementing periodic

inspections at the present garage to work on periodic maintenance at the new workshop. Moreover, another 6 mechanics will need to be employed, however, their required allowance of BDT 1,440,000 will not be a problem.

2-6 Project Operation and Maintenance Plan

The Project aims to strengthen the solid waste collection and transportation capacity of DCC and thereby improve the living environment and reduce CO_2 emissions, and operation and maintenance in the Project are divided into the following two components:

- ◊ Implementation, planning and management of collection and transportation
- ◊ Inspection and maintenance of collection and transportation equipments

In executing the above work, DCC established the Solid Waste Management Department in July 2008 with the aim of unifying solid waste management administration that until then had been divided into a number of departments. Therefore, the current setup should be able to handle the work.

(1) Implementation, planning and management of collection and transportation

The Solid Waste Management Department has 422 employees. The budget covers employment of 183 drivers, while it is planned to employ 120 more from outside the department. Considering that there are currently 297 vehicles, there are adequate staff. Furthermore, concerning collection vehicle fuel costs, BDT 350 million was appropriated in the 2007 budget, and so far DCC has not experienced situations where it couldn't afford to buy fuel. Accordingly, the collection and transportation setup is well in place.

The Master Plan contains forecasts of the future amount of solid waste in the Project. Currently Matwail disposal site uses a truck scale to measure the amount of incoming waste. Furthermore, it is planned to install a truck scale at Aminbazar disposal site to be constructed under the Japan Debt Cancellation Fund (JDCF). As a result, DCC will be able to measure all collected waste and monitor it against the design waste collection amount. Furthermore, through aggregating the measured data, it will be possible to review vehicle allocation plans and identify inefficient vehicles, thereby enabling collection and transportation to be managed.

(2) Inspection and Maintenance of Collection and Transportation Equipments

The inspection and maintenance of collection vehicles will continue to be implemented at Workshop 1 belonging to the Engineering Department. The maintenance budget for collection and transportation equipments in 2007 was BDT 45 million. As of 2008, DCC has 297 collection vehicles and the amount of money that can be spent on each vehicle is approximately BDT 150,000.

At Workshop 1, the Study Team recognized room for improvement concerning the parts procurement and management system and the technical level of mechanics. Accordingly, the Project proposes to dispatch a mechanical expert to help with improving the workshop systems and build the capacity of mechanics. The Project also intends to build a new workshop so it is deemed that DCC inspection and maintenance setup will be able to ensure the ample maintenance of equipments supplied under the Project.

Table 2-5 shows the present number of vehicle mechanics. Following the introduction of new vehicles, it is planned to put the Isuzu small truck department in charge of general repairs. It is planned to place five employees (including two mechanics) who currently work on periodic inspections at the garage in charge of periodic inspections at the new workshop. The new workshop will conduct periodic inspections in four work bays. In periodic inspections, since two mechanics will work on each vehicle, eight mechanics will be required in total. Therefore, it will be necessary to recruit six additional mechanics which shouldn't be a problem.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

The implementation of the Project is expected to achieve the various effects described below.

Table 3-1 Project Effects

Current Situation and Problems	Remedial Measures under the Project	Direct Effects and Extent of Improvement	Indirect Effect and Extent of Improvement
Compared to the discharged amount of solid waste, the number of collection vehicles is too small and vehicles are deteriorated. Compared to the waste unit collection quantity, a lot of greenhouse gas is emitted. As more vehicles reach the end of their service lives in future, the vehicle shortage will grow even worse.	Procure new collection vehicles including CNG vehicles, construct a new vehicle maintenance workshop, and implement technical assistance.	Whereas current diesel vehicles emit 45.2 kg/day of CO_2, the new diesel vehicles will emit 18.6 kg/day while CNG vehicles will emit 16.9 kg/day. Whereas the current DCC waste collection amount is 1,619 tons/day (collection rate 58%), it will b e 2,121 tons/day (collection rate 67%) in 2012.	Improvement in the waste collection quantity will aid beautification of the city. Moreover, risk of diseases from discarded waste will be reduced and the sanitary situation will be improved.
There is no general awareness of the need to reduce greenhouse gas emissions.	Reduce greenhouse gas emissions through giving technical assistance to vehicle managers, mechanics and drivers and implementing appropriate maintenance of vehicles. Moreover, through advertising for new collection vehicle design, enlighten the general public about the need for reducing greenhouse gases.	Vehicle managers, mechanics and drivers will learn about and implement the appropriate operation and maintenance of vehicles, and this will sustain greenhouse gas reductions compared to the unit collection quantity of solid waste. General residents will understand the importance of solid waste management and the need for greenhouse gas reductions.	Introduction of new vehicles will help improve collection efficiency and reduce costs per unit collection amount. Through conducting proper operation and maintenance of vehicles, vehicles can be used over the long term.

3-2 Recommendations

In order to realize and sustain the effects of the Project, the Bangladeshi side needs to tackle the following issues.

- ◊ Maintenance of equipment shall be strengthened with improvement of maintenance system, provision of necessary fund and capacity development of personnel.
- ◊ Operation of collection vehicles shall be improved.
- ◊ Awareness to low carbon society shall be promoted.
- ◊ Use of CNG vehicles shall be expanded in order to reduce emission of CO_2 with provision of DCC's own CNG station.

In order to appropriately operate and maintain the Project equipments and facilities after they are handed over, it will be necessary to secure and appropriately allocate drivers, cleansing staff and mechanics without delay. Moreover, it will be necessary to get the maintenance setup in the Solid Waste Management Department up and running straight away.

[APPENDIX]

APPENDIX 1 MEMBER LIST OF THE STUDY TEAM

Name	Work Assignment	Position
Kazuya SUZUKI	Leader of the first study	Chief Project Management Group II Grand Aid Management Dept. JICA
Mitsuyoshi KAWASAKI	Leader of the third study	Deputy Director General, South Asia Department, JICA
Naotaka YAMAGUCHI	Planning Management	Senior Officer, Grant Aid Project Management Division 3, Financing Facilitation and Procurement Supervision Dept., JICA
Katsumi ITAGAKI	Cooperation Policy	Ministry of Foreign Affaires
Shin-ichiro SERIZAWA	Procurement Management	Japan International Cooperation System (JICS)
Naoyuki MINAMI	Chief Consultant	Yachiyo Engineering Co., Ltd.
Akio ISHII	Solid Waste Collection and Transportation Plan	Yachiyo Engineering Co., Ltd.
Koji UZAWA	Equipment Plan / Operation & Maintenance	Yachiyo Engineering Co., Ltd.
Koji ODA	Architectural Plan & Design	Yachiyo Engineering Co., Ltd.
Tetsuo YATSU	Construction & Procurement Plan / Cost Estimate	Yachiyo Engineering Co., Ltd.
Takashi NAKAMURA	Construction & Procurement Plan / Cost Estimate 2	Yachiyo Engineering Co., Ltd.
Takatoshi ARAI	Solid Waste Management Plan / Low Carbon Environment Plan (Work in Japan)	Yachiyo Engineering Co., Ltd.

APPENDIX 2 STUDY SCHEDULE

<First Study in Bangladesh>

No.	Date	Day	Official				Consultant					
			Leader JICA	Planning Management JICA	Cooperation Policy MOFA	Procurement Management JICS	Chief Consultant	Solid Waste Collection and Transportation Plan	Equipment Plan / Operation & Maintenance	Architectural Plan & Design	Construction & Procurement Plan / Cost Estimate1	Construction & Procurement Plan / Cost Estimate2
			Mr. Kazuya Suzuki	Mr. Naotaka Yamaguchi	Mr. Katusmi Itagaki	Mr. Shinichiro Serizawa	Mr. Naoyuki Minami	Mr. Akio Ishii	Mr. Koji Uzawa	Mr. Koji Oda	Mr. Tetsuo Yatsu	Mr. Takashi Nakamura
1	1-Aug-08	Fri							Trip [Tokyo (16:15) JL703 → Bangkok (20:50)]			
2	2-Aug-08	Sat						Team Meeting	Trip[Bangkok (10:40) TG321 → Dhaka (12:10)] Team Meeting			
3	3-Aug-08	Sun						9:15 Meeting at JICA Bangladesh Office 10:30 Meeting with EOJ 13:00 Meeting on Inception Report with DCC				
4	4-Aug-08	Mon					Trip [Tokyo (16:15) JL703 → Bangkok (20:50)]	Meeting with DCC Site Survey				Trip [Tokyo (16:15) JL703 → Bangkok (20:50)]
5	5-Aug-08	Tue					Trip[Bangkok (10:40) TG321 → Dhaka (12:10)] 16:00 Meeting with DCC	Site Survey 16:00Meeting with DCC				Trip[Bangkok (10:40) TG321 → Dhaka (12:10)] 16:00 Meeting with DCC
6	6-Aug-08	Wed					Survey in Chittagong					Preparing Report
7	7-Aug-08	Thu					Discussion car decision Courtesy call on CEO at DCC					Discussion car decision Courtesy call on CEO at DCC
8	8-Aug-08	Fri				Trip[Tokyo → Singapore → Dhaka]	Preparing Progress Report					Preparing Progress Report
9	9-Aug-08	Sat				11:00 Team Meeting						11:00 Team Meeting
10	10-Aug-08	Sun				10:30 Call on Ambassador of Japan 15:30 Meeting with Vehicle Agency 17:00 Meeting with JICA	10:30 Call on Ambassador of Japan Meeting with DCC and Related Organization 17:00 Meeting with JICA	Trip [Dhaka (13:10) TG322 → Bangkok (16:35)] [Bangkok (22:25) JL718 →	11:00 Site Survey 15:30 Meeting with Vehicle Agency 17:00 Meeting with JICA	10:30 Call on Ambassador of Japan Natural Condition Meeting 17:00 Meeting with JICA		11:00 Site Survey Natural Condition Meeting 17:00 Meeting with JICA
11	11-Aug-08	Mon				10:30 TV Meeting at JICA Procurement situation survey	10:30 TV Meeting at JICA Procurement situation survey	6:00 Arrival at Tokyo 13:30 TV Meeting at JICA H/Q	10:30 TV Meeting at JICA RPGCL relation agencies survey	10:30 TV Meeting at JICA Building Code, Standard & Regulation		10:30 TV Meeting at JICA Building Code, Standard & Regulation
12	12-Aug-08	Tue				Procurement situation survey in Chittagong	Collection car decision, Signing of Technical Notes & Meeting with JICA		Collection car decision, Signing of Technical Notes & Meeting with JICA			Collection car decision, Signing of Technical Notes & Meeting with JICA
13	13-Aug-08	Wed				Procurement situation survey in Chittagong	Technical Assistance Plan		Market Survey	Contract for Natural Condition Survey		Market Survey
14	14-Aug-08	Thu				Procurement situation survey	Environmental society consideration 17:00 Meeting with JICA		Equipment Condition Survey 17:00 Meeting with JICA	Facilities Planning 17:00 Meeting with JICA		Equipment Condition Survey 17:00 Meeting with JICA
15	15-Aug-08	Fri				Data analysis	Preparation of Report		Preparation of Report	Preparation of Report		Preparation of Report
16	16-Aug-08	Sat				Data analysis	10:00 Meeting with DCC & JICA Preparing report		10:00 Meeting with DCC & JICA Procurement Condition Survey	10:00 Meeting with DCC & JICA Facilities Planning	Trip [Tokyo (16:15) JL703 → Bangkok (20:50)]	10:00 Meeting with DCC & JICA Construction Plan
17	17-Aug-08	Sun	Trip [Tokyo→Singapore→Dhaka]			Meeting with DCC	Meeting with DCC		Procurement Condition Survey	Facilities Planning	Trip[Bangkok (10:40) TG321 → Dhaka (12:10)]	Procurement Condition Survey
18	18-Aug-08	Mon	8:00 Meeting at JICA Bangladesh Office 11:00 Courtesy call to Japanese Ambassador						8:00 Meeting at JICA Bangladesh Office 11:00 Courtesy call to Japanese Ambassador			
19	19-Aug-08	Tue	Discussion with DCC						Equipment Condition Survey	Facilities Designing	Meeting with Local companies	Meeting with Local companies
20	20-Aug-08	Wed	Coutesy call & Discussion with LGD & ERD						Equipment Condition Survey	Facilities Designing	Market survey	Market survey
21	21-Aug-08	Thu	10:00Workshop construction site inspection Minutes meeting with DCC		Minutes meeting with DCC	10:00Workshop construction site inspection Minutes meeting with DCC			Equipment Condition Survey	10:00Workshop construction site inspection Facilities Designing	Construction & Procurement Plan	Market survey
22	22-Aug-08	Fri	15:00Filling station inspection		15:00Filling station inspection Trip [Dhaka(SQ435)23:55 → Singapore(5:55)]	15:00Filling station inspection			Equipment Plan, Maintenance/ Operation Plan	Facilities Designing	15:00Filling station inspection Construction & Procurement Plan	Trip [Dhaka (13:10) TG322 → Bangkok (16:35)] [Bangkok (22:25) JL718 →
23	23-Aug-08	Sat	Site & Collection situation inspection		Trip [Singapore (8:35) NH112 → Tokyo (16:15)]	Site & Collection situation inspection			Equipment Plan, Maintenance/ Operation Plan	Facilities Designing	Construction & Procurement Plan	6:00 Arrival at Tokyo
24	24-Aug-08	Sun	Minutes meeting Data analysis			Minutes meeting Data analysis	Minutes meeting Preparation of Progress Report		Preparation of Progress Report	Preparation of Progress Report	Preparation of Progress Report	
25	25-Aug-08	Mon	9：30Report to EOJ 15：30Signing for Minutes of Discussion with ERD & DCC Report to EOJ Trip [Dhaka(SQ435)23:55 → Singapore(5:55)]			9：30Report to EOJ 15：30Signing for Minutes of Discussion with ERD & DCC Report to EOJ Trip [Dhaka(SQ435)23:55 → Singapore(5:55)]	9：30Report to EOJ 15：30Signing for Minutes of Discussion with ERD & DCC Report to EOJ		Discussion on Work of DCC and Technical Assistance	Discussion on Work of DCC and Technical Assistance	Discussion on Work of DCC and Technical Assistance	
26	26-Aug-08	Tue	Trip [Singapore (8:35) NH112 → Tokyo (16:15)]			Trip [Singapore (8:35) NH112 → Tokyo (16:15)]	Preparing Progress Report		Preparation of Progress Report			
27	27-Aug-08	Wed					19:00 Explanation & Discussion on Progress Report		19:00 Explanation & Discussion on Progress Report			
28	28-Aug-08	Thu					Meeting with DCC		Meeting with DCC	Meeting with local consultant		
29	29-Aug-08	Fri					Trip [Dhaka (13:10) TG322 → Bangkok (16:35)] [Bangkok (22:25) JL718 →		Trip [Dhaka (13:10) TG322 → Bangkok (16:35)] [Bangkok (22:25) JL718 →		Trip [Dhaka (13:10) TG322 → Bangkok (16:35)] [Bangkok (22:25) JL704 →	
30	30-Aug-08	Sat					6:15 Arrival at Tokyo		6:15 Arrival at Tokyo		7:15 Arrival at Tokyo	

DCC Dhaka City Corporation
ERD Economic Relation Department
MLGRDC Ministry of Local Government, Rural Development and Cooperatives
RPGCL Rupantarita Prakritik Gas Company Limited

<Second Study in Bangladesh>

No.	Date	Day	Chief Consultant
			Mr. Naoyuki Minami
1	6-Oct-08	Mon	Trip [Tokyo (16:15) JL703 → Bangkok (20:50)]
2	7-Oct-08	Tue	Trip[Bangkok (10:40) TG321 → Dhaka (12:10)] M: Meeting with JICA Bangladesh office
3	8-Oct-08	Wed	Meeting with DCC counterpart Site survey (infrastructure of workshop) Request quotation to local consultants on detail design of the workshop
4	9-Oct-08	Thu	Prepering documents
5	10-Oct-08	Fri	Prepering documents
6	11-Oct-08	Sat	Site survey
7	12-Oct-08	Sun	Explanation & Meeting Draft Final report (DCC)
8	13-Oct-08	Mon	Discussion with DCC Obtaining estimate from Local Consultants
9	14-Oct-08	Tue	Discussion with DCC
10	15-Oct-08	Wed	Discussion on Technical Notes Contract with Local Consultant
11	16-Oct-08	Thu	Singning for Technical Notes Report to JICA, EOJ
12	17-Oct-08	Fri	Trip [Dhaka (13:10) TG322 → Bangkok (16:35)] [Bangkok (22:25) JL718 → Tokyo (06:30+1)]
13	18-Oct-08	Sat	6:00 Arrival at Tokyo

