JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ULAANBAATAR CITY
MONGOLIA

THE STUDY ON SOLID WASTE MANAGEMENT PLAN FOR ULAANBAATAR CITY IN MONGOLIA

Summary

Final Report

March 2007

KOKUSAI KOGYO CO., LTD.

Exchange Rate Used in the Report
US$ 1.0 ＝1,200 MNT、1 Yen ＝ 10 MNT

PREFACE

In response to a request from the Government of Mongolia, the Government of Japan decided to conduct "The Study on Solid Waste Management Plan for Ulaanbaatar City in Mongolia" and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Susumu Shimura of KOKUSAI KOGYO Co., LTD. between December 2004 and January 2007.

In addition, JICA set up an advisory committee headed by Dr. Hidetoshi Kitawaki, a Professor of Toyo University, which examined the study from specialist and technical points of view.

The team held discussions with the officials concerned of the Government of Mongolia and conducted field surveys in the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the implementation of this plan and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Mongolia for their close cooperation extended to the study.

March 2007

Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency

March 2007

Mr. Ariyuki MATSUMOTO
Vice President
Japan International Cooperation Agency

Letter of Transmittal

Dear Mr. Matsumoto

We are pleased to submit the report of the Study on Solid Waste Management Plan for Ulaanbaatar City in Mongolia.

The report consists of three components: a study on the present practices of waste management; the solid waste management master plan until 2020; and the feasibility of the priority projects.

The current issues have been identified by analyzing the existing data and evaluating the results of nine kinds of surveys conducted in the study on the present practices. We set the fundamental goal of the master plan as "To establish an environmentally sound SWM system in MUB by the target year 2020", and in order to achieve this goal, proposed the active promotion of the 3Rs (Reduce, Reuse and Recycle) of waste, as well as final waste disposal to be done in a proper manner without negative environmental impacts. Moreover, we conducted a study on the feasibility to improve the collection system to provide services to all residents, and a proposal for the construction of the Narangiin Enger Disposal Site and development of Narangiin Enger Recycling Complex. Assuredly, the validity of implementation of these projects was verified from technical, social, environmental, financial and economical points of view.

During the study period, the pilot projects such as emergency improvement of Ulaan Chuluut Disposal Site, thermal recycling of "RDF", improvement of the waste collection system, organization of waste pickers and so on were implemented and capacity development of counterparts and stakeholders of solid waste management were conducted Implementation of the master plan is now underway. Upon the recommendations made by the study, the Municipality of Ulaanbaatar established a new organization, the CMPUA (City Maintenance and Public Utility Agency), on 15th September 2006 during the study period in order to strengthen the current organization for solid waste management in Ulaanbaatar replacing the old organization, CMPUD (City Maintenance and Public Utility Department). At this time, the CMPUA wields strong authority to employ the necessary workforce, like an independent organization, to provide solid waste management with as many as 45 MUB members of staff.

We would like to take this opportunity to express our sincere gratitude to your Agency, the Advisory Committee, the Ministry of Foreign Affairs, and the Ministry of Environment of Japan. We would also like to extend our deep appreciation to the Government of Mongolia, The Embassy of Japan and the JICA Mongolian office for their vital cooperation during the implementation of the study in Mongolia.

Last but not least, we hope that the output of the study presented here will contribute to the sustainable development of not only Ulaanbaatar City but the whole country.

Respectfully,

Susumu SHIMURA
Team Leader
The Study on Solid Waste Management Plan for Ulaanbaatar City in Mongolia.

Executive Summary

1 Outline of the Study

1.1 Objectives of the Study

The objectives of the study are as follows.

1. To formulate a master plan (Target Year 2020) for SWM in Ulaanbaatar City and conduct a Feasibility Study for the priority projects proposed in the Master Plan (M/P).
2. To enhance the institutional, organizational, and human capacity related to solid waste management in Ulaanbaatar City

1.2 Study Area

The study area consists of seven (7) districts in Ulaanbaatar City; Sukhbaatar District, Chingeltei District, Bayanzurkh District, Songinokhairkhan District, Bayangol District, Khan-Uul District, and Nalaikh District, of which area and population 3,944km2 and 866,591 in 2005 respectively.