<Third Study in Bangladesh>

No.	Date	Day	Leader JICA	Planning Management JICA	Chief Consultant	Solid Waste Management Plan / Low Carbon Environment Plan
			Mr. Mutsuyoshi Kawasaki	Mr. Naotaka Yamaguchi	Mr. Naoyuki Minami	Mr. Tkashi Nakamura
1	6-Jan	Tue			Trip [Tokyo (16:00) JL703 → Bangkok (21:05)]	
2	7-Jan	Wed			Trip[Bangkok (11:00) TG321 → Dhaka (12:30)] Meeting with JICA & DCC Checking Draft Tender Documents	
3	8-Jan	Thu			Preparation of DraftTender Documents	
4	9-Jan	Fri			Preparation of DraftTender Documents	
5	10-Jan	Sat	Trip [Tokyo (16:00) JL703 → Bangkok (21:05)]		Preparation of Final Report & Draft Tender Docments	
6	11-Jan	Sun	Trip[Bangkok (11:00) TG321 → Dhaka (12:30)]		Preparation of Final Report & Draft of Tender Docments	
7	12-Jan	Mon	Meeting with JICA & EOJ (Ambassador) Explanation & Discussion on Final Report & Draft Tender documents to DCC Discussion on Minutes with DCC			
8	13-Jan	Tue	Meeting with LGD Discussion on Mintes with DCC Mini-workshop on Technical Assistance with DCC			
9	14-Jan	Wed	Meeting with ERD Discussion on Minutes with DCC, Visit at Mechanical Workshop			
10	15-Jan	Thu	Meeting with EOJ (Ambassador) & JICA Trip [Dhaka --> Singapole]			
11	16-Jan	Fri	Trip [Singapole → Tokyo]		Preparation of Tender Documents	
12	17-Jan	Sat			Preparation of Tender Documents	
13	18-Jan	Sun			Disscussion & Preparation of Tender Documents Meeting with JICA Bangladesh Office	
14	19-Jan	Mon			Trip [Dhaka (13:40) TG322 → Bangkok (17:10)] [Bangkok (23:30) JL704 → Tokyo (07:15+1)]	
15	20-Jan	Tue			7:15 Arrival at Tokyo	

APPENDIX 3 LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

Organization and Name	Job Title
Economic Relations Division (ERD)	
Mr. Md. Mosharraf Hossain Bhuiyan, ndc	Additional Secretary
Ms. Nasreen Akhtar Chowdhury	Deputy Secretary
Dr. Md. Atiqur Rahman	Deputy Secretary, (Japan Branch)
Ms. Fahmida	Senior Assistant Secretary
Ministry of Local Government, Rural Development and Cooperatives (MLGRD&C)	
Local Government Division	
Mr. Mirza Rahman	Joint Secretary
Ms. Mahmuda Sharmeen Benu	Deputy Secretary
Mr. Shamsul Karim Bhuiyan	Deputy Chief
Mr. Ausanul Haave	Senior Assistant Secretary
Mr. Mr. Md. Delwar Hossain	Senior Assistant Secretary
Dhaka City Corporation (DCC)	
Mr. Md. Alauddin	Chief Executive Officer
Col. Md. Ashfakul Islam	Chief Engineer
Commander Makshudur Rahman Chowdhury	Chief Waste Management Officer
Lt. Col. Shameem Ahmed, psc, EME	Superintendent Engineer
Mr. Syed Quratullah	Superintendent Engineer
Dr. Tariq Bin Yousuf	Project Director
Mr. Abul Hasnat Md. Ashraful Alam	Executive Engineer (Mechanical)
Mr. Md. Abdus Satter	Manager, Transport
Mr. Md. Mahaboob Alam	Assistant Engineer
Mr. Maksud Alam	Assistant Engineer
Mr. Md. Faridul Islam	Assistant Engineer
Mr. Md. Benozir Ahmed	Conservancy Officer
Engr. Md. Anisur Rahman	Executive Engineer(Mechanical Devision-1)
Mr. Md. Ekramul Houe Khondoker	Assistant Engineer(Mechanical Devision-1)
Mr. Md. Zakir Hossain	Sub-Assistant Engineer, Mechanical-1
Mr. Md.Mahbubul Alam	Sub-Assistant Engineer, Mechanical-1
Chittagong City Corporation (DCC)	
Mr. Samsu Duha	Secretary
Arch. A. K. Rezaul Karim	City Planner & Head
Dr. Rafiaul Islarm	Executive Engineer
Mr. Md. Abul Hasnat	Superintending Engineer (Mechanical)
Mr. Md. Ohed Ullah	Sub Assistant Engineer
Mr. Jewel Banik	Sub Assistant Engineer

Embassy of Japan in Bangladesh

Mr. Masayuki Inoue	Ambassador
Mr. Yonezo Fukuda	Minister
Mr. Yoshihiro Sakakibara	First Secretary
Mr. Yuichi Inagaki	Second Secretary

JICA Bangladesh Office

Ms. Nobuko Kayashima	Resident Representative
Mr. Eiichiyo Cho	Additional Resident Representative
Ms. Akiko Bushimata	Deputy Resident Representative
Mr. Jin Hirosawa	Deputy Resident Representative
Mr. Takayuki Sugawara	Deputy Resident Representative
Mr. Itaru Chiba	Assistant Representative
Mr. Zaki Md. Ziaul Islam	Program Officer

APPENDIX 4 MINUTES OF DISCUSSION

Minutes of Discussions on the Outline Design Study on the Programme for Improvement of Solid Waste Management in Dhaka City toward the Low Carbon Society in the People's Republic of Bangladesh

Based on the request from the Government of the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh"), the Government of Japan decided to conduct an Outline Design Study on the Programme for Improvement of Solid Waste Management in Dhaka City toward the Low Carbon Society (hereinafter referred to as "the Programme") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Bangladesh the Outline Design Study Team (hereinafter referred to as "the Team"), which was headed by Mr. Kazuya SUZUKI, Director, Environmental Management Division I, Global Environment Department, JICA and was scheduled to stay in the country from August 17 to 25, 2008.

The Team held a series of discussions with the officials concerned of the Government of Bangladesh and conducted a field survey at the study area. In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Outline Design Study Report.

Dhaka, August 25, 2008

Mr. Kazuya SUZUKI
Leader
Outline Design Study Team
Japan International Cooperation Agency
(JICA)

Ms. Nasreen Akhtar Chowdhury
Deputy Secretary
Economic Relations Division
Ministry of Finance

Commander Maksudur Rahman Chowdhury
Chief Waste Management Officer,
Dhaka City Corporation

Mr. Ganesh Chandra Sarker
Director-1
Local Government Division
Ministry of Local Government, Rural Development & Cooperatives

ATTACHMENT

1. Objectives of the Programme

The objectives of the Programme are to improve the capacity of solid waste collection and transportation and to reduce the emission of greenhouse gas in Dhaka City through the provision of necessary equipments, facilities and technical assistance.

2. Scheme of the Grant Aid

Both sides confirmed that the Japan's Grant Aid for Environment and Climate Change would be applied for the Programme.

3. Programme site

The Programme site is the administrative area of Dhaka City Corporation (hereinafter referred to as "DCC") and the final disposal sites, as shown in Annex I.

4. Responsible and Implementing Agency

The organization responsible for the Programme is the Local Government Division of the Ministry of Local Government, Rural Development & Cooperatives (hereinafter referred to as "MLGRD&C"), and the implementing agency is DCC.

5. Items requested by the Bangladesh Side

5.1. After discussions with the Team, the components described in Annex II were requested by the Government of Bangladesh, and the priorities on each component are agreed between both sides. The requested components will be able to fulfill approximately 52% of the target amount of waste collection 2,121 tons per day analyzed in the Clean Dhaka Master Plan by the year of 2012. It also contributes to the reduction of greenhouse gas emission. Both sides confirmed that the Programme covers a part of the provision of equipments and facilities in accordance with the Clean Dhaka Master Plan. In this sense, the priorities are established according to the urgency and the relevance with the Plan.

5.2. Both sides confirmed that the CNG (Compressed Natural Gas) type vehicles will use private CNG stations.

5.3. DCC requested for technical assistance in maintenance and management of the equipments.

6. Japanese Grant Aid

The Government of Bangladesh understood the Japan's Programme Grant Aid for Environment and Climate Change with the flow of the budget described in Annex III and IV explained by the Team.

6.1. Both sides confirmed that the Consultative Committee and Working Group of the Programme will be established in order to realize proper and smooth execution of the Programme. The Programme Implementation Structure is shown in Annex V.

The members of the Consultative Committee are as follows:

1) Representative of Economic Relations Division (ERD), Ministry of Finance
2) Representative of the Local Government Division
3) Representative of DCC
4) Representative of the Procurement Agent
5) Representative of the Embassy of Japan
6) Representative of JICA Bangladesh Office

The members of the Working Group are as follows:

1) Representative of DCC
2) Representative of the Procurement Agent
3) Representative of the Embassy of Japan
4) Representative of JICA Bangladesh Office

6.1.1. The first meeting of the Committee shall be held immediately after the approval of the Government of Japan of the Agent Agreement which shall be concluded between DCC and the Procurement Agent. The employment of the Agent will be agreed between the two Governments. Further meetings will be held upon request of either the Bangladesh side or the Japanese side. The Procurement Agent may advise both sides on the necessity to call a meeting of the Committee.

6.2. The Government of Bangladesh will take necessary measures, as described in Annex VII, to expedite the smooth implementation of the Programme, as a condition for the Japanese Grant Aid to be implemented.

7. Schedule of the Study

The consultants will proceed to further studies in Bangladesh until August 29, 2008.

JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around the second week of October, 2008.

JICA will prepare the Draft Tender Documents of the Programme and dispatch a consultant team in order to explain its contents around the first week of December, 2008.

JICA will complete the Outline Design Study Report and the Draft Tender Document of the Programme by the second week of January, 2009.

8. Other Relevant Conditions

8.1. The Procurement Guidelines of Japan's (Bilateral, Programme-Type) Grant Aid for Disaster Prevention and Reconstruction would be applied for the procurement procedure of the Programme.

8.2. The Government of Bangladesh shall exempt or bear the customs duties, internal taxes and other fiscal levies and complete necessary procedures. DCC will send a guarantee certificate of the way to undertake these customs duties, internal taxes and fiscal levies and inform about the details to JICA Bangladesh Office officially by September 15, 2008.

8.3. DCC prefers the tender procedures for procurement of equipments to be held in Japan for smooth implementation of the Programme.

8.4. The Government of Bangladesh shall take necessary steps to approve the Development Project Proposal (DPP) by November 15, 2008.

8.5. DCC intends to take every possible effort to strengthen the financial conditions of solid waste management to ensure proper operation of additional equipments and facilities as well as necessary manpower related to the Programme.

END

Annex I. Location of the Programme Area
Annex II. Components and items requested by the Government of Bangladesh
Annex III. Programme Grant Aid for Environment and Climate Change of the Government of Japan
Annex IV. Flow of Funds for Implementation under the Japan's Grant Aid for

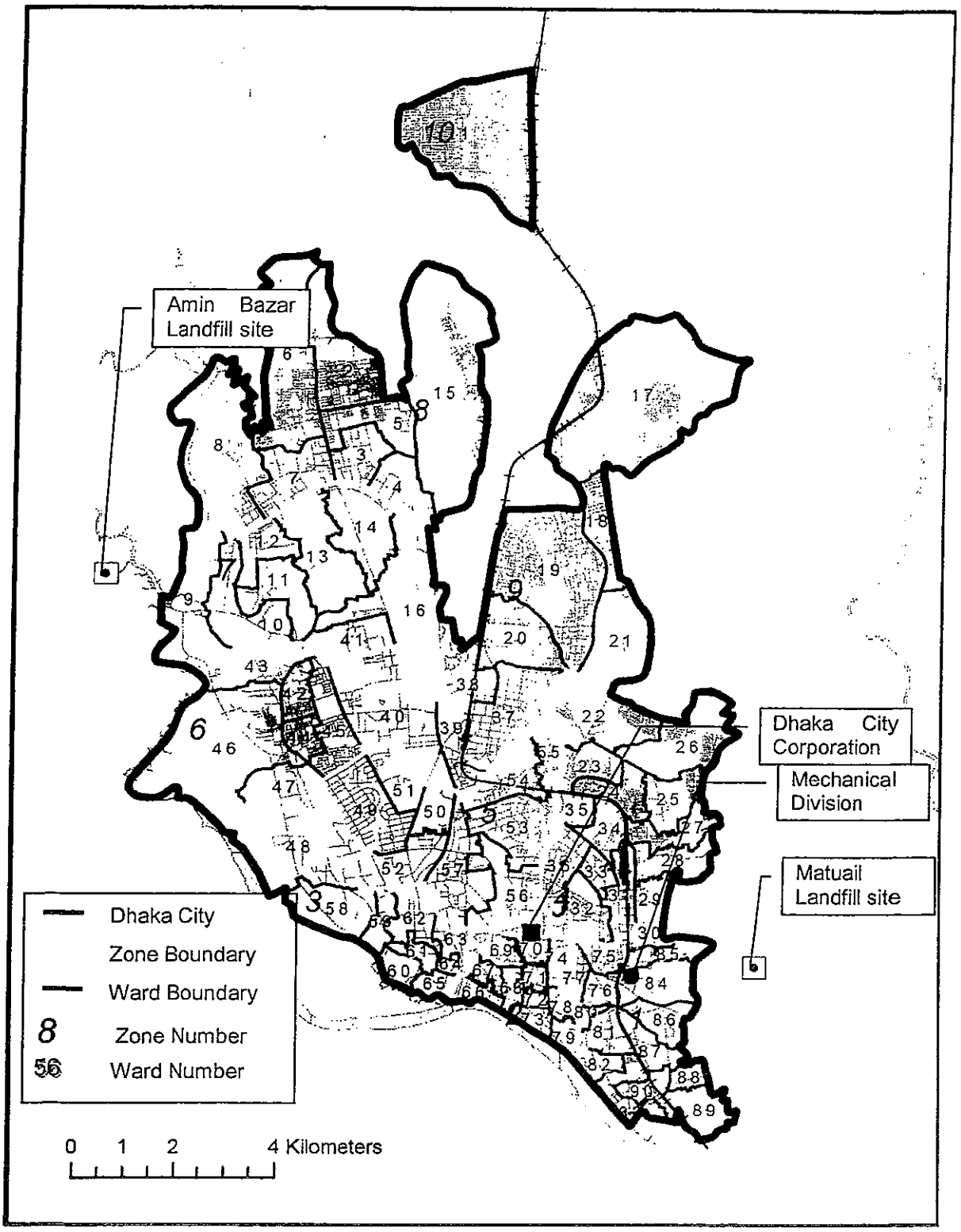
Environment and Climate Change

Annex V. Chart of the Programme Implementation Organization under the Japan's Grant Aid for Environment and Climate Change in Bangladesh

Annex VI. Terms of Reference of the Consultative Committee

Annex VII. Major Undertakings to be taken by Each Government

Annex I



Location of the Programme Area

Annex II

Components and items requested by the Government of Bangladesh

No.	Project Component	Waste amount loaded (ton)	Engine	Requested Number	Remarks
1	Container Carrier	3	CNG	15	The numbers are provisional. These are subjected to change.
2	Container Carrier	5	CNG	30	
3	Armroll Truck	7	Diesel	20	
4	Compactor Truck	2	Diesel	15	
5	Compactor Truck	5	Diesel	20	
	Total number of vehicles			100	
6	Workshop civil works and related machineries			1	
7	Capacity Development Programme on repair /maintenance management, operation management and technical assistance			1	
8	Agent fee inclusive of consultant fee			1	

Annex-III

Programme Grant Aid for Environment and Climate Change of the Government of Japan

(Provisional)

The Grant Aid provides a recipient country ("the Recipient") with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

The Program Grant Aid for Environment and Climate Change ("GAEC") aims toward emission reduction such as achievement of energy saving (environmental-easing measures) and environmental damage control by climate change. Multiple components can be combined to effe
ctively meet the needs. Contractors, suppliers or consultants are not confined to Japanese firms only, and construction can be done based on the local method.

1. Procedures for GAEC

GAEC is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Outline Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by the Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

Firstly, the application or request for a GAEC programme submitted by the Recipient is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for GAEC. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the Outline Design Study, using Japanese consulting firms.

Thirdly, the Government of Japan appraises the programme to see whether or not it is suitable for Japan's GAEC, based on the Outline Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the programme, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the Recipient.

For the smooth and proper execution of the Grant, JICA is designated by the Government of Japan as an organization responsible for necessary works aiming at expediting the proper execution of the Grant.

Procurement Agent ("the Agent") is designated to conduct the procurement services of products and services (including fund management, preparing tenders, contracts and so on) for GAEC on behalf of the Recipient. The Agent is an impartial and specialized organization and shall render services according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the Agreed Minutes ("A/M").

2. Outline Design Study

1) Contents of the Study

The aim of the Outline Design Study ("the Study"), conducted by JICA on a requested programme ("the Programme"), is to provide a basic document necessary for the appraisal of the Programme by the Government of Japan. The contents of the Study are as follows:

(1) Confirmation of the background, objectives, and benefits of the Programme and also institutional capacity of agencies and communities concerned of the recipient country necessary for the Programme's implementation.
(2) Evaluation of the appropriateness of the Programme to be implemented under the Grant Aid Scheme for Environment and Climate Change from a technical, social and economic point of view;
(3) Confirmation of items agreed upon by both parties concerning the basic concept of the Programme.
(4) Preparation of an outline design of the Programme.
(5) Estimation of cost for the Programme.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid programme. The Outline Design of the Programme is confirmed considering the guidelines of Japan's Grant Aid scheme.

The Government of Japan requests the Government of the Recipient to take whatever measures are necessary to ensure its self-reliance in the implementation of the Programme. Such measures must be guaranteed even through they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Programme. Therefore, the implementation of the Programme is confirmed by all relevant organizations of the Recipient through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses registered consulting firms. JICA selects firms based on proposals submitted by interested firms. The firms selected carry out an Outline Design Study and write a report, based upon terms of reference set by JICA.

The consulting firms to work on the Programme's implementation after the Exchange of Notes could be, in principle, of any nationality as long as the Firm satisfies the conditions specified in the tender documents.

3. Implementation of GAEC after the E/N

1) Exchange of Notes (E/N)

GAEC is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the programme, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

2) Procedural details

Procedural details on the procurement of products and services under GAEC are to be agreed upon between the authorities of the two governments concerned at the time of the signing of the E/N.

Essential points to be agreed upon are outlined as follows:

a) JICA is in a position to expedite the proper execution of the program.

b) The products and services shall be procured and provided in accordance with "Procurement Guidelines for Disaster Reconstruction Grant Aid" of the Ministry of Foreign Affairs.

c) The Recipient shall conclude an employment contract with the Agent.

d) The Agent is the representative acting in the name of the Recipient concerning all transfers of funds to the Agent.

3) Focal Points of "The Procurement Guidelines of Japan's (Bilateral, Programme-Type) Grant Aid for Disaster Prevention and Reconstruction"

a) The Agent

The Agent is the organization which provides procurement services of products and services on behalf of the Recipient according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the A/M.

b) Agent Agreement

The Recipient shall conclude an Agent Agreement, within one month after

the date of entry into force of the E/N, in accordance with the A/M. The scope of the Agent's services shall be clearly specified in the Agent Agreement.

c) Approval of the Agent Agreement

The Agent Agreement, which is prepared as two identical documents, shall be submitted to the Government of Japan by the Recipient through the Agent. The Government of Japan confirms whether or not the Agent Agreement is concluded in conformity with the E/N and the Procurement Guidelines for Disaster Reconstruction Grant Aid, and approves the Agreement.

The Agent Agreement concluded between the Recipient and the Agent shall become effective after the approval by the Government of Japan in a written form.

d) Payment Methods

The Agent Agreement shall stipulate that "regarding all transfers of the fund to the Agent, the Recipient shall designate the Agent to act on behalf of the Recipient and issue a Blanket Disbursement Authorization ("the BDA") to conduct the transfer of the fund (Advances) to the Procurement Account from the Recipient Account."

The Agent Agreement shall clearly state that the payment to the Agent shall be made in Japanese yen from the Advances and that the final payment to the Agent shall be made when the total Remaining Amount becomes less than 3 % of the Grant and its accrued interest.

e) Products and Services Eligible for Procurement

Products and services to be procured shall be selected from those defined in the E/N and the A/M.

f) Firms

In principle, a Firm of any nationality could be contracted as long as the Firm satisfies the conditions specified in the tender documents.

g) Method of Procurement

In implementing procurement, sufficient attention shall be paid so that there is no unfairness among tenderers who are eligible for the procurement of products and services.

For this purpose, competitive tendering shall be employed in principle.

h) Tender Documents

The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured by GAEC.

The rights and obligations of the Recipient, the Agent and the Suppliers of the products and services should be stipulated in the tender documents to be prepared by the Agent. Besides this, the tender documents shall be prepared in consultation with the Recipient.

i) Pre-qualification Examination of Tenderers

The Agent may conduct a pre-qualification examination of tenderers in advance of the tender so that the invitation to the tender can be extended only to eligible firms. The pre-qualification examination should be performed only with respect to whether or not the prospective tenderers have the capability of accomplishing the contracts concerned without fail. In this case, the following points should be taken into consideration:

(1) Experience and past performance in contracts of a similar kind
(2) Property foundation or financial credibility
(3) Existence of offices, etc. to be specified in the tender documents.

j) Tender Evaluation

The tender evaluation should be implemented on the basis of the conditions specified in the tender documents.

Those tenders which substantially conform to the technical specifications, and are responsive to other stipulations of the tender documents, shall be judged in principle on the basis of the submitted price, and the tenderer who offers the lowest price shall be designated as the successful tenderer.

The Agent shall prepare a detailed tender evaluation report clarifying the reasons for the successful tender and the disqualification and submit it to the Recipient to obtain confirmation before concluding the contract with the successful tenderer.

The Agent shall furnish JICA with a detailed evaluation report of tenders, giving the reasons for the acceptance or rejection of tenders.

k) Additional Procurement

If there is an additional procurement fund after competitive and / or selective tendering and / or direct negotiation for a contract, and the Recipient would like an additional procurement, the Agent is allowed to conduct an additional procurement, following the points mentioned below:

(1) Procurement of the same products and services

When the products and services to be additionally procured are identical with the initial tender and a competitive tendering is judged to be disadvantageous, the additional procurement can be implemented by a direct contract with the successful tenderer of the initial tender.

(2) Other procurements

When products and services other than those mentioned above in (1) are to be procured, the procurement should be implemented through a competitive tendering. In this case, the products and services for additional procurement shall be selected from among those in accordance with the E/N and the A/M.

l) Conclusion of the Contracts

In order to procure products and services in accordance with the E/N and the A/M, the Agent shall conclude contracts with firms selected by tendering or other methods.

m) Terms of Payment

The contract shall clearly state the terms of payment. The Agent shall make payment from the "Advances", against the submission of the necessary documents from the Firm on the basis of the conditions specified in the contract, after the obligations of the Firm have been fulfilled. When the services are the object of procurement, the Agent may pay certain portion of the contract amount in advance to the firms on the conditions that such firms submit the advance payment guarantee worth the amount of the advance payment to the Agent.

4) Undertakings required to the Government of the recipient country

In the implementation of the Grant Aid Programme, the recipient country is required to undertake such necessary measures as the following:

a) To secure land necessary for the sites of the Programme and to clear, level and reclaim the land prior to commencement of the Programme,
b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,
c) To secure buildings prior to the procurement in case the installation of the equipment,
d) To ensure all the expense and prompt execution for unloading and customs clearance at the port of disembarkation of the products purchased under the Grant Aid,

e) To exempt all the concerned parties from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the contracts,

f) To accord all the concerned parties, whose services may be required in connection with supply of the products and services under the contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

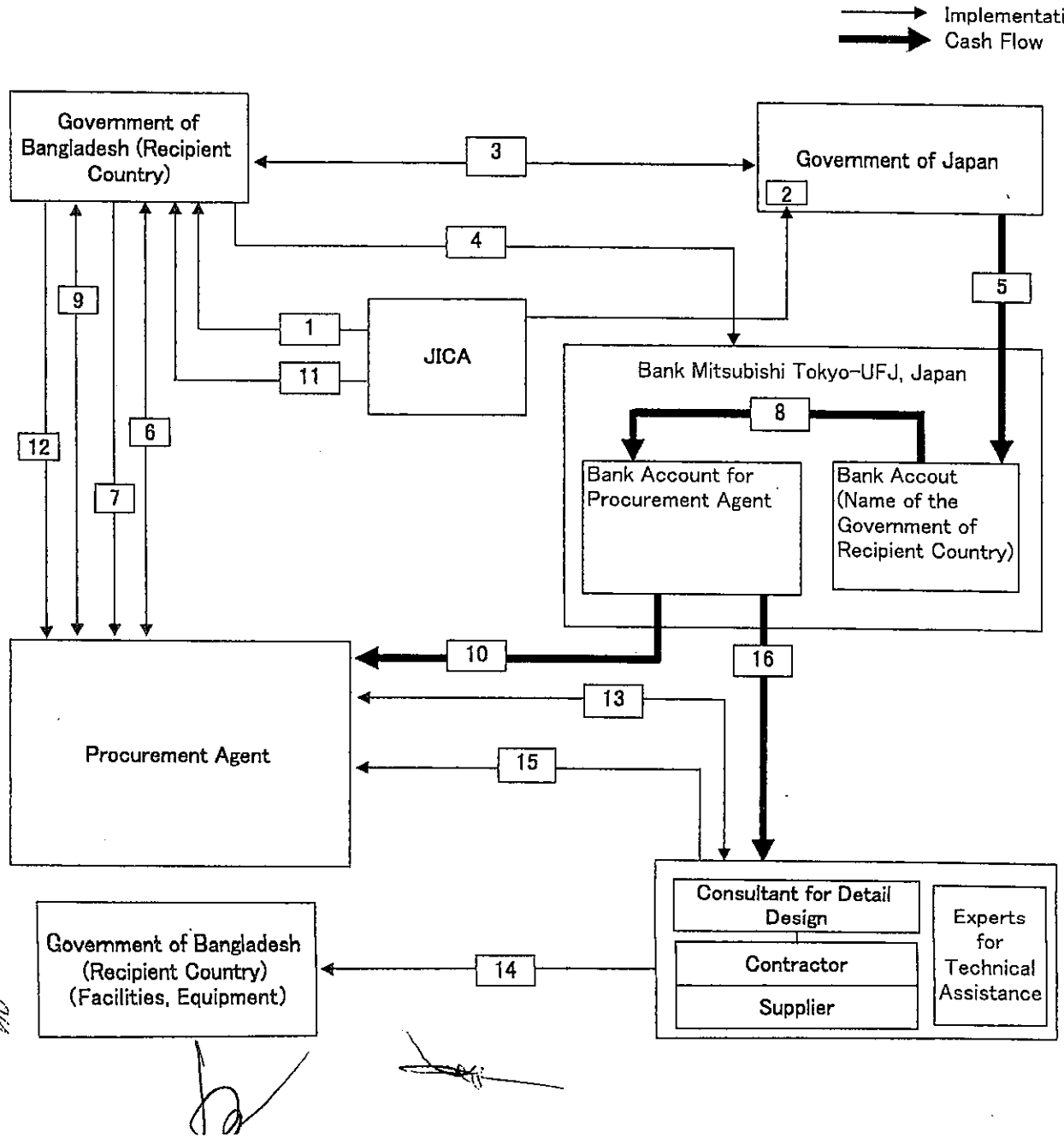
5) Proper Use

The recipient country is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

6) Re-export

The products purchased under the Grant Aid should not be re-exported from the recipient country.

FLOW OF FUNDS FOR IMPLEMENTATION UNDER THE JAPAN'S GRANT AID FOR ENVIRONMENT AND CLIMATE CHANGE



1 Outline Design Study / Materials for Tender Documents

2 Approval of Cabinet

3 Signing of Exchange of Notes (E/N)

4 Banking Arrangement (B/A)

5 Disbursement of Funds from the Government of Japan

6 Signing of Agreement for Agent (A/A)

7 Decision of Project Components

8 Transfer of Funds

9 Decision of Project Components

10 Payment of Remuneration for Agent

11 Recommendation of Consultant for Detail Design/Supervision (JICA→Government of Bangladesh)

12 Recommendation of Consultant for Detail Design / Supervision (Government of Bangladesh→Procurement Agent)

13 Conclusion of Contract

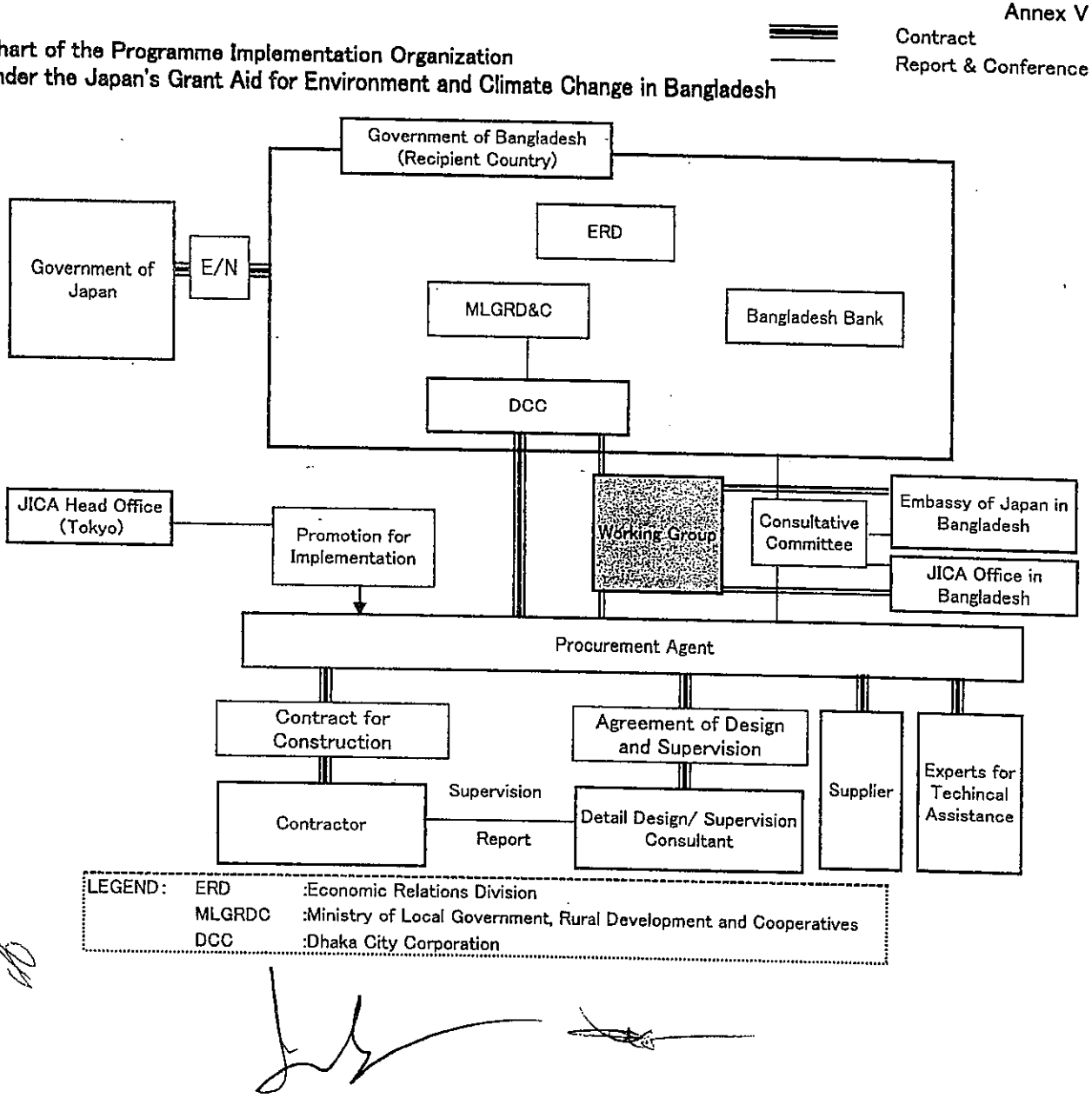
14 Construction and Procurement

15 Application for Payment

16 Payment

Annex V

Chart of the Programme Implementation Organization under the Japan's Grant Aid for Environment and Climate Change in Bangladesh



Annex VI

Terms of Reference of the Committee

1. To confirm an implementation schedule of the Programme for the speedy and effective utilization of the Grant and its accrued interest.

2. To discuss the modifications of the Programme for the implementation of the Programme.

3. To exchange views on allocations of the Grant and its accrued interest as well as on potential end-users.

4. To identify problems which may delay the utilization of the Grant and its accrued interest, and to explore solutions to such problems.

5. To exchange views on publicity related to the utilization of the Grant and its accrued interest.

6. To discuss any other matters that may arise from or in connection with the Exchange of Notes.

Annex - VII

Major Undertakings to be taken by Each Government (GAEC version)

	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct gates and fences in and around the sites		●
4	To construct the parking lot		●
5	To construct roads		
	1) Within the site	●	
	2) Outside the site		●
6	To construct the building	●	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. The distributing line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (from storm sewer and other to the site)		●
	b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site	N/A	N/A
	b. The gas supply system within the site	N/A	N/A
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8	To bear the following commissions to the Japanese bank for banking services based upon the B/A		
	1) Payment commission		●
9	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products to the recipient	●	
	2) To exempt or bear tax and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	●
10	To accord all concerned parties, whose service may be required in connection with the supply of the products and the services under the contract, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
11	To exempt or bear on behalf of all concerned parties from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the contract		●
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant		●
13	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment		●

MINUTES OF DISCUSSIONS
ON
OUTLINE DESIGN STUDY
ON
THE PROGRAM FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT IN DHAKA CITY TOWARD THE LOW CARBON SOCIETY
IN
THE PEOPLES'S REPUBLIC OF BANGLADESH
(EXPLANATION ON DRAFT FINAL REPORT)

In August and in October 2008, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched Outline Design Study Teams on the "Program for Improvement of Solid Waste Management in Dhaka City Toward the Low Carbon Society" (hereinafter referred to as "the Program") as the Program Grant Aid for Environment and Climate Change to the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh"), and through discussions, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult with the officials concerned of the Bangladesh on the components of the draft report, JICA sent to Bangladesh the Draft Final Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Mitsuyoshi Kawasaki, Deputy Director General, JICA South Asia Department, from January 6 to 19, 2009.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

January 29, 2009

Mr. Mitsuyoshi Kawasaki
Leader
Draft Report Explanation Team
Japan International Cooperation Agency

Dr. Md. Atiqur Rahman
Deputy Secretary
Economic Relations Division
Ministry of Finance

Mr. Md. Alauddin
Chief Executive Officer
Dhaka City Corporation

Mr. Md. Shamsul Karim Bhuiyan
Deputy Chief
Local Government Division
Ministry of Local Government, Rural Development & Cooperatives

ATTACHMENT

1. Components of the Draft Report

The Bangladesh side agreed and accepted in principle the components of the draft report explained by the Team.