1.3 Target Waste

The target waste in the study is Solid Waste handled by the Municipality of Ulaanbaatar. As for hazardous/infectious medical waste and hazardous industrial waste, the study includes an estimation of the generation rate and proposes general recommendations on how to properly handle the waste based on existing information.

2 The Master Plan

2.1 Goal

The fundamental goal of the M/P for SWM in MUB is “to establish an environmentally sound SWM system in MUB by the target year 2020”. In concrete term, the 3Rs (Reduce, Reuse and Recycle) of waste are promoted and the following situation should be established.

- Waste reduction is encouraged at the generation source such as households and business enterprises.
- Waste generated after the attempt of waste reduction is reused or recycled as much as possible.
- Waste is properly collected only after the efforts of waste reduction, reuse or recycling at the generation source, and recycled/treated, then finally disposed of in a proper manner without negative environmental impacts.
- Such a SWM system will be established by requiring the governmental sector, private sector and general public to bear adequate responsibilities under a transparent and fair rule is achieved.

2.2 Quantitative Targets

The aforementioned goal will be achieved progressively as shown in the three stages listed below and the targets for the components of the main technical system are proposed in the table below. As shown in the table waste amount and composition of UBC significantly differs in winter and summer.

- Phase 1 Short Term Improvement： from 2006 to 2010（F/S target year）
- Phase 2 Medium term Improvement： from 2011 to 2015
- Phase 3 Long Term Improvement： from 2016 to 2020

Table 1: M/P Quantitative Targets for Ulaanbaatar SWM

Items	Present (2006)	First Phase (2010)	Second Phase (2015)	Third Phase (2020)
Waste Collection Rate (%)				
Apartment Area	100	100	100	100
Ger Area	42*1	100	100	100
Percentage of self-disposal and improper disposal in generation amount (%)				
Winter	54.2	1.2	1.0	0.7
Summer	20.2	2.6	1.9	1.2
Separate collection in apartment area				
Separate collection rate (%)	0	15	40	70
Covered population (person)	0	83,587	289,809	634,432
Percentage of separate collection in generation amount (%)*2				
Winter	0	4.9	17.7	40.4
Summer	0	8.5	25.4	48.9
Percentage of intermediate treatment in generation amount (%)*3				
Winter	0	2.2	8.0	18.5
Summer	0	3.6	11.1	21.8
Percentage of recycling in generation amount (%)*4				
Winter	3.0	4.8 (1.0)	9.3 (3.8)	16.9 (8.9)
Summer	6.6	8.4 (1.7)	13.6 (5.3)	20.5 (10.5)
Final Disposal Method				
Narangiin Enger Disposal Site (NEDS)	Open Dumping		Sanitary Landfill Level 4	
Other 3 disposal sites	Open Dumping		Sanitary Landfill Level 2	

(Note): *1: Service fee collection rate identified by the Questionnaire survey to the Khoroo governors in ger area in August 2006
*2: This rate includes recyclable and non-recyclable wastes separated.
*3: This rate means it of recyclable waste which will be processed at the sorting yard and RDF facility.
*4: Figures in （ ） are rate of RDF production.

3 Capacity Development and Pilot Projects

3.1 Capacity Development

The ultimate aim of the study is to construct capable / sustainable organizations for SWM in the study area that implement an improvement plan for SWM in Ulaanbaatar City and conduct suitable revisions of it. In order to achieve this aim, it is established as the study policy to “support capacity development (CD) at an individual, organizational, institutional and societal level for SWM in Ulaanbaatar City”.

Support for CD on individual level was focused 21 members of the Technical Working Group (TWG) through mainly 62 weekly meetings Each meeting spent two to three hours .

Support for CD for organization, institution and social level was conducted through the TWG members as a core. As a result, the following CD was achieved based on the recommendation of the study:

- The MUB established City Maintenance and Public Utility Agency (CMPUA) of which core personnel (5 persons) came from the City Maintenance and Public Utility Division (CMPUD) and takes responsibility on SWM in UBC.
- The Citizen’s Representatives Khural regulated the current UCDS and MDDS and future NEDS and their surrounding areas as especially reserved areas to prevent the sites from the expansion of Ger area.