2. List of Components

Both sides agreed on the components and its priority described as the List of Components in the Draft Outline Design Report. As the components were requested by the Government of Bangladesh, and they were adequately examined through the Outline Design Study, any additional request shall not be approved in the future.

However, the List of Components is subject to be examined through revision of the Outline Design Study that shall be implemented by the consultants after the approval of the Program by the Government of Japan.

3. Cost

Both sides agreed that the Program Cost shall not exceed the total amount of the Cost Estimation described in Annex-I. If the expense comes to run over the budget due to price changes, exchange rate fluctuation or unavoidable circumstances, the numbers of facilities and/or equipments shall be adjusted to implement the Program on the budget.

4. Japan's Grant Aid scheme

The Bangladesh side confirmed the Japan's Grant Aid for Environment and Climate Change with the flow of the budget described in Annex - III, IV and V. The Team remarked that according to the new JICA law entered into effect on October 1st, 2008, and based on grant agreement to be concluded between the Government of Bangladesh and JICA, JICA would be the executing agency of the Grant Aid.

5. Confidentiality of the Program

5.1. Detailed specifications of the Facilities

Both sides confirmed that all the information related to the Program including detailed drawings and specifications of the facilities and equipment and other technical information shall not be released to any outside parties before the conclusion of all the contract(s) for the Program.

5.2. Confidentiality of the Cost Estimation

The Team explained the cost estimation of the Program as described in Annex-I. Both sides agreed that the Program Cost Estimation should never be duplicated or released to any outside parties before conclusion of all the contract(s) for the Program. Bangladesh side understood that the Program Cost Estimation attached as Annex-I is not final and is subject to change by the result of examination through revision of the Outline Design Study.

6. The Consultative Committee

Both sides agreed to establish a Consultative Committee (hereinafter referred to as "the Committee") in order to implement the Program in good conditions. The Terms of Reference of the Committee was settled in Annex-VI of the Minutes of Discussions signed by both parties on August 25, 2008,

The members of the Committee are as follows:

1) Representative of Economic Relations Division (ERD), Ministry of Finance
2) Representative of the Planning Commission, Ministry of Planning
3) Representative of the Local Government Division, Ministry of Local Government, Rural Development and Cooperatives
4) Representative of DCC
5) Representative of the Procurement Agent
6) Representative of the Embassy of Japan
7) Representative of JICA Bangladesh Office

The members of the Working Group are as follows:

1) Representative of DCC
2) Representative of the Procurement Agent
3) Representative of the Embassy of Japan
4) Representative of JICA Bangladesh Office

The first meeting of the Committee shall be held immediately after the JICA's approval of the Agent Agreement which shall be concluded between DCC and the Procurement Agent. The employment of the Agent shall be agreed between the two Governments. Further meetings shall be held upon request of either the Bangladesh side or the Japanese side. The Procurement Agent may advise both sides on the necessity to call a meeting of the Committee.

7. Implementation Mechanism

The Team confirmed that the responsible departments of DCC regarding the facilities and equipments to be procured in the Program and personnel to be assigned under the Program are several: Waste Management Department, Engineering Department and Transport Department. Both sides agreed that DCC shall be responsible for coordinate all related departments by assigning proper officials or establishing any other mechanism for smooth implementation of the Program. DCC promised to submit a coordination plan to JICA before the Program starts.

8. Other relevant issues

The Bangladesh side agreed to make the following arrangements in accordance with the schedule of the Program.

8.1 Budget Arrangement

The Bangladesh side committed to allocate necessary budget for the Program before, during and after its implementation and to complete the necessary undertakings as shown in Annex-VII of the Minutes of Discussions signed by both parties on August 25, 2008. In addition to the Annex-VII, DCC agreed to prepare the extra containers for the container carriers by program implementation.

The Government of Bangladesh shall also complete necessary procedures to bear the customs duties, internal taxes and other fiscal levies. DCC promised to take necessary support for this matter.

8.2 Approval of DPP

The Team requested the Bangladesh side to approve the Development Program Proposal (DPP) at an early date. The Bangladesh side promised to take necessary measures to approve it.

8.3 Banking Arrangement

Bangladesh side, being convinced that the conclusion of the Banking Arrangement (B/A) and Blanket Disbursement Authorization (BDA) constitutes a very important factor to implement the Program smoothly and without delay, shall take the necessary measures in order that the Ministry of Finance appoint an appropriate bank, signer of the Banking Arrangement with the Bank of Tokyo-Mitsubishi UFJ, Ltd, on or before March 15, 2009. The flow of funds is shown in the Annex-IV.

By signing the BDA, the Recipient designates the Procurement Agent as the representative authorized to act in the name of the Recipient concerning all transfers of the Grant plus any interest earned to the Procurement Account.

8.4 Approval of Bidding plan

DCC shall take measures to approve the bidding plan after the revision of the Outline design study is concluded, if it is required. The approval of the bidding plan shall be relied on "The Procurement Guidelines of Japan's Grant Aid for Environment and Climate Change".

8.5 Procurement Procedure

"The Procurement Guidelines of Japan's Grant Aid for Environment and Climate Change" as shown in the Annex VII shall be applied for the procurement procedure of the Program.

Regarding the vehicle procurement the country of origin shall be limited to OECD-DAC (Development Assistance Committee of the Organization for Economic Co-operation and Development) member countries in order to ensure the quality of the vehicles, adequate maintenance including ready availability of spare parts, and their feasible cost.

8.6 Arrangement Plan for Technical Assistance

In order to implement the Program smoothly, the Bangladesh side shall submit the arrangement plan for Technical Assistance to JICA by implementation of the Program. In accordance with this plan, the Bangladesh side shall assign appropriate Counterparts as shown in the Annex - VI before the Program commences, and mobilize participants to the seminars in the Program.

8.7 Operation and Maintenance

DCC is responsible for keeping operation and maintenance mechanism of solid waste collection vehicles during and after the Program in accordance with the manuals made in the Program. In order to operate efficiently, the Bangladesh side shall provide a computer for the workshop 1 before the activities of the Technical Assistance start.

8.8 Bangladesh Regulation

If there are any other Bangladesh regulations that are to be applied for the implementation of the Program, the Bangladesh side shall take necessary measures in order not to disturb smooth implementation of the Program.

9. Schedule of the Study

JICA shall complete the final report in accordance with the confirmed items and send it to the Government of Bangladesh in February, 2009.

10. Remarks

The Team explained the comparative advantage of manual loading compactor trucks. DCC mentioned that necessity of bin lifting system to the compactor trucks need to be studied in future.

Annex – II	Components
Annex – III	Grant Aid Scheme for Environment and Climate Change
Annex – IV	Flow of Funds for Implementation under the Japan's Grant Aid for Environment and Climate Change
Annex – V	Chart of the Program Implementation Organization under the Japan's Grant Aid for Environment and Climate Change in Bangladesh
Annex – VI	Counterparts of the Technical Assistance
Annex – VII	The Procurement Guidelines (Provisional)

Programme Component

No.	Project Component	Engine	Unit	Quantity
1	Container Carrier 3ton	CNG	Unit	15
2	Container Carrier 5ton	CNG	Unit	30
3	Detachable Container Truck 7ton	Diesel	Unit	20
4	Compactor Truck 2ton	Diesel	Unit	15
5	Compactor Truck 5ton	Diesel	Unit	20
	Total number of vehicles			100
6	Workshop civil works and procurement of related maintenance equipment		LS	1
7	Technical assistance on environmental education and technical maintenance		LS	1

Annex-III

Programme Grant Aid for Environment and Climate Change of the Government of Japan

(Provisional)

The Grant Aid provides a recipient country ("the Recipient") with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

The Program Grant Aid for Environment and Climate Change ("GAEC") aims toward emission reduction such as achievement of energy saving (environmental-easing measures) and environmental damage control by climate change. Multiple components can be combined to effectively meet the needs. Contractors, suppliers or consultants are not confined to Japanese firms only, and construction can be done based on the local method.

1. Procedures for GAEC

GAEC is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Outline Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by the Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

Firstly, the application or request for a GAEC programme submitted by the Recipient is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for GAEC. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the Outline Design Study, using Japanese consulting firms.

Thirdly, the Government of Japan appraises the programme to see whether or not it is suitable for Japan's GAEC, based on the Outline Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the programme, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the Recipient.

Simultaneously, the Grant will be made available by concluding a grant agreement between the Government of the Recipient Country or its designated authority and the Japan International Cooperation Agency (JICA) (hereinafter referred to as "the G/A").

JICA is designated by the Government of Japan as an organization responsible for the proper execution of the Grant.

Procurement Agent ("the Agent") is designated to conduct the procurement services of products and services (including fund management, preparing tenders, contracts and so on) for GAEC on behalf of the Recipient. The Agent is an impartial and specialized organization and shall render services according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the Agreed Minutes ("A/M").

2. Outline Design Study

1) Contents of the Study

The aim of the Outline Design Study ("the Study"), conducted by JICA on a requested programme ("the Programme"), is to provide a basic document necessary for the appraisal of the Programme by the Government of Japan. The contents of the Study are as follows:

(1) Confirmation of the background, objectives, and benefits of the Programme and also institutional capacity of agencies and communities concerned of the recipient country necessary for the Programme's implementation.
(2) Evaluation of the appropriateness of the Programme to be implemented under the Grant Aid Scheme for Environment and Climate Change from a technical, social and economic point of view;
(3) Confirmation of items agreed upon by both parties concerning the basic concept of the Programme.
(4) Preparation of an outline design of the Programme.
(5) Estimation of cost for the Programme.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid programme. The Outline Design of the Programme is confirmed considering the guidelines of Japan's Grant Aid scheme.

The Government of Japan requests the Government of the Recipient to take whatever measures are necessary to ensure its self-reliance in the implementation of the Programme. Such measures must be guaranteed even through they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Programme. Therefore, the implementation of the Programme is confirmed by all

relevant organizations of the Recipient through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Study, JICA uses registered consulting firms. JICA selects firms based on proposals submitted by interested firms. The firms selected carry out an Outline Design Study and write a report, based upon terms of reference set by JICA.

The consulting firms to work on the Programme's implementation after the Exchange of Notes could be, in principle, of any nationality as long as the Firm satisfies the conditions specified in the tender documents.

3. Implementation of GAEC after the E/N

1) Exchange of Notes (E/N) and Grant Agreement (G/A)

GAEC is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the programme, period of execution, conditions and amount of the Grant Aid, etc., are confirmed. The conclusion of the Grant Agreement (hereinafter referred to as "the G/A") between JICA and the recipient government will be followed to define the necessary engagement to implement the project such as payment conditions, responsibilities of the recipient government and procurement conditions.

2) Procedural details

Procedural details on the procurement of products and services under GAEC will be agreed upon between the Recipient and JICA at the time of the signing of the E/N and G/A.

Essential points to be agreed upon are outlined as follows:

a) JICA is in a position to expedite the proper execution of the program.
b) The products and services shall be procured and provided in accordance with "Procurement Guidelines for Environment and Climate Change of JICA.
c) The Recipient shall conclude an employment contract with the Agent.
d) The Agent is the representative acting in the name of the Recipient concerning all transfers of funds to the Agent.

3) Focal Points of "The Procurement Guidelines of Japan's (Type I - E) Grant Aid for Environment and Climate Change"

a) The Agent

The Agent is the organization which provides procurement services of products and services on behalf of the Recipient according to the Agent

Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the A/M.

b) Agent Agreement

The Recipient shall conclude an Agent Agreement, within one month after the date of entry into force of the E/N and the G/A, in accordance with the A/M. The scope of the Agent's services shall be clearly specified in the Agent Agreement.

c) Approval of the Agent Agreement

The Agent Agreement, which is prepared as two identical documents, shall be submitted to the Government of Japan by the Recipient through the Agent. The Government of Japan confirms whether or not the Agent Agreement is concluded in conformity with the G/A and the Procurement Guidelines for Disaster Reconstruction Grant Aid, and approves the Agreement.

The Agent Agreement concluded between the Recipient and the Agent shall become effective after the approval by the Government of Japan in a written form.

d) Payment Methods

The Agent Agreement shall stipulate that "regarding all transfers of the fund to the Agent, the Recipient shall designate the Agent to act on behalf of the Recipient and issue a Blanket Disbursement Authorization ("the BDA") to conduct the transfer of the fund (Advances) to the Procurement Account from the Recipient Account."

The Agent Agreement shall clearly state that the payment to the Agent shall be made in Japanese yen from the Advances and that the final payment to the Agent shall be made when the total Remaining Amount becomes less than 3 % of the Grant and its accrued interest.

e) Products and Services Eligible for Procurement

Products and services to be procured shall be selected from those defined in the G/A.

f) Firms

In principle, a Firm of any nationality could be contracted as long as the Firm satisfies the conditions specified in the tender documents.

g) Method of Procurement

In implementing procurement, sufficient attention shall be paid so that there is no unfairness among tenderers who are eligible for the procurement of products and services.

For this purpose, competitive tendering shall be employed in principle.

h) Tender Documents

The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured by GAEC.

The rights and obligations of the Recipient, the Agent and the Suppliers of the products and services should be stipulated in the tender documents to be prepared by the Agent. Besides this, the tender documents shall be prepared in consultation with the Recipient.

i) Pre-qualification Examination of Tenderers

The Agent may conduct a pre-qualification examination of tenderers in advance of the tender so that the invitation to the tender can be extended only to eligible firms. The pre-qualification examination should be performed only with respect to whether or not the prospective tenderers have the capability of accomplishing the contracts concerned without fail. In this case, the following points should be taken into consideration:

(1) Experience and past performance in contracts of a similar kind
(2) Property foundation or financial credibility
(3) Existence of offices, etc. to be specified in the tender documents.

j) Tender Evaluation

The tender evaluation should be implemented on the basis of the conditions specified in the tender documents.

Those tenders which substantially conform to the technical specifications, and are responsive to other stipulations of the tender documents, shall be judged in principle on the basis of the submitted price, and the tenderer who offers the lowest price shall be designated as the successful tenderer.

The Agent shall prepare a detailed tender evaluation report clarifying the reasons for the successful tender and the disqualification and submit it to the Recipient to obtain confirmation before concluding the contract with the successful tenderer.

The Agent shall furnish JICA with a detailed evaluation report of tenders, giving the reasons for the acceptance or rejection of tenders.

k) Additional Procurement

If there is an additional procurement fund after competitive and / or selective tendering and / or direct negotiation for a contract, and the Recipient would like an additional procurement, the Agent is allowed to conduct an additional procurement, following the points mentioned below:

(1) Procurement of the same products and services

When the products and services to be additionally procured are identical with the initial tender and a competitive tendering is judged to be disadvantageous, the additional procurement can be implemented by a direct contract with the successful tenderer of the initial tender.

(2) Other procurements

When products and services other than those mentioned above in (1) are to be procured, the procurement should be implemented through a competitive tendering. In this case, the products and services for additional procurement shall be selected from among those in accordance with the G/A.

l) Conclusion of the Contracts

In order to procure products and services in accordance with the G/A, the Agent shall conclude contracts with firms selected by tendering or other methods.

m) Terms of Payment

The contract shall clearly state the terms of payment. The Agent shall make payment from the "Advances", against the submission of the necessary documents from the Firm on the basis of the conditions specified in the contract, after the obligations of the Firm have been fulfilled. When the services are the object of procurement, the Agent may pay certain portion of the contract amount in advance to the firms on the conditions that such firms submit the advance payment guarantee worth the amount of the advance payment to the Agent.