- Based on the financial analysis of the study the waste management fee was revised and the waste service fund was established to enable a cross-subsidy which is the precondition for the expansion of waste collection service to Ger area.
- MUB/Nuuts Co. organized waste picker and established a Waste Picker Fund which enables them to help each other.

3.2 Pilot Project

To obtain the data necessary for the priority project plan together with examining the feasibility of the M/P, the following pilot projects were conducted:

- Improvement of the current UCDS
- Production of refuse derived fuel (RDF) to be introduced at NERC and mixed combustion testing of RDF with coal at the existing heating plant
- Trials of swapping waste for toilet paper (Chirigami-kokan), experienced widely in Japan after the oil crisis
- Improvement of collection efficiency by establishing discharge rules
- Experimental introduction of separate collection which is a prerequisite for commercialization of RDF and NERC
- Organization of the Waste Pickers

4 Feasibility Study of Priority Projects

Based on the M/P the following three projects were selected as priority projects to be implemented by year 2010 and feasibility study for the projects was conducted.

Table 2: Priority Project

Priority Project	Contents
1. Improvement of collection system	1.1. Improvement of collection efficiency in the Planned area (Apartment area) 1.2. Provision of a collection service to all the households in UB, including the Unplanned area (Ger area) 1.3. Introduction of a separate collection system in the Planned area 1.4. Construction and management of a central workshop
2. Development of Narangiin Enger Disposal Site (NEDS)	2.1. Construction of a final disposal site for sanitary landfill operation 2.2. Implementation of a sanitary landfill operation
3. Development of Narangiin Enger Recycling Complex	3.1. Construction and operation of a sorting yard 3.2. Construction and operation of a RDF plant 3.3. Development of a industrial site for private recycling businesses and attraction of them

In order to promptly reform the SWM system in Ulaanbaatar, the Mongolian Government made a request to the Government of Japan in June 2005 for grant aid for the F/S target work. The Government of Japan accepted this request and sent a Basic Design Study Team in September 2006 and the possibility of the cooperation is currently under investigation (February 2007).

5 Recommendations

a. To Transfer Successful Results to Other Municipalities

In cooperation with the C/P, the Study Team tried to establish the M/P which reflecting the unique features of UBC.

It can be said that the C/P is well acquainted with formulation of SWM M/P reflecting this kinds of unique features of UBC, and it is important for MUB to transfer these experiences and knowledge to other major municipalities in cooperation with MOE.