4) Undertakings required to the Government of the recipient country

In the implementation of the Grant Aid Programme, the recipient country is required to undertake such necessary measures as the following:

a) To secure land necessary for the sites of the Programme and to clear, level and reclaim the land prior to commencement of the Programme,
b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,

c) To secure buildings prior to the procurement in case the installation of the equipment,

d) To ensure all the expense and prompt execution for unloading and customs clearance at the port of disembarkation of the products purchased under the Grant Aid,

e) To exempt all the concerned parties from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the contracts,

f) To accord all the concerned parties, whose services may be required in connection with supply of the products and services under the contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

5) Proper Use

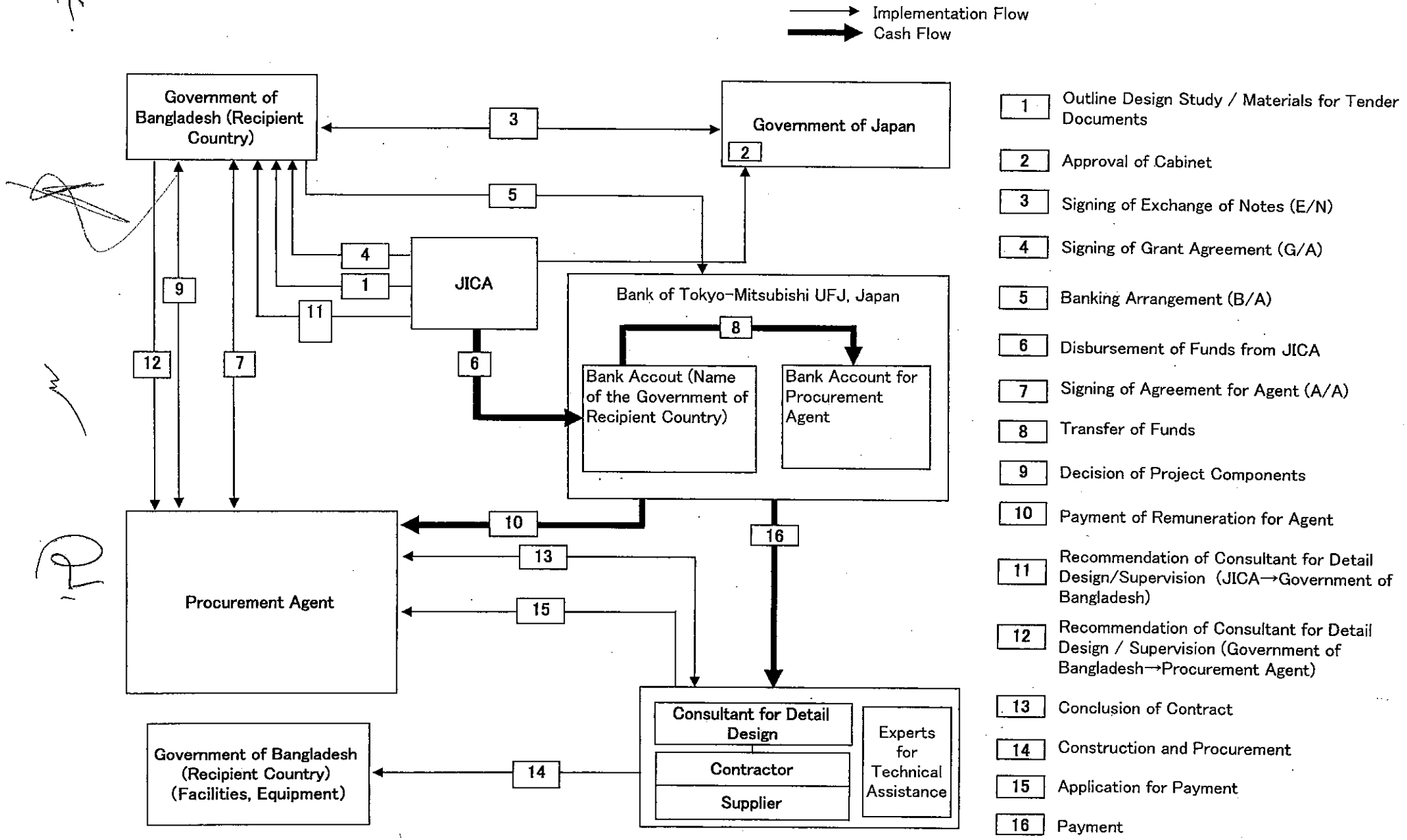
The recipient country is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

6) Re-export

The products purchased under the Grant Aid should not be re-exported from the recipient country.

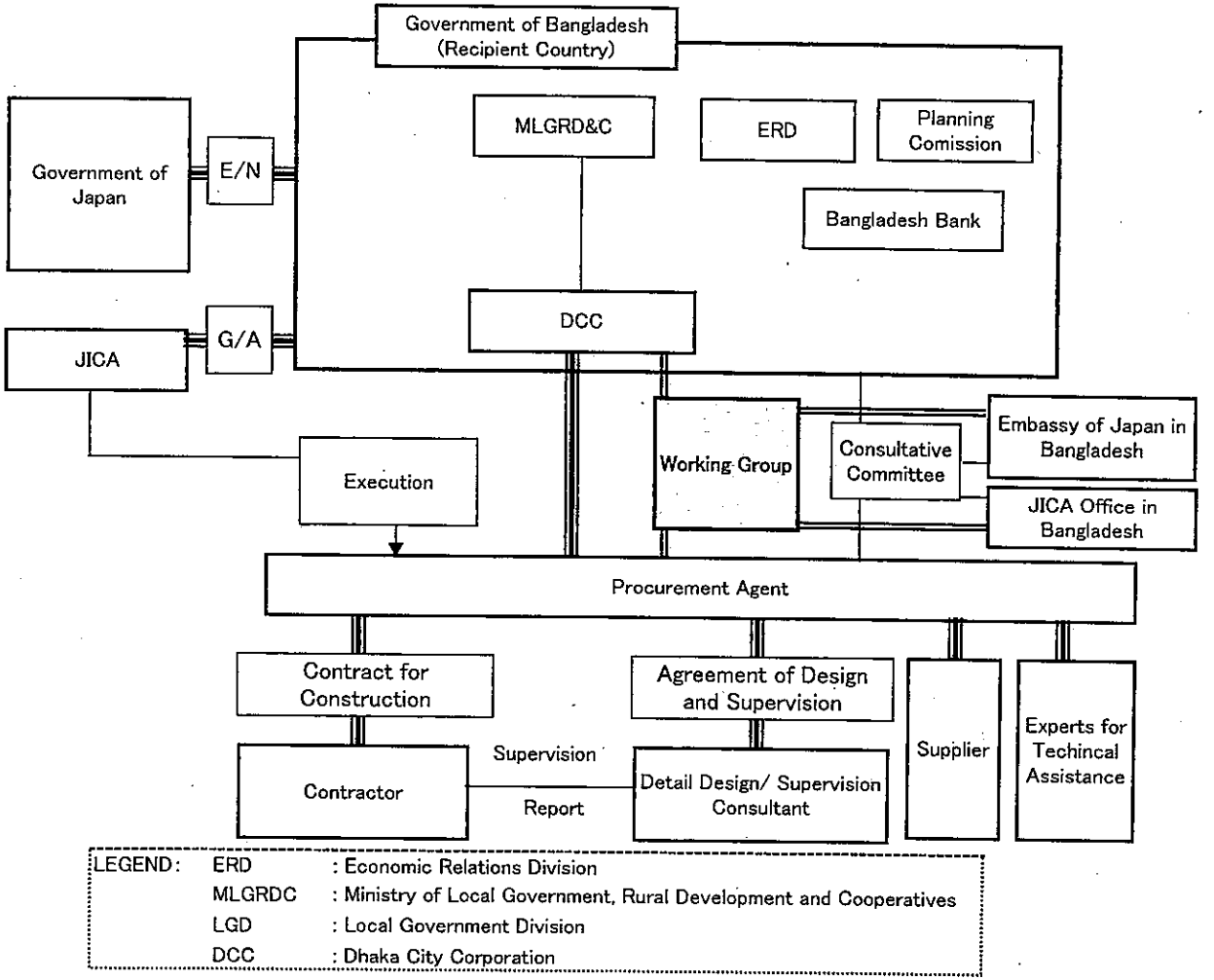
Annex IV

FLOW OF FUNDS FOR IMPLEMENTATION UNDER THE JAPAN'S GRANT AID FOR ENVIRONMENT AND CLIMATE CHANGE



Annex V

Chart of the Programme Implementation Organization
under the Japan's Grant Aid for Environment and Climate Change in Bangladesh



Annex VI

Counterparts of the Technical Assistance (Person)

	Coordinator	Environmental Education	Mechanical Maintenance	CNG
Counterpart(s)	Coordinator:(1)	Environmental education: (1)	Workshop: (1) Mechanic: (1) Driver: (1)	CNG planner: (1) CNG trained engineer: (1)
Assistant Counterpart(s)		Waste Management Dpt. (1) Transport Dpt. (1) Engineering Dpt. (1)	Workshop: (1) Accountant:(1) Inventory control: (1) Mechanic: (1) Driver: (1)	

Procurement Guidelines for the Grant Aid for Environment and Climate Change (Type I-E) (Provisional)

January 2009

Japan International Cooperation Agency

(JICA)

PART I Basic Principles

I-I Introduction

These Guidelines (Type I-E) , which are prepared by Japan International Cooperation Agency (hereinafter referred to as "JICA") and are authorized by the Government of Japan, set forth the general rules to be followed by the Government of the recipient country (hereinafter referred to as "the Recipient") in using Japanese Grant (hereinafter referred to as "the Grant") for the procurement of the products and services for the implementation of the programme (hereinafter referred to as "the Programme") which is agreed upon in the Exchange of Notes (hereinafter referred to as "the E/N") between the Government of Japan and the Recipient. These Guidelines (hereinafter referred to "the Guidelines") are applicable to the Grant Aid for Environment and Climate Change.

The application of the Guidelines to a particular programme funded by the Grant will be stipulated in the Grant Agreement (hereinafter referred to as "the G/A") concluded between JICA and the Recipient.

The rights and obligations of the Recipient, procurement agent (hereinafter referred to as "the Agent") and the firm(s) which supplies or provides the products and services for the Programme (hereinafter referred to as "the Firm") are governed by the employment contract (hereinafter referred to as "the Agent Agreement") concluded between the Recipient and the Agent which is defined in the Agreed Minutes on procedural details (hereinafter referred to as "the A/M") signed together with the E/N and in the G/A, by the tender documents, and by the contracts concluded between the Agent and the Firm, and not by the Guidelines.

I-II Parties Concerned

In the Guidelines, the Grant Aid means a set of arrangements where, based on the E/N between the Government of Japan and the Recipient, JICA concludes the G/A with the Recipient and provides to the Recipient the Grant to be expended for procuring products and services necessary for the implementation of the Programme, whereas the Recipient implements the Programme using the Grant. The roles of the concerned parties, including the Government of Japan, JICA, the Recipient, the Agent and the Firm in relation to the implementation of the Programme under the Grant are understood as follows:

1) The Government of Japan extends the Grant for the Programme.

2) JICA executes the Grant by making payments of the amount agreed upon in the E/N and pays serious attention to ensure the accountability on proper and effective use of the Grant for the Programme.

3) The Recipient is the beneficiary of the Grant and is responsible for the implementation of the Programme. The Recipient entrusts the Agent with the procurement of the products and

services.

4) The Agent is an impartial and specialized organization which provides procurement services of the products and services on behalf of the Recipient according to the Agent Agreement with the Recipient.

5) The Firm is the contractor who provides the products and services for the Programme in accordance with the contract with the Agent.

I-III Safety Considerations

The Recipient shall comply with all the applicable safety regulations and pay full attention to all the safety measures.

Part II Guidelines for the Use of the Agent

II-I General

II-I-1 Role of the Agent

The Agent shall conduct the procurement services of the products and services for the Programme on behalf of the Recipient. The Agent shall render services with due expertise and in a fair and impartial manner to ensure the smooth and proper implementation of the Programme in order to contribute to fulfilling the purpose of the assistance.

The Agent shall work to maintain rights and interests of the Recipient and maximize the impacts of Japan's assistance. The Agent is also required to pay attention to minimizing the burden of the Recipient.

II-I-2 Agent Agreement

The Recipient shall conclude an Agent Agreement, in principle within two (2) months after the date of signing of the G/A, with the Agent in accordance with the G/A.

After the approval of the Agent Agreement by JICA in a written form, the Agent shall conduct the services referred to in paragraph II-I-3 below on behalf of the Recipient.

II-I-3 Services of the Agent

The Agent shall conduct the services referred to in the Schedule I of the G/A.

II-II Approval of the Agent Agreement

II-II-1 General

The Agent Agreement is prepared as two identical documents and the copy of the Agent Agreement shall be submitted to JICA by the Recipient through the Agent. JICA confirms whether or not the Agent Agreement is concluded in conformity with the G/A and the Guidelines, and approves the Agent Agreement.

The Agent Agreement concluded between the Recipient and the Agent shall become effective after the approval by JICA in a written form.

II-II-2 Reference to the G/A

The Agent Agreement shall refer to the G/A as follows:

JICA shall execute the Grant to the Government of (name of recipient country) in accordance with the G/A signed on (date of signature) between JICA and the Government of (name of recipient country).

II-II-3 Scope of the Services

The scope of the Agent's services shall be clearly specified in the Agent Agreement. The Agent Agreement with the scope of Agent's services in conflict with the G/A shall not be approved by JICA.

II-II-4 Completion of the Services

The Agent Agreement shall clearly state that when the entire amount of the fund transferred from the Recipient's account in the name of the Recipient at a bank in Japan (hereinafter referred to as "the Recipient Account") to the account in the name of the Agent (hereinafter referred to as "the Procurement Account") has been paid for the procurement of the products and services, or when the remaining amount of the said fund has been transferred to the Recipient Account, the Agent's services shall be regarded as complete.

II-II-5 Agent's Fees

The amount and currency or calculations of Agent's fees shall be precisely and correctly stated in the Agent Agreement. The conditions and amount or calculation for additional fees to which the Agent is entitled shall be clearly stated.

II-II-6 Approval of the Agent Agreement

The Agent Agreement shall clearly state that it shall become effective after the approval by JICA in a written form.

II-II-7 Payment Methods

The Agent Agreement shall stipulate that "regarding all transfers of the fund to the Agent, the Recipient shall designate the Agent to act on behalf of the Recipient and issue a Blanket Disbursement Authorization to conduct the transfer of the fund (hereinafter referred to as "the Advances") to the Procurement Account from the Recipient Account."

The Agent Agreement shall clearly state that the payment to the Agent shall be made in Japanese yen from the Advances and that the final payment to the Agent shall be made when the total remaining amount become less than three percent (3%) of the Grant and its accrued interests excluding the Agent's fees.

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II-II-8 Force Majeure

The conditions of the Agent Agreement shall contain a clause stating that failure on the part of the Agent to fulfill obligations under the Agent Agreement would not be considered a default if such failure is the result of an event of force majeure. The scope of force majeure shall be defined in the conditions of the Agent Agreement.

II-II-9 Responsibilities and Obligations of the Recipient

The Agent Agreement shall clearly state the responsibilities and obligations of the Recipient in accordance with the G/A.

II-II-10 Amendment to the Agent Agreement

If an amendment to the Agent Agreement is required, the amended Agent Agreement shall clearly state that:

(1) all the clauses except that which is / are amended, remain unchanged; and

(2) the amendment to the Agent Agreement shall become effective only after the approval by JICA in a written form.

Part III Guidelines for the Procurement of the Products and Services by the Agent

III-I General

III-I-1 Products and Services Eligible for Procurement

The products and services to be procured shall be selected from those defined in the G/A.

The guidelines issued by the Agent shall be applied to the selection of consultants (persons or juridical persons including universities, NGOs, and others with expertise and experience) necessary for the Programme.

III-I-2 Firm and Expert(s)

(1) In principle, a firm of any nationality could be contracted as long as the firm satisfies the conditions specified in the tender documents.

(2) Not withstanding the provision (1) above, as a general rule, consultants that will be employed to do detail design and supervise the work for the Programme shall be Japanese nationals recommended by JICA, for the purpose of maintaining technical consistency with the preliminary examination and other related studies, conducted prior to the signing of the G/A (hereinafter referred to as "the Studies").

The recommendation of the consultant by JICA to the Recipient does not mean that JICA shall assume the responsibilities which the consultant shall bear to the Agent for the Recipient on the basis of the Contract

(The term "Japanese nationals" wherever used in the Guidelines means Japanese physical persons or Japanese juridical persons controlled by Japanese physical persons.)

(3) Expert(s) could be deployed to carry out technical assistance to support policy planning of the Recipient in view of achieving economic growth and contributing to climate stability. The expert(s) shall be recommended by JICA to maintain the conceptual consistency with the Studies. In principle, expert(s) is/are preferable to be Japanese nationals if appropriate.

(4) Furthermore, the Firm may be Japanese nationals and the products to be procured may be the products made in Japan or produced or manufactures by Japanese manufacturer(s) in any country if the Recipient requests to procure and / or if the said products have comparative advantages over products produced or manufactures by non- Japanese manufacturer(s).

III-I-3 Misprocurement

JICA requires that, under contracts funded by the Grant, tenderers and Firms observe the highest standard of ethics during the procurement and execution of such contracts. In this regard, JICA shall demand that the Recipient and the Agent shall reject a tender if it determines that the tenderer has engaged in corrupt or fraudulent practices in competing for the contract in question. JICA will recognize a firm as ineligible, for a period determined by JICA, to be awarded a contract funded by the Grant if it at any time determines that the Firm has engaged in corrupt or fraudulent practices in competing for, or in executing any other contracts funded by the Grant or other Japanese ODA.