b. To Build up a Closer Relationship between MUB and MOE

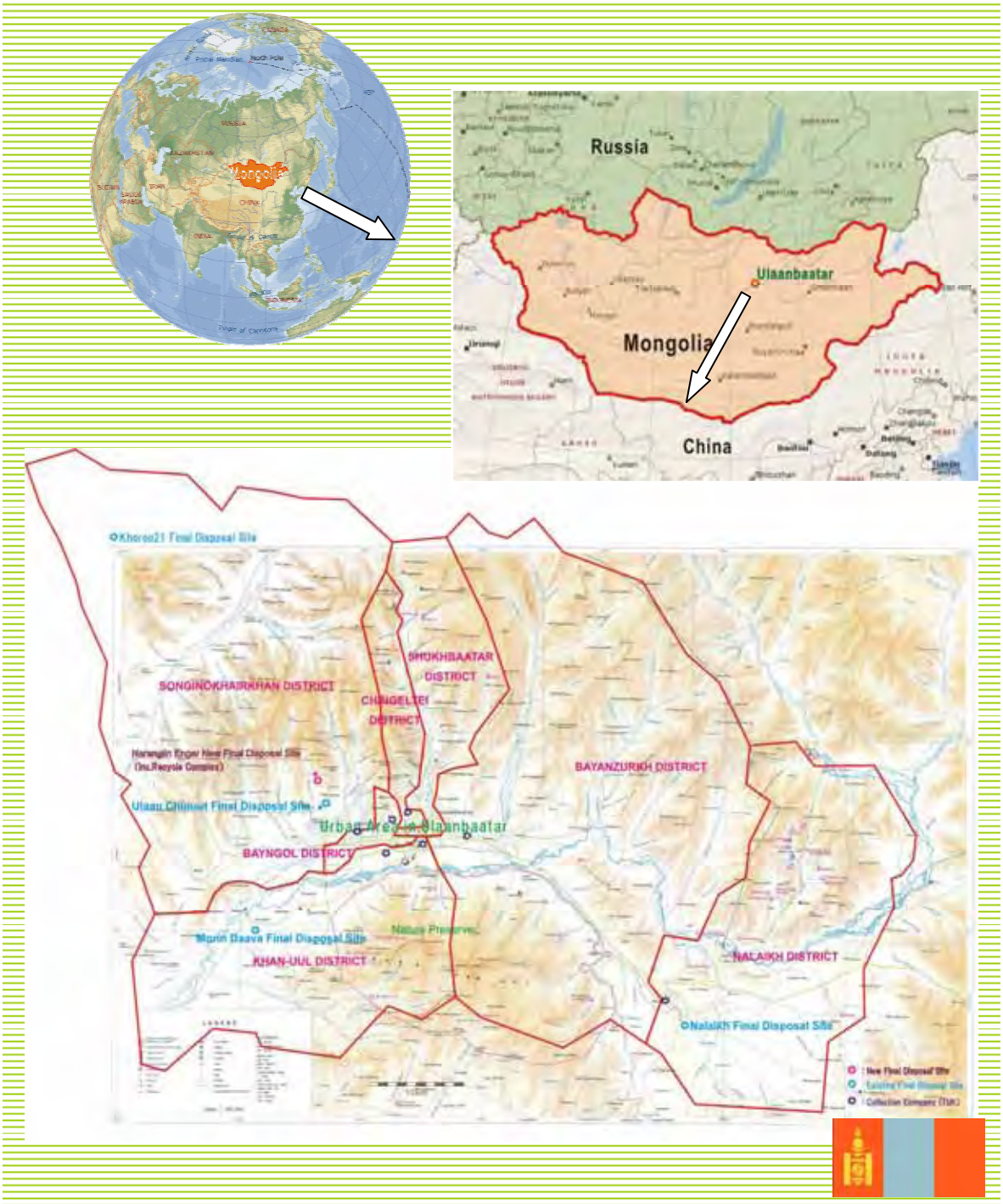
It is critical to tighten the relations between MOE and MUB further in order to solve problems which UBC as well as Mongolia face. In particular, the team recommends that MOE implement the following issues based on the experiences of MUB in cooperation with MUB.

- To improve SWM system in other major cities based on the successful results of MUB.
- To formulate SWM criteria and to develop appropriate technologies reflecting area conditions in Mongolia.
- To develop a recycling system suitable for the area conditions in Mongolia

c. Request of Technical Cooperation Project

In order to solve problems which UBC as well as Mongolia face, the team recommends that MUB request donor countries to implement technical cooperation projects in cooperation with other organizations concerned, especially MOE.

1. Support to develop a system to provide collection services to all residents :
2. Support to promote the 3Rs :
3. Support and proliferation of sanitary landfilling :
4. Support to develop a control system for Hazardous Medical Waste (HMW) and Hazardous Industrial Waste (HIW) :
5. Support to develop a control system for construction wastes :
6. Support to spread the results of the Master Plan for improvement of SWM in UBC to the other cities :



Study Area
for the Study on Solid Waste Management for Ulaanbaatar City in Mongolia

Waste generated in the Apartment area contains a lot of paper and plastic waste, so its relative density is low. A compactor truck is suitable but a dump track is mainly used.

Recently secondhand compactor trucks are used, but the malfunction of the compactor reduces the collection efficiency and could cause an injury.

In the center of the city, there is a daily collection service, but waste heaps are observed all over the area.

In order to remove waste heaps, containers are installed. The container system, however, does not work well, due to the lack of discharge rules and collection vehicles with lifting devices

Waste pickers scatter waste in the container. Waste are always scattered around the container.

High-rise apartments have a dust chute. Waste collected through the dust chute is stored in a storage room. Waste is stored long and often causes odor and breeding of vermin.

Plate 1: Current Conditions of SWM in UB (1): Collection Work in the Apartment Area

<Waste Generated in the Ger Area>
Waste in the Ger Area in the winter mainly consists of ashes. Waste is usually stored and discharged in a drum. It is very heavy.

<Collection Work in the Ger Area>
Dump truck is suitable for collecting heavy waste such as ashes. Loading work is very hard.

<Fee Collection>
Fee collection is conducted along with waste collection work.

<Illegal Dumping of Waste>
In the Ger area, many residents cannot afford to pay the collection fee, and collection service is not provided for those who do not pay the fee. Many of them dump waste in open space.

<Wastewater Treatment>
Residents are requested to discharge wastewater frozen in winter, rather than dumping it on the road, so that road surface freezing can be prevented.

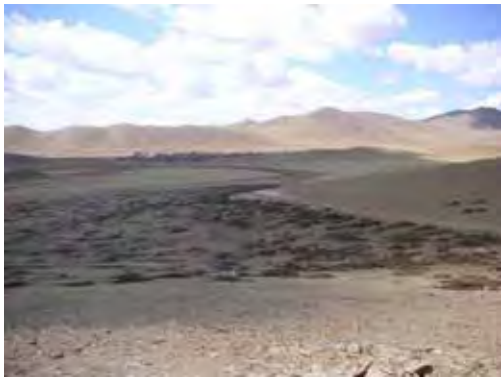
<Container in the Summer House Area>
Many people spend summer time in the Summer House Area. The container collection system is applied in many parts of the area, but this makes it difficult for TUK to collection the collection fee.

Plate 2: Current Conditions of SWM in UB (2): Collection Work in the Ger and Summer House Area

<Ulaan Chuluut Disposal Site, June 2005 >
The UCDS is the largest one in UB, and 90% of the generated waste in UB is disposed of here.

< Morin Davaa Disposal Site, September 2006 >
The MDDS, which is located a few km from the international airport, is the second largest one and 5% of the generated waste in UB is disposed of here.

< Nalaikh Disposal Site, August 2006>
The NDS is exclusively used for the disposing waste generated in the Nalaikh district.



<Khoroo 21 Disposal Site, May 2005 >
The site is located in Khoroo 21 of Songinokhairkhan District, 70km northwest from the center of the city. The site is exclusively used for the waste generated in Khoroo 21.

<Waste Picker (WP) in UCDS>
Around 300 waste pickers are working at UCDS. In order to realize a sanitary landfill operation, it is indispensable to cooperate with them.

<Scattered waste at the UCDS>
Waste is scattered due to the strong wing. This is a serious obstacle for landfill operation.。

Plate 3: Current Conditions of SWM in UB (3): Final Disposal of Waste

<Recycling Activity>
In the center of UB, recyclables are recovered by waste pickers.

<Problem Caused by Waste Pickers>
Recovery of recyclables by waste pickers is one of the main reasons for waste scattering.

<Buy-back Shop>
Street Waste Pickers earn small money by selling collecting valuable resource to a Buy-back Shop shown in a picture.

<Illegal Dumping of Waste>
There are numerous illegal dumping places other than 4 authorized disposal sites. This is one of largest place next to the 4th power plant.

<Illegal Dumping of Waste>
Many parts of the Ger Area are left without a regular collection service. This results in illegal dumping of waste in a open space.

<Illegal Dumping of Waste>
Waste dumped illegally in open space cause serious environment problems such as odor and breeding of vermin in summer. It is urgent for MUB to provide a collection service.

Plate 4: Current Conditions of SWM in UB (4): Recycling Activity and Illegal Dumping of Waste

<Waste Amount and Composition Survey>
The weight of discharged ash waste is measured.

<Time & Motion Survey>
The survey result revealed the collection efficiency of a Japanese secondhand collection vehicle is better than dump trucks.

<Public Opinion Survey>
Interviewers visited selected households in conduct an interview about the opinions about the current SWM in UB and their behaviors

<Environmental Social Survey>
Interview surveys and focus group meetings were organized at and around disposal sites. The picture shows an interview with a waste picker at UCDS.

<Water Quality Survey in winter>
Water quality of under ground water around existing disposal sites was investigated.

<Medical Institution Survey>
Infectious medical waste in a red bucket is burned in a small incinerator inside the hospital premises.