When the authorities concerned of the Government of Japan decide to impose against a firm such administrative sanctions as debarment, exclusion of goods manufactured, etc., from Japanese governmental procurement, JICA may ask the Recipient and the Agent to exclude the goods manufactured by the sanctioned firm from the procurement under the Grant, for the period of the sanctions by such authorities concerned of the Government of Japan.

III-II Procurement Procedures

III-II-1 Transfer of the fund

The Agent shall take necessary measures for transferring the fund necessary for the procurement of the products and services from the Recipient Account to the Procurement Account prior to the procurement procedures. The fund transferred to the Procurement Account is called the Advances.

III-II-2 Method of Procurement

(1) Competitive Tendering

In implementing procurement, sufficient attention shall be paid so that there is no unfairness among tenderers who are eligible for the procurement of the products and services.

For this purpose, competitive tendering shall be employed in principle.

(2) Other Procurement Methods

If competitive tendering is deemed inappropriate or impractical due to any of the following special situations, the Agent is permitted to proceed with procurement on selective tendering , international shopping or direct contracting :

1) when spare parts or accessories, etc. for existing equipment or equipment manufactured by specified manufacture are procured (In this case direct contracting is expected);

2) when there are adequate reasons to maintain uniformity and continuity of the products and services provided under an existing contract (In this case direct contracting is expected);

3) when the number of firms to satisfy the conditions is limited (In this case selective tendering or international shopping is expected);

4) when it is quite doubtful that the prospective tenderers would be interested in participating in competitive tendering, and thereby the advantages of competitive tendering would be outweighed by the administrative burdens involved (In this case selective tendering or international shopping is expected);

5) part or all of the tender procedure was not successfully completed and re-tendering is implemented (In this case selective tendering or international shopping is expected);

6) when emergency procurement is required (In this case selective tendering or international shopping is expected);and

7) when consultants are to be selected (In this case, competitions among contents of Technical Proposals and financial proposal
or direct contracting with the consultant recommended by JICA is expected).

When procurement method other than competitive tendering are employed, the Agent shall implement procedures in such a manner as to comply with the competitive tendering procedures described in the Guidelines to the fullest possible extent, in order to ensure the transparency of the selecting procedures.

(3) Modifications of the Programme

The Grant must only be used for procuring the products and services necessary for implementing the Programme, based on the Studies. Therefore, the Recipient is to implement each component based on the items listed on the report of the Studies prepared and submitted for the Recipient by JICA and / or concerned parties. However, on the occasion that the content the Programme shall be modified due to various reasons at the stage of determining the details or implementing the Programme, the Recipient must obtain prior approval from JICA under the consensus of committee established in the G/A through the Agent, provided that the modifications of the Programme are beyond the concept of the Studies.

The prior consent for the modifications is conducted by JICA to ensure that the modifications of the Programme are appropriate and to confirm whether any modifications are required on the contract price or not, however it does not mean that JICA will assume the legal or technical responsibilities for the substance of the modifications.

On the other hand, provided that the modifications of the Programme are minor than the concept of the Studies, the Recipient, through the Agent, must obtain post-identification from JICA.

The details of the procedures for modifications will be advised by JICA separately.

(4) Additional Procurement

If the Recipient may request an additional procurement by using the Remaining Amount described in (5) 1) below, the Agent is allowed to conduct an additional procurement, following the points mentioned below:

1) Procurement of the same products and services

The additional procurement may be implemented by a direct contracting with the successful tenderer of the initial tender when a competitive tendering is judged to be disadvantageous or uneconomical in such cases where the products and services to be additionally procured are identical with the initial tender and also the quantity to be additionally procured is limited, or there was no other participants than the successful tenderer in the initial tender. When a direct contracting with the same firm is not necessarily advantageous or appropriate in such case where a portion of the balance is relatively large, firms shall be selected through a new tendering procedure.

2) Other procurements

When the products and services other than those mentioned in (1) above are to be procured, the procurement shall be implemented in principle through a competitive tendering. In this case, the products and services for additional procurement shall be selected from among those in accordance with the G/A.

(5) Handling of the Remaining Amount

1) "The Remaining Amount" refers to the difference in amount between "the total amount of the Grant, accrued interests, and where available, the resources received as delay damages, compensations or penalty(ies) (hereinafter referred to as "the Charges")" and "the total payment amount to the Firm and the Agent."

2) In the case conditions described in 3) below are fulfilled, the Recipient may use the Remaining Amount to cover the change of the contract price due to the modifications of the Programme and to fund additional procurements needed in the implementation of the Programme (including changes in the type of procurement of services, etc.) by taking steps described in (6) below. Any funds that remain after the completion of all procurements are to

be returned to JICA.

3) Conditions for using the Remaining Amount are as follows:

(a) It must be used for purposes and scopes stipulated in the G/A;

(b) It must be used in line with the procedure stipulated in the G/A;

(c) It must be used in line with the aims and content listed in the Studies and other documents;

(d) The procurements shall be of the products and services necessary for effectively implementing the relevant projects, and such procurements shall be completed within the period set at the beginning;

(e) In the case of purchasing or additionally procuring spare parts, the amount used for this out of the Remaining Amount must not exceed twenty percent (20%) of the contract price of each equipment (or anticipated price by tender, if more appropriate); and

(f) The reimbursement of the Remaining Amount shall be carried out as stipulated in the G/A.

(6) Authorization Process for Using the Remaining Amount

The following steps shall be taken to obtain prior approval of JICA to use the Remaining Amount:

1) the implementing agency of the Recipient submits a proposal for using the Remaining Amount to the committee stipulated in the G/A and obtains its consensus;

2) upon obtaining the committee's consensus, the implementing agency of the recipient country submits to JICA, through the Agent, a request form clearly indicating, together with the design modifications proposal and/or the proposal of additional procurement, the aim and specific reasons (including technical reasons) for the use of the Remaining Amount;

3) JICA, based on the request form mentioned in 2) above, considers from a technical standpoint whether or not to authorize the use of the Remaining Amount; and

4) JICA responds to the implementing agency of the Recipient, through the Agent, regarding the result mentioned in 3) above.

III-II-3 Size of Tender Lot

If a possible tender lot may be technically and administratively divided and such a division is likely to result in the broadest possible competition, the tender lot shall be divided into two or more. On the other hand, in the interest of obtaining the broadest possible competition, any one lot for which a tender is invited shall, whenever possible, be of a size large enough to attract tenderers.

III-II-4 Tender Conditions

The Agent shall fully study and consider technical specifications, construction period, required technical standards, prices, manufacturing, transportation, trade regulations, etc. regarding the products and services to be procured and finalize appropriate tender and

procurement conditions after obtaining confirmation by the Recipient. Also, the price expected for the procurement (referential price) shall be set in advance for reference in the selection of firms.

III-II-5 Public Announcement

Public announcement shall be carried out in such a way that all potential tenderers will have fair opportunity to learn about and participate in the tender.

The invitation to prequalification or to tender shall be publicized at least in a newspaper of general circulation in the recipient country (or neighboring countries) or in Japan, and in the easily accessible webpage operated by the Agent. The items to be contained in the public announcement are as follows:

(1) name of the Grant;

(2) names of the products and services to be procured;

(3) name of the Agent and contact information including a location of its webpage (written as an agent for the Recipient);

(4) required qualifications of tenderers;

(5) date, time and place of the distribution and price of tender documents; and

(6) other relevant information considered to be necessary for firms to determine whether to participate in the tender.

The Agent is required to publicize the information from (1) to (3) above in the newspapers if other details including (4) to (6) above are advertised on the webpage of the Agent.

III-II-6 Language

The tender invitation, tender documents and contracts should be prepared in principle in English, French or Spanish. In case that announcement is made in a newspaper in circulation in Japan, Japanese translation shall be attached when possible.

III-III Tender Documents

III-III-1 General

(1) The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured for the Programme.

(2) The rights and obligations of the Recipient, the Agent and the Firm of the products and services should be stipulated in the tender documents to be prepared by the Agent. The tender documents shall be prepared in consultation with the Recipient.

(3) The tender documents shall clearly state that JICA shall execute the Grant to the Government of (name of recipient country) in accordance with the G/A signed on (date of signature) between JICA and the Government of (name of recipient country).

(4) The tender documents shall clearly state that "JICA requires that, under contracts funded by the Grant, tenderers and the Firm observe the highest standard of ethics during the

procurement and execution of such contracts. In this regard, JICA will demand that the Recipient and the Agent shall reject a tender if it determines that the tenderer has engaged in corrupt or fraudulent practices in competing for the contract in question. JICA will recognize a firm as ineligible, for a period determined by JICA, to be awarded a contract funded by the Grant if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing any other contracts funded by the Grant or other Japanese ODA. When the authorities concerned of the Government of Japan decide to impose against a firm such administrative sanctions as debarment, exclusion of goods manufactured, etc., from Japanese governmental procurement, JICA may ask the Recipient and the Agent to exclude the goods manufactured by the sanctioned firm from the procurement under the Grant, for the period of the sanctions by such authorities concerned of the Government of Japan."

III-III-2 Contents of the Tender Documents

The tender documents should consist of the following documents:

(1) instruction to tenderers;

(2) procurement conditions;

(3) form of the tender; and

(4) draft of the contract.

If a fee is charged for the tender documents, it should be reasonable and reflect the cost of implementation of the tender procedure.

III-III-3 Major Items Related to the Instruction to Tenderers

(1) The instruction to tenderers should clearly describe the procedure for question and answers, and correction regarding the tender documents, tender procedures, tender evaluations, and the other relevant issues of the tendering process.

(2) The instruction to tenderers should clearly describe the products and services to be procured, qualifications required of tenderers, existence of local agents, elimination of disqualified firms from the tender, eligible source countries, size of contract, place of delivery and date of shipment, insurance, transportation, bond, warranty, tax exemption described in the G/A and other pertinent terms.

(3) The instruction to tenderers should clearly describe that the tender price shall be stated in figures and words as firm and final, and if there is a difference between the price in words and that in figures, the price in words is deemed correct.

III-III-4 Procurement Conditions

(1) Clarity and Accuracy of Conditions

The procurement conditions should specify clearly and in detail the services to be performed, the products and services to be supplied and the relevant terms such as contents of the

products and services, technical specifications, the place of delivery, etc.

The procurement conditions should identify the main factors or criteria to be taken into account in evaluation and comparison of tenders. The procurement conditions should be prepared so as to secure the broadest possible competitive tendering.

(2) Impartiality of the Technical Specifications

The technical specifications supplied with Procurement Conditions should be based on the related characteristics and required capacities of the products and services to be procured. Making reference to trademark names, catalogue numbers or similar classifications should be avoided unless in the case of the procurement of particular spare parts, etc.

(3) Standards

In the event that specifications require products to comply with industrial standards, technical specifications should be decided in appropriate manner, considering that the products meeting internationally accepted standards and domestically accepted standards and should be stated in the tender document.

III-III-5 Forms of Tender

The following forms of tender should be clarified:

(1) tender qualification certificates;

(2) tender specifications; and

(3) tender price.

III-III-6 Draft of the Contract

The draft contract should clearly state "the contract terms" such as "the rights and obligations of the Recipient, the Agent and the Firm, etc." and the following items:

(1) terms of payment;

(2) warranty period;

(3) performance bond;

(4) non-performance of the contract;

(5) force majeure; and

(6) settlement of disputes.

III-IV Implementation of Tender

III-IV-1 Preparatory Period for the Tender

The allowable period for the preparation and submission of the tender should be determined with due consideration to the particular circumstances related to the Programme in the recipient country and the scale and complexity of the tender lots. Sufficient period before the date of tender should be allowed from the date when the documents are made available for potential tenderers.

III-IV-2 Guarantee for the Tender

The Agent may request that the tenderers submit bid bond (e.g. bank guarantees) for the tender. The amount of the bid bond, however, should not be so high as to discourage potential tenderers. The bid bonds submitted from the unsuccessful tenderers should be returned immediately after the award of the contract.

III-IV-3 Questions and Answers regarding the Tender Documents

The Agent, for the purpose of the smooth implementation of the tender, should accept questions about the tender documents from the purchasers of the documents and provide answers to the questions, in accordance with the following points:

(1) a reasonable period should be set, respectively for accepting questions and providing answers to those questions; and

(2) the answers should be given to all those who have purchased the tender documents well in advance of the date of tender so that the prospective tenderers can take proper measures.

III-IV-4 Correction and Alteration of the Tender Documents

Any additional information, supplementary explanations, correction of errors and alterations related to the tender documents should be notified to all those who have purchased the tender documents well in advance of the date of tender so that prospective tenderers can take proper measures.

III-IV-5 Pre-qualification Examination of Tenderers

(1)The Agent may conduct a pre-qualification examination of tenderers in advance of the tender so that the invitation to the tender can be extended only to eligible firms.

(2)The pre-qualification examination should be performed not to limit the tenderers but to confirm the capability and resources of potential tenderers to perform the particular work satisfactorily and should not hinder the objective of the competitive tendering.

(3)In this case, the following points should be taken into consideration:

1) experience and past performance in contracts of a similar kind;

2) property foundation or financial credibility;

3) existence of local offices, etc. to be specified in the tender documents; and

4) their potentialities to use necessary personnel, equipment and facilities.

III-IV-6 Tender Procedures

(1) The tender documents should clearly indicate the deadline of the date and time for accepting the tendering as well as the date and place for opening the tender.

(2) The tenderer should be instructed to submit the following necessary tender documents:

1) tender qualification certificates;

2) tender specifications; and

3) tender price.

(3) All tenders should be opened in the presence of the Agent and tenderers or their representatives at the fixed date, time and place. The presence of tenderers is not requirement as far as transparency and necessary confidentiality are secured Tenderers who do not attend the tender opening should not be disadvantaged in the respect of selection procedure.

(4) Any tender submitted after the specified deadline is not acceptable as a valid tender.

(5) In opening tenders with the attendance of tenderers, the name of each tenderer and the tender price concerned shall be read aloud and recorded.

III-IV-7 Supplementary Explanation and Modifications of the Tender during Tender Evaluation

(1) No tenderers shall be permitted to modify the contents of the tenders after the tenders have been opened.

(2) The Agent may request any tenderers to make a supplementary explanation but not permitted to request them for a substantial modifications of the contents of the tenders and a change in tender prices.

III-IV-8 Confidentiality of Tender Process

Until notification of the award has been sent to the successful tenderer, the Recipient and the Agent shall not disclose to the tenderers and to other people who are not officially concerned with the tender procedures, any information on the examination of the tenders, supplementary explanations and evaluations, or any information related to the recommendation of a successful tenderer.

III-IV-9 Examination of Tenders

The Agent shall examine the following items with regard to the submitted tenders:

(1) serious errors in calculation;

(2) attachment of requested documents;

(3) attachment of requested certificates;

(4) attachment of requested guarantees;

(5) confirmation of proper signatures to the documents; and

(6) conformity of the submitted tenders with the instruction of the tender documents.

In examining the tenders, if a tender does not substantially conform to the specifications, or contains inadmissible reservations or is otherwise not substantially responsive to the tender documents, it should be disqualified.

After the above examination, each tender that satisfies the conditions should be technically examined for evaluation and comparison, in principle beginning with those submitted from the tenderer with the lowest tender price.

III-IV-10 Tender Evaluation

(1)The tender evaluation shall be implemented on the basis of the conditions specified in the tender documents.

(2)Those tenders which substantially conform to the technical specifications, and are responsive to other stipulations of the tender documents, shall be judged in principle on the basis of the submitted price, and the tenderer who offers the lowest price shall be designated as the successful tenderer. In case the selection of successful tenderer solely based on the submitted prices is not appropriate or irrational in the respect of the natures of the products and services to be procured, other elements than the price such as length of delivery or construction periods, superiority of technical specifications, etc. might be considered by qualifying their degrees and evaluated comprehensively together with the price competitiveness. In such cases, method and standard of tender evaluation shall be clearly explained in the tender documents.

(3)In cases where satisfactory results in the respect of price or other relevant elements, if any, are not offered in the tender, the Agent may negotiate with the most advantageous tenderer (if this fails to obtain satisfactory results, the second ranking tenderer) to try and conclude a satisfactory contract (a contract ad libitum).

(4)If the tender is divided into several lots, the tender evaluation shall be performed for each lot.

III-IV-11 Tender Evaluation Report

The Agent shall prepare a detailed tender evaluation report clarifying the reasons for the successful tender and the disqualification, and submit it to the Recipient to obtain confirmation before concluding the contract with the successful tenderer. The Agent shall submit a detailed evaluation report of tenders to JICA for its information, while the notification of the results to the tenderers will not be premised on the confirmation by JICA.

III-IV-12 Notification of the Results

(1)The Agent, within the validity period specified in the tender documents, should notify all the tenderers of the results of the tender. In case notification of result within the validity period is not possible, the Agent shall notify all the tenderers of the extension of the period before the expiry of the original period.

(2) No tenderers shall be required, as a condition to be successful tenders, to bear responsibilities or obligations that are not described in the tender documents.