Plate 5: Field Surveys

<Embankment Dam and Litter Control Fence>
Embankment Dam was constructed on the south edge of the landfill area and litter control fence was installed on the dam.

<Weighbridge>
The weighbridge, which was installed at the gate, measures the weight of waste every time a collection vehicle enters the disposal site.

<Weighbridge Control Office>
Nuut Co staff input data on the weight of waste brought to the disposal site, and the data is compiled into a database.
［Visit of President Enkhbayar to the UCDS］

<Organizing Waste Pickers>
Registration system of waste pickers was established and a meeting with group leaders is organized every week in order to establish and strengthen the relation with them.

<Raw Materials of RDF>
Plastic waste for RDF production. The other raw material is paper waste. Kitchen waste is not used, because it causes a problem such as fermentation, this makes RDF instable.

<RDF Production>
RDF is produced by a locally available machine. After mixing and heating plastic and paper waste, RDF was cast by a extruder.

Plate 6: Pilot Project

(Urgent Improvement of the UCDS/Organizing Waste Pickers/Thermal Recycling “RDF”)

<Mixed Combustion Test>
Combustion test was conducted the Nalaikh Heating Plant, by changing the mixture rate of RDF to coal from 2% to 4%.

<Sampling of Emission Gas>
Sampling of emission gas was conducted using a sampling equipment brought from Japan. The analysis of dioxin was conducted in Japan.

<Chirigami Kokan>
A truck waits for people coming with recyclables while playing a misuc.

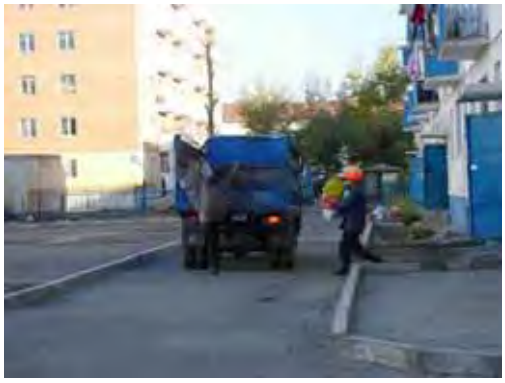
<Lifting device>
A lifting device, which makes it easier for collection workers to load heavy waste such as ashes, apply the principle of leverage,

<Community Meeting>
Before the start of discharge rules, community meetings were organized in each housing association.

<New Discharge and Collection System>
In the morning of the collection day, residents place waste at a designated place and a keeper bring it in front of her apartment before a collection vehicle comes.

Plate 7: Pilot Projects

(Thermal Recycling “RDF”/Chirigami Kokan/Examination of the Loading Device for Heavy Waste/Collection System Improvement)



<New Discharge and Collection System>
A collection worker load waste which are placed in front of each entrance of the apartment.

<Monitoring Activity>
For several days after the start of discharge rules, people selected by Khoroo were in charge of monitoring at former illegal dumping places

Feasibility Study
<Second Public Hearing>
Public Hearing about the development plan of NEDS and NERC were organized three times

Feasibility Study
<Follow-up Survey>
Every time public hearing was organized, a follow-up survey was conducted.

Capacity Development
<First Seminar>
Three seminars were organized.

Capacity Development
<Third Workshop>
Workshops were organized 4 times.

Plate 8: Pilot Project (Collection System Improvement)