III-IV-13 Rejection of Tenders and Re-tender

(1) The Agent shall not implement the re-tendering with the same specifications merely for the purpose of reducing the price except when the lowest tender price has exceeded the referential price. The rejection of all tenders may only be justified in the following cases:

1) successful tender was not given even after the result of negotiation with the advantageous tenderers in such case where offer prices extremely exceed the referential price;

2) all tenders do not comply with the tender documents as a result of the examination and evaluation of the tenders;

3) it is clear that competition is impeded in the process; and

4) there is a rational reason to believe that the aim of procurement shall not be achieved by continuing the ongoing tender procedure.

(2) In case all the tenders are to be rejected and the re-tender to be called, the Agent should examine the causes and consider revising the specifications and other conditions specified in the original tender documents as well as procurement methods.

III-V Conclusion of the Contract

III-V-1 General

In order to procure the products and services in accordance with the G/A, the Agent shall conclude contracts with the Firm selected by tendering or other methods. If more than one lot is awarded to the same contractor, the contracts may be combined into one.

III-V-2 Reference to the G/A

The contract shall clearly state that JICA shall execute the Grant to the Government of (name of recipient country) in accordance with the G/A signed on (date of signature) between JICA and the Government of (name of recipient country).

III-V-3 Contents of the Products and Services

The contract shall clearly state the contents of the products and services to be procured. The contract of the procurement of the products and services which are not covered by the G/A shall not be concluded.

III-V-4 Contract Price

The amount of all contract prices and, where there is/are amendment(s) of the contract, amended contract prices (hereinafter jointly referred to as "the Contract Prices") and the Agent's Fee shall not exceed the amount of the Grant and its accrued interest. In case that there are the Charges, the total amount of the Contract Prices shall not exceed the sum of the Grant, its accrued interests and the Charges. Each of the Contract Prices and the Agent's Fee shall be precisely and correctly stated in both words and figures. If there is a discrepancy between the price in words and that in figures, the price in words is deemed correct.

III-V-5 Terms of Payment

The contract shall clearly state the terms of payment. The Agent shall make payment from

the Advances, against the submission of the necessary documents from the Firm on the basis of the conditions specified in the contract, after the obligations of the Firm have been fulfilled. When the services are the object of procurement, the Agent may pay certain portion of the contract amount in advance to the Firm on the conditions that such the Firm submits the advance payment guarantee worth the amount of the advance payment to the Agent.

III-V-6 Warranty

The contract shall clearly state the contents and the period of warranty if warranty is provided to the products and services to be procured from the providers of such products and services.

III-V-7 Performance Guarantee

Each of the Firm may be requested to submit performance guarantees. Such performance guarantees shall be of an appropriate amount, and it shall be returned immediately after delivery of the products and completion of the services.

III-V-8 Non-performance of the Contract

The contract shall clearly state that if the performance of a contract by the Firm is delayed from the contracted period of execution or results in non-performance due to other reasons including bankruptcy, etc., the Agent is permitted to claim the payment of indemnities, forfeiture of the performance guarantees, or cancellation of the contract against the Firm

III-V-9 Force Majeure

The contract should contain a clause to the effect that failure on the part of the Firm to fulfill obligations under the contract would not be considered a default if such failure is the result of an event of force majeure as defined in the terms of the contract.

III-V-10 Consultation and Resolution Procedures

The procedures for consultation and resolution shall be clearly stipulated for both cases that the damage is ascribed to the Recipient / the Agent and/or the Firm or that the damage is ascribed to force majeure.

III-V-11 Disputes and Arbitration Procedures

The procedures for disputes and arbitration shall be clearly stipulated.

III-V-12 Modifications Procedure

The modifications procedures of the contract shall be clearly stipulated, when modification is deemed necessary by the Recipient / the Agent and the Firm.

III-V-13 Responsibilities and Obligations of Each Party

The contract shall clearly state the responsibilities and obligations of the Recipient, the Agent and the Firms.

III-V-14 Applicable Law

The contract shall clearly state the applicable law by which the contract is governed and interpreted.

III-V-15 Effectuation, Amendment, and Announcement of the Results of the Contract

(1) The contract shall become effective only after the signing of the contract between the Agent and the Firm.

(2) The Agent shall submit the copy of the contract with the Firm to JICA for its information.

(3) If an amendment to the contract is required, the Agent, obtaining the consent of the Recipient in advance, shall conclude a contract for the amendment with the Firm. The amended contract shall clearly state that "All clauses except that which is or are amended, remain unchanged". Also, the Agent shall submit a copy of the amended contract to JICA.

(4) The Agent shall, as soon as the contract is concluded, announce information on the contract such as names of procured items, name of the Firm, amount of contract and date of contract on the webpage of the Agent.

III-V-16 Reporting to JICA

The Recipient, through the Agent, shall periodically submit a written report on the progress of the Programme to JICA.

APPENDIX 5 LIST OF ACQUIRED REFERENCE MATERIALS AND DATA

THE PROGRAMME FOR IMPROVEMENT OF SOLID WASTE MANAGEMENT IN DHAKA CITY TOWARD THE LOW CARBON SOCIETY IN THE PEOPLE'S REPUBLIC OF BANGLADESH

No.	Name	Form Book/Video/Map/ Photograph etc.	Original/Copy	Issue Organization	Issue Year
1	Directive of Waste Management Department	Book	Original	Dhaka City Corporation	2008
2	Clean Dhaka Master Plan	Book	Copy	DCC-JICA	2005
3	Schedule of Rates for Civil Works	Book	Original	Public Works Department	2008
4	Schedule of Rates for Civil Works for Electrical/ Mechanical Works	Book	Original	Public Works Department	2008
5	Analysis of Schedule of Rates for Civil Works	Book	Original	Public Works Department	2008
6	Bangladesh National Building Code 2006	Book	Original	Ministry of Housing and Public Works	2006
7	National Energy Policy	Book	Copy	Dhaka City Corporation	
8	Dhaka City Guide Map	Map	Original	The Mappa Ltd.	2008

APPENDIX 6 SUB-SOIL INVESTIGATION REPORT

Improvement of Solid Waste Management in Dhaka City Toward the Low Carbone Society In the People's Republic of Bangladesh, Funded by the Government of Japan.

Yachiyo Engineering Co. Ltd. Japan
(Study Team of JICA)

REPORT ON :

SUB-SOIL INVESTIGATION IN THE PROPOSED LOCATION OF WORKSHOP CONSTRUCTION IN DCC MECHANICAL DIVISION-1, ZONE-1, DHALPUR, OUTFALL NO.-14, DHAKA-1203

SEPTEMBER, 2008.

SUB-SOIL INVESTIGATION REPORT
PREPARED BY:

BETS Consulting Services Ltd.

House No. 10, Road No. 135, Gulshan – 1,
Dhaka – 1212, Bangladesh.
Phone: 9889923-24, 9861529-32, FAX: 880-2-9889967

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ATTACHMENT:

1. INTRODUCTION:

A reasonably accurate conception about the subsoil parameters of any project site is an essential priority for proper planning and designing the foundation of the concerned structure, so that the structure after its construction would remain safe and stable although out it's service period. Paying due consideration to those **Yachiyo Engineering Co. Ltd, (Study team of JICA) engased BETS Consulting Services Ltd. Bangladesh.**

According to the Contrat detailed Sob-soil investication including field and laboratory test was carried out in each selcated site. Boring was executed upto a depth of 30m below from the existing ground level and soil samples were colleded as per the iustructions laid down in the Terms of Reference (TOR) .

2.0 METHODOLOGY:

BETS Consulting Services Ltd. sent SPT Test teams for field test at the site. According to work order, Team Leader of SPT Test team contracted with the field officer of BETS and the Engineer of respective project for recognizing the selected land and locations for field test. After complete the field test, Team Leader collected signature on Bore Logs sheet from the Engineer that Project.

3.0 CLIENT:

Yachiyo Engineering Co. Ltd. (Study Team of JICA for the Improvement of Solid Waste Management In Dhaka City Toward The Low Carbone Society In Bangladesh) has awarded this contract of the aforesaid sub-soil investigation work to **BETS Consulting Services Ltd.**

4.0 LOCATION:

Borings were executed at the proposed site of workshop construction in DCC Mechanical Division-1, zone-1, Dhalpur, Outfall No. -14, Dhaka-1203.

5.0 SCOPE OF WORK:

The main scopes of this investigation work are:

a. Execution of exploratory borings, recording of sub-soil stratification and position of ground water table.

b. Execution of standard penetration test (SPT) at an interval of 1m. depth with collection of disturbed soil samples up to the final depth exploration of each boring.

c. Collection of undisturbed soil samples by thin walled Shelby tubes for each bore hole.

d. Carrying laboratory tests

e. From the field tests and laboratory tests, calculation for bearing capacity value for design shallow foundation.

f. For loose and soft strata, from the field tests and laboratory tests, calculation for skin friction and bearing values for design deep foundation.

g. Preparation of final report with all works including detailed description of soil stratification sub-soil.

6.0 FIELD WORKS:

All the field works and field tests were conducted as per standard procedure as laid down in ASTM specification are as follows.

6.1 Exploratory Boring Drilling:

Drilling was executed by wash boring method. A hole was started by driving vertically a 100cm diameter steel casing into the ground to some depth and then the formation ground casing was broken up by repeated drops of a chopping bit attached to the lower and of drilling pipe. The upper end of the same was forced at high pressure through the pores of the chopping bit, and returns to the surface through the annular space between drilling pipe and the side of the casing or hole, carrying with it the broken-up soils. In this way drilling is advance up to a level of 30 m below the existing ground level and SPT at every meter has been executed.

6.2 Standard Penetration Test:

Standard penetration Tests have been executed in all the bore holes at 1.0m Intervals of depth up to the final depth of boring. In this test, a split spoon sampler of 5cm out diameter and 3.5cm inner diameter, is made to penetrate 0.55 m, into the soil by drops of a hammer weighting 140 Ibs. Falling freely for a height of 0.76m. Number of blows of hammer required for penetration of each 150mm length of the sampler are recorded. The number of blows for the last 300mm penetration of the total 0.55m is known as the standard penetration value (N-Values) as specified by ASTM and is plotted the SPT value of the particular depth.

6.3 Extraction of soil samples:

Disturbed soil samples were collected at 1.0m intervals and at every change of soil strata by split spoon sampler. These soil samples were studied visually and the soil classification were done to prepare strata chart of soils up to the explored depth. Before collection of samples, the hole is wasted and cleaned the drill pipe with the help of an adapter and is lowered into the hole. The sample is then pressed down into the ground in one rapid continuous top is filled with soil sample. Undisturbed soil samples were taken at 3 m depth in selvey tube for each boring.

7.0 LABORATORY TESTS:

All Laboratory Tests conducted on soil samples collected either in the disturbed or in the undisturbed state. All tests were done as per ASTM procedures, are as follow:

7.1 Natural Moisture Content:

The water content of a soil sample is the ratio of the weight of the water in the sample to its dry weight. It is usually expressed as a percentage. The soil sample is weighted both in natural state and in oven dry state and the moisture content is calculated by driving the loss of weight of the sample by its dry weight.

7.2 Complete Grain Size Analysis:

The object of grain size analysis is to determine the size of the soil grains, and the percentage by weight of soil particles of different particles size, comprising a soil sample. The process consists of either sieve analysis or hydrometer analysis or both.

The hydrometer analysis is adopted for sample passing sieve No. 200. For hydrometer analysis, a 40 gms. of the oven dry sample, is thoroughly mixed with required quantity of water in a calibrated glass cylinder. In order to avoid flocculation, a little dispersing agent is add. The density of the suspension is measured at specified time intervals, by means of a hydrometer or special design. At any particular time the size of largest particle remounting in suspension at the level of the hydrometer can be computed by means of Stocks law, where as the weight of the particles finer than size, can be computed from the density of the suspension at the same level.

The mixture is washed through U.S Standard sieve No. 200 and the fraction retained is dried. The friction retained of each sieve is weighted for calculation of the percentage of different fraction. The results are represented by cumulative curves plotted on semi logarithmic graph paper.

7.3 Atterberg Limits:

Physical properties of clay are greatly influenced by water content. A given soil behave as a fluid or a soil or, as a plastic materials, depending on how much water it contains. The water contents that correspond to the boundaries between the states of consistency are called as the Atterberg limit.

Liquid Limit is the minimum water content at which a clay soil just starts behaving like a fluid. It is determined with the help of a standard limit device which consists of brass cup and an arrangement to impart blows to cup at an uniform as the limit.

The plastic limits is the minimum water content at which a soil is just plastic and is determine by rolling out a soil sample at a slowly decreasing water content until, the desired water content is reached, at which a thread of 3 mm diameter. Just begging to crumble. The thread is rolled on glass plate with hand.

7.4 Specific Gravity Tests:

The specific gravity of a solid defined as the rate of the unit weight of the solid in air to the unit weight of water. To determine the specific gravity of soil sample, 25 grams of oven dried soil sample is thoroughly pulverized and is placed in a calibrated pycnometer. Water is poured incise the pycnometer until it's top is slightly below the calibrated mark. The mixture is then belled thoroughly in order to eliminate the air baubles. More water is then added to mixture till it overnight, the temperature is then recorded and the bottle is weighted. The Specific Gravity Gs is given by :

$$Gs = (Gt \times Ws) \div (Ws - W_1 + W_2)$$

Where, Gt = Specific Gravity of water at TOC.
Ws = The weight of over dry soil (25 gms)
W_1 = Weight of flask + soil + water
W_2 = Weight of flask + water

7.5 Unconfined compression Test:

Unconfined compression test is a simple method for determination of shearing strength of cohesive soil which is important to determine the bearing capacity of soil. As the name implies the lateral confining pressure in an unconfined compression test is kept zero.. Unsupported specimen and at failure is measured. The specimen is prepared from the undisturbed soil sample by carefully trimming it to a cylindrical shape of 7cm height and

3.5cm dia. The specimen is then placed on the level pedestal of the unconfined compression apparatus in a vertical position. The load is applied axially on the top of the specimen an is distributed uniformly over surface of the specimen with the help of double providing rain assembly fitted with a strain gauge, fitted with apparatus. The help of double providing ring assembly fitted with a strain gauge, fitted with apparatus. The load is applied at such a rate that the vertical deformation of the sample is nearly 2% (Two percent) per minute in order to avoid and drainage during compression. The load is ketp increasing until the specimen fails along shearing plane. The maximum load at failure known as the unconfined compressive strength of the sample the shearing strength of the sample is half of the unconfined compressive strength.

7.6 Consolidation Test:

The gradual process of compression of soil under the action of static load and with decrease of void ratio due to expulsion of water from the soil pores is termed consolidation. The phenomenon compressibility characteristics of a soil as the period and magnitude of settlement of a foundation depends on these characteristics.

The test is performed on a specimen of circular shape of 6.35cm dia and 2.54 cm thickness, the specimen is prepared from the undisturbed sample by carefully trimming it to the required dimension with the help of a cutting edge and wire saw. The specimen is then placed in the consolidation ring and its top and bottom are trimmed off level with that of the ring. The specimen along with the ring on the top and the other at the bottom of the specimen. The load is then applied on porous stone and on the specimen with the help of a level arrangement with the apparatus. Decreases in volume of specimen are read from a strain gauge attached to the consolidation unit at specified time intervals the consolidation unit is always kept full with water in order to avoid evaporation of the specimen.

The load increment is allowed after each twenty four hours. the observed readings are then plotted on semi-logarithmic graph paper to give the pressure -void ratio curve from which compression index Cc can be calculated Cc is important factor governing the settlement process of underlying soils.

8.0 GEOLOGICAL SET-UP & SOIL COMPOSITION:

8.1 Regional Geology:

Geologically, the project area is located in central edge of Patuakhali and Bagerhat Terrace. The Terrace is a part of coastal Inlier. An elevated landmass surrounded by the flood plain of the Bay of Bangal. Terrace is about 6.1 m from the mean sea level. The Terrace is bounded by umber of faults. The Terrace is formed of elevated plain land. The depressions are interconnected by depression of the Terrace.

Tectonically the site is located in the deeper part of Bengal Basin. No. surface folding or faulting could be identified in and around the area.

The project area is located in Seismic Zone-11 of Seismic Zoning Map of Bangladesh where the basic Seismic Co-efficient may be considered around 0.075.

8.2 Description of Soil Composition:

The following terms are used in this report for description of soil composition:

Trace : 1 to 10%
Little : 11 to 20%
Some : 21 to 35%
Sandy : 35 to 50% sand
Clayey : 35 to 50% clay
Silty : 35 to 50% silt

9.0 CORRELATION TABLE OF SOILS BASED ON SPT - VALUES:

Two tables for Non-cohisive and Cohisive soils based on N-Values are presented below:

9.1 Values of Unit Weight and Angle of Internal Friction of Non-Cohesive soil based on N-Values (Afer K. Terzaghi and R.B. Peck):

Values apply for dry /moist cohesion less sand are presented in Table No. 1 below

Table No. 1

N-Values	Condition	Relative density	Angle of internal friction	Moist unit wt. In KN/m³
0-4	very Loose	0.0-02	$25\text{-}30^0$	11-15.72
4-10	Loose	0.2-0.4	$30\text{-}35^0$	14.15-18.01
10-30	Medium	0.4-0.6	$35\text{-}40^0$	17.29-20.44
30-50	Dense	0.6-0.85	$40\text{-}45^0$	17.29-22.01
Over	Very dense	1.00	45^0	20.44-23.58

For silty sands the bearing capacity values must be reduced by study of grain size classification and applying judgment. Correction for water table close to bottom of foundation the bearing values should be reduced to half. The bearing values are, however, not affected by the water table at a depth greater than 1.5B below foundation level, B being least dimension of the bottom of foundation. Bearing values for intermediate position of water table may be reduced by liner interpolation.

9.2. Values of Approximate Unconfined Compressive Strength Based on N-Values for Cohesive Soil (After K. Terzaghi and R.B.Peck)

Table No. 2

N-Values	Condition	Unconfined compressive strength, KN/m²	Remarks
Below 2	Very soft	Below 26.81	To be used with extreme caution
2-4	Soft	26.81 – 53.63	
4-8	Medium	53.63 – 107.25	
8-15	Stiff	107.25 – 214.50	
15-30	Very stiff	214.50 – 429.00	
Over 30	Hard	Over 429.00	

In the above table the shear strength of cohesive soil is equal to ½ of unconfined compressive strength and the angle of shearing resistance to zero. It should be remembered that the correlation for cohesive soil is always much reliable.

10.0 PHYSICAL PROPERTIES

The overall physical properties of the subsoil formation of the project area have been evaluated on the basis of the results of two borings executed at the locations selected by the JICA Study Team upto a depth of 30 m each. The physical properties of the sub-soil at the proposed site may be discussed as follows:

10.1 Sub-soil stratification:

The top layers of the investigated site extending roughly to the depth of 5.5m at an around bore holes are soft to medium stiff condition gray clay, some silt, trace fine sand and 2nd layer all up to depth of 5.5m to 10m at around all bore hole stiff to very stiff condition brown clay, some to little silt, trace fine sand strata. Under layer up to depth 30m hole medium dense to very dense condition brown fine sand, some to little to trace silt measured from existing ground surface (Ref: Bore logs).

10.2 Consistency/compactness:

The cohesive layer predominates in a stiff consistency. The subsequent granular layer have been observed in a medium dense to dense state.

10.3 Ground water table:

The position of Ground Water Table (GWT) is about 2.8 m for all bore hole down from existing ground level.

10.4 Natural moisture content, Unit weight, Specific Gravity and Limits:

Table No. 3: Rang of Variation in Laboratory Test Result:

Name of the Test	No. of Tests	Range of Variation
Natural moisture content %	20	From 17.90 to 26.30
Natural Unit Weight, KN/m^3	02	From 19.72 to 20.90
Dry density, KN/m^3	02	From 15.80 to 17.46
Specific gravity	60	From 2.650 to 2.789
Liquid limit %	20	From 26 to 51
Plasticity index %	20	From 12 to 24
Grain size	60	From curve

11.0 ENGINEERING PROPERTIES

The engineering properties of the soil, including the cohesion and compressibility have been determined by the performance of laboratory test on the soil samples collected during field investigation. These are as follows:

11.1 Cohesion:

The values of cohesion, obtained from unconfined compression (02 Nos.) tests vary from 97.76 KN/m^2 to 192.25 KN/m^2.

11.2 Compressibility:

The top layer of plastic silty soil usually has been observed moderately compressible in nature by consolidation (2 Nos.) tests as the values of compression index Cc obtained from consolidation tests varies from 0.089 to 0.158 and natural void ratio e_0 varies from 0.588 to 0.737.

12.0 EVALUATION OF BEARING CAPACITY:

12.1 Bearing Capacities of the shallow foundation from SPT:

The bearing capacities of the shallow foundation particularly for top layer of cohesive soil may be estimated from the SPT values, as suggested by Terzaghi, according to following Table.

Table No. 4: Bearing Capacities of the Shallow Foundation (Values in KN/m², F.S=3.0)

SPT range	Consistency	Allowable Bearing Capacity	
		Continuous Footing	Isolated Column Footing
0-2	Very soft	0.00 - 24.13	0.00 – 32.18
2-4	Soft	24.13 – 48.26	32.18 – 64.35
4-8	Medium	48.26 – 101.8	64.35 – 128.7
8-15	Stiff	101.8 – 193.1	128.70 – 257.40
15-30	Very stiff	193.1 – 386.1	257.40 – 514.80
>30	Hard	>386.1	>514.80

Note: a. Width = 1.22m for strip footing and width = 2.44m for isolated footing respectively.
b. The above values are the net allowable Bearing capacities.
c. The cohesive soil has been considered in a saturated condition.

12.3 Bearing capacity of the shallow foundations from the soil parameters:

The bearing capacities of the shallow foundation may more appropriately be determined from the parameters of soil such as the values of cohesion and the angle of internal friction as obtained from the performance of laboratory tests. These have been done considering the general equations of the Bearing capacity of the foundation as suggested by Terzaghi. The evaluated values are provided in the following Table No. 5 & Table No. 6.

Table No. 5: Bearing Capacities of the Shallow Foundation From Lab Tests (Values In KN/m², F. S = 3)

Bore Hole	Depth in m.	Unconfined Compression strength			Bearing capacity (KN/m²)	
		psi	Kg/cm²	KN/m²	For Circular or square footing	For strip or Continuous footing
BH-1	3.0	25.04	1.76	192.25	2.04	1.65
BH-2	3.0	12.66	0.89	97.76	1.03	0.84

Table No. 6. Bearing Capacities of the Shallow Foundation from Field and Laboratory Test (F.S= 3) and Bearing Capacity of the Pile from SPT and soil Parameters (F.S = 2.5): (Values In KN/m²)

BH-1							
Depth in meter	Field SPT (N)	Correct Field SPT (N´)	Cohesion Kg/cm²	Bearing capacity (KN/m²)		The Skin Friction and End Bearing Capacity of the Pile (KN/m²)	
				Circular or square footing	strip or Continuous footing	Skin Friction (Fs) 0.57456 x N' (KN/m²)	End Bearing Capacity (Fq) 114.91 x N' (KN/m²)
1	3		0.19	53.57	37.50	1.7238	344.73
2	2		0.13	37.50	26.79	1.1492	229.82
3	3		0.19	53.57	37.50	1.7238	344.73
4	3		0.19	53.57	37.50	1.7238	344.73
5	5		0.32			2.873	574.55
6	8		0.50			4.5968	919.28
7	14		0.88			8.0444	1608.74
8	10		0.63			5.746	1149.1
9	8		0.50			4.5968	919.28
10	12		0.75			6.8952	1378.92
11	20	17.5				10.0555	2010.925
12	22	18.5				10.6301	2125.835
13	25	20.0				11.492	2298.2
14	28	21.5				12.3539	2470.565
15	30	22.5				12.9285	2585.475
16	40	27.5				15.8015	3160.025
17	40	27.5				15.8015	3160.025
18	43	29.0				16.6634	3332.39
19	45	30.0				17.238	3447.3
20	43	29.0				16.6634	3332.39
21	45	30.0				17.238	3447.3
22	45	30.0				17.238	3447.3
23	49	32.0				18.3872	3677.12
24	50	32.5				18.6745	3734.575
25	50	32.5				18.6745	3734.575
26	50	32.5				18.6745	3734.575
27	50	32.5				18.6745	3734.575
28	50	32.5				18.6745	3734.575
29	50	32.5				18.6745	3734.575
30	50	32.5				18.6745	3734.575

BH-2							
Depth in meter	Field SPT (N)	Correct Field SPT (N´)	Cohesion Kg/cm^2	Bearing capacity (KN/m²)		The Skin Friction and End Bearing Capacity of the Pile (F. S = 2.5) (KN/m²)	
				Circular or square footing	strip or Continuous footing	Skin Friction (Fs) 0.57456 x N' (KN/m²)	End Bearing Capacity (Fq) 114.91 x N' (KN/m²)
1	2		0.13	37.50	26.79	1.1492	229.82
2	3		0.19	53.57	37.50	1.7238	344.73
3	3		0.19	53.57	37.50	1.7238	344.73
4	4		0.25	66.43	53.57	2.2984	459.64
5	5		0.32			2.873	574.55
6	9		0.57			5.1714	1034.19
7	13		0.82			7.4698	1493.83
8	9		0.57			5.1714	1034.19
9	8		0.50			4.5968	919.28
10	10		0.63			5.746	1149.1
11	18	16.5				9.4809	1896.015
12	21	18.0				10.3428	2068.38
13	25	20.0				11.492	2298.2
14	27	21.0				12.0666	2413.11
15	31	23.0				13.2158	2642.93
16	39	27.0				15.5142	3102.57
17	40	27.5				15.8015	3160.025
18	43	29.0				16.6634	3332.39
19	43	29.0				16.6634	3332.39
20	42	28.5				16.3761	3274.935
21	44	29.5				16.9507	3389.845
22	46	30.5				17.5253	3504.755
23	47	31.0				17.8126	3562.21
24	50	32.5				18.6745	3734.575
25	50	32.5				18.6745	3734.575
26	50	32.5				18.6745	3734.575
27	50	32.5				18.6745	3734.575
28	50	32.5				18.6745	3734.575
29	50	32.5				18.6745	3734.575
30	50	32.5				18.6745	3734.575

Note: SPT Correction depends on overburden pressure, water table. F. S. = 3.0 as Bangladesh National Building Code **(BNBC)**

(Formula & sample calculation at appendix)

a. N = Blows/m, N' = Correct SPT, C = Cohesion (kg/cm2)

b. Fs = Allowable value of the skin friction.

c. Fq = Allowable value of the pile end bearing capacity.

d. SPT (N) Value are corrected within calculation.

13.0 FORMULA USED FOR COMPUTATION:

Ultimate Skin Friction (Fs) and End Bearing (Fq) capacity of Pile:

Fs = F Cd (M. J. Tomlinson)
Where, Cd = qu /2

qu = Unconfined Compression strength of soil and
F = Bearing Capacity Factor (Ranges between 0.60 & 45)

For Non-Cohesive Soil:

The values of the skin friction as well as the end Bearing capacities of the pile for the Non-cohesive soil may be evaluated on the basis of the corrected values of the field SPT as suggested by Meyerhof according to the following formulae:

$Fq = 4 \times N' (Tsf) = 4 \times 95.76\ N' (KN/m^2)$
$Fs = 4 \times N'/200 (Tsf) = 4 \times 95.76/200\ N' (KN/m^2)$

But in our case, the investigated soil are not purely sand, rather there exhibit some silt materials, we modify the above relations of Meyerhof according to Schmertmaun,s (1970) observation in the following way:

$Fq = 3 \times N' (Tsf)$ (F.S. = 2.5) $= 3 \times N' \times 95.76\ N' (KN/m^2) = 114.91 \times N' (KN/m^2)$
$Fs = 3 \times N'/200 (Tsf)$ (F.S. = 2.5) $= 3 \times N'/200\ N' (KN/m^2) = 0.57456 \times N' (KN/m^2)$

For Cohesive Soil:

The Ultimate Bearing Capacity:
Qult = C Nc = Qu Nc/2 (J. E. Bowles)
Qall = (qu Nc)/ (2x3) + γ Df (F. S. = 3.0)

Where, qu = Unconfined Compressive strength in TSF.
Nc = Bearing Capacity Factor
= 6.80 square footing
= 5.50 continuous footing.

For Non-Cohesive Soil:

Qult = C Nc Sc + γ Df Nq + 0.5 γ B Nγ Sγ (J. E. Bowles)

Where, C = Cohesion, γ = Unit weight of soil, Df = Depth of footing, B = width of footing

Nc, Nq & Nγ = Bearing Capacity Factor = f (ϕ) = f (N)

Sc & Sγ = shape Factors = f (B, Df)

Qallowable = Qult / F. S. (F. S. = 3.0)

(Ref. Book: Foundation Analysis and Design by J. E. Bowles, page No. 213-277)

Consolidation Settlement:

$S = \{Cc / (1 + e0)\} * H * \log(P0 + \Delta P) / P0\}$

(Ref. Book: Soil Mechanics and foundation Engineering by K. R. Arora, page No. 383-450, 638-647 & 1003-1006)

14.0 COMPUTATION FOR CONSOLIDATION SETTLEMENT:

The vertical downward movement of the base of a building is called settlement and its effect upon the structure depends on its magnitude, its uniformity, the length of the over which it takes place, and the nature of the clay soils. The consolidation settlement can be calculated from test result of unit weight and consolidation tests.

The approximate settlement = 49.46mm for BH-1 & 80.27mm for BH-2.

Calculaton:

Bore Hole	Cc / (1 + e0)	H	log(P0 + ΔP) / P0	S = {Cc / (1 + e0)}*H*log(P0 + ΔP) / P0}
BH-1	0.089/(1+0.588)	3 m	Log(8+7.75)/8	0.04946 m = 49.46mm
BH-2	0.158/(1+0.737)	3m	Log(8+7.75)/8	0.08027 m = 80.27mm

15.0 CONCLUSIONS:

On the basis of above analysis and discussion, the following conclusions may be drawn regarding the sub-soil condition of the project area.

a. The overall soil formation of the investigated site are more or less regular in between the bore hole locations.

b. The top layer of the investigated site have been encountered with comprising soft to medium stiff to very stiff condition gray to brown clay, some silt, trace fine sand (Ref. Bore logs).

c. The underlying soil is of loose to medium dense to very dense condition brown fine sand, trace to little silt (Ref. Bore logs).

d. Bearing capacities for shallow foundation including Isolated column footing are moderate / suitable for project (ref. Table No. 5 & Table No. 6).

e. Shallow foundation including Isolated column footing may be provided for the project site.

f. Isolated column footing / Pile foundation may be provided for the project site.

16.0 RECOMMEDNDATION:

On the basis of aforesaid conclusion, the following recommendation are suggested for proposed one storied workshop building for DCC at the campus of Mechanical division-1, Zone-1, of DCC, Dhaka city.

Bore Hole	Pre-Cast Driving Pile	Pre-Cast Driving Pile
BH-1	R.C.C. Pre-cast pre- stressed driving pile may be provided preferably from the depth of 1.5m. and ownwards, pile should be 50mm x 250mm size and the embedment length upto 6m. from the base level of footing considering carrying capacity of 138 KN per pile safely.	The bearing capacities (F.S.=2.5) of different pile with the embedment length up to 15m. from EGL. = 600 KN for 400 mm dia pile. = 650 KN for 450 mm dia pile. = 800 KN for 500 mm dia pile.
BH-2	R.C.C. Pre-cast pre- stressed driving pile may be provided preferably from the depth of 1.5m. and downwards, pile should be 250mm x 250mm size and the embedment length upto 6m. from the base level of footing considering carrying capacity of 136 KN per pile safely.	The bearing capacities (F.S.=2.5) of different pile with the embedment length up to 15m from EGL. = 550 KN for 600 mm dia pile. = 650 KN for 750 mm dia pile. = 800 KN for 900 mm dia pile.

Note: a. 1 Tsf = 2 Ksf = 95.76 KN/m², EGL= Existing Ground Level & F.S. = Factor of Safety.

b. The designer may select any other alternative type. Depth as well as the bearing capacity of the foundation in the light information provided in this report.

c. Foundation base should be kept dry during construction Period.

d. Pile load test should be performed. If pile load test is not performed then the value of capacity should be halved.

Claculation:

A = For 400 mm dia of pile perimeter = π x dia of pile = 3.14 x 400 = 1256 mm = 1.26 m

B = For 450 mm dia of pile perimeter = π x dia of pile = 3.14 x 450 = 1413 mm = 1.41 m

C = For 500 mm dia of pile perimeter = π x dia of pile = 3.14 x 500 = 1570 mm = 1.57 m

D = For 400 mm dia of pile area = π x (dia of pile)²/4 = 3.14 x (400)²/4 = 0.13 m²

E = For 450 mm dia of pile area = π x (dia of pile)²/4 = 3.14 x (450)²/4 = 0.16 m²

F = For 500 mm dia of pile area = π x (dia of pile)²/4 = 3.14 x (500) ²/4 = 0.20 m²

L = Length of pile

Fs' = On an average of Fs (Skin friction of pile)

Load of Pile, P = (Fs' x A x L + Fq x E)

P = Fs' x (A / B / C) x L + Fq x (D / E / F)

Bore Hole	Fs' x (A / B / C) x L (KN)	Fq x (D / E / F) (KN)	P (KN)
BH-1	12.93 x 1.26 x 15 = 244.38	2585 x 0.13 = 336.05	610 say 600 (For 400mm dia of pile)
	12.93 x 1.41 x 15 = 273.47	2585 x 0.16 = 413.60	687 say 650 (For 450mm dia of pile)
	12.93 x 1.57 x 15 = 304.50	2585 x 0.20 = 517.00	821 say 800 (For 500mm dia of pile)
BH-2	13.22 x 1.26 x 15 = 249.85	2642 x 0.13 = 343.46	593 say 550 (For 400mm dia of pile)
	13.22 x 1.41 x 15 = 279.60	2642 x 0.16 = 422.72	702 say 650 (For 450mm dia of pile)
	13.22 x 1.57 x 15 = 311.33	2642 x 0.20 = 528.40	839 say 800 (For 500mm dia of pile)