Feasibility Study/Capacity Development

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Abbreviations

ADB	Asian Development Bank
ATP	Ability To Pay
BGD	Bayangol District
BKhD	Bagakhangai District
BND	Baganuur District
BZD	Bayanzurkh District
ChD	Chingeltei District
CD	Capacity Development
CDPPD	City Development Policy Planning Division
CMPUD	City Maintenance and Public Utilities Division
CMPUA	City Maintenance and Public Utilities Agency
CPUDC	Construction and Public Utilities Development Center
C/P	Counterpart
CSIA	City Specialized Inspection Agency
CTP	Community thermal plant
DF/R	Draft Final Report
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
F/S	Feasibility Study
GOM	Government of Mongolia
HIW	Hazardous Industrial Waste
IC/R	Inception Report
IEE	Initial Environmental Examination
IT/R	Interim Report
JICA	Japan International Cooperation Agency
JICA ST	JICA Study team
JOCV	Japan Overseas Cooperation Volunteer
JV	Joint Venture
KhUD	Khan Uul District
KH21DS	Khoroo 21 Disposal Site in Songinokhairkhan
M/M	Minutes of Meeting
MDDS	Morin Davaa Disposal Site
MIC	Ministry of Industry and Commerce
MOCUD	Ministry of Construction and Urban Development
MOECS	Ministry of Education, Culture and Science
MOE	Ministry of Environment
MOF	Ministry of Finance
MOH	Ministry of Health
M/P	Master Plan
MSWM	Municipal Solid Waste Management
MUB	Municipality of Ulaanbaatar
NaD	Nalaikh District
NDS	Nalaikh Disposal Site
NEDS	Narangiin Enger Disposal Site
NERC	Narangiin Enger Recycling Complex
Non-HIW	Non-Hazardous Industrial Waste
NPV	Net Present Value
NSO	National Statistical Office
Nuuts	Reserve Company
O&M	Operation and Maintenance
OSNAAG	Ulaanbaatar Housing and Communal Services Company
POS	Public Opinion Survey
P/P	Pilot Project
PR	Public Relations

P/R	Progress Report
RDF	Refuse Derived Fuel
SBD	Sukhbaatar District
SKhD	Songinokhairkhan District
SSIA	State Specialized Inspection Agency
ST	Study Team
St/C	Steering Committee
S/W	Scope of Work
SWM	Solid Waste Management
TFT	Task Force Team
T&M	Time and Motion Survey
TUK	Renovation company which provides which provides waste collection, street sweeping, park cleaning, greening services
TWG	Technical Working Group
UB	Ulaanbaatar
UBCSIA	Ulaanbaatar City Specialized Inspection Agency
UCDS	Ulaan Chuluut Disposal Site
UNDP	United Nations Development Program
UNESCO	United Nations Science and Cultural Organization
USAG	Water Supply and Sewage System Company
USIP	Ulaanbaatar Service Improvement Project
WACS	Waste Amount and Composition Survey
WB	World Bank
WTP	Willingness to Pay

1. Outline of the Study

1 Outline of the Study

1.1 Background of the Study

Ulaanbaatar City (UBC) in Mongolia occupies an area of 4,704km^2 and has a population of approximately 894,000 (2005) which is where a little under 40% of Mongolia's 2,500,000 citizens live. Due to a recent population surge (3.1% from 1990-2000 and 3.6% from 2001 to 2003) and a switch to a market economy, there has been a variation in consumption resulting in a rise in the amount of discarded waste and issues related to Solid Waste Management (SWM) have become severe.

Under such circumstances, in 2001 the Government of Mongolia (GOM) requested the Government of Japan to conduct Technical Cooperation (Development Study) to formulate a plan for a comprehensive solid waste management system for UBC.

On the basis on this request, in September 2004 GOM and the Japan International Cooperation Agency (hereinafter referred to as JICA) agreed on the Scope of Work (S/W) for the "The Study on Solid Waste Management Plan for UBC in Mongolia[1]" (the study). From this agreement, JICA selected Kokusai Kogyo Co., Ltd to conduct the study for duration of 28 months from November 2004 to February 2007.

1.2 Objectives, Overall Goal and Scope of the Study

1.2.1 Objectives of the Study

The objectives of the study are as follows.

1. To formulate a master plan (Target Year 2020) for SWM in Ulaanbaatar City and conduct a Feasibility Study for the priority projects proposed in the Master Plan (M/P).
2. To enhance the institutional, organizational, and human capacity related to solid waste management in UBC

1.2.2 Overall Goals

By achieving the above-mentioned objectives, the overall goals are as follows.

Goal 1 . Establish a Sustainable SWM System in UBC, properly collect daily discarded waste and conduct sanitary landfilling of the collected waste at designated sites.

Goal 2 . Implement the plan, formulated with the cooperation of stakeholders, for SWM in UBC and enable suitable revision of the plan in response to change of the circumstances.

1.2.3 Study Area

The study area consists of seven (7) districts in Ulaanbaatar City; Sukhbaatar District, Chingeltei District, Bayanzurkh District, Songinokhairkhan District, Bayangol District, Khan-Uul District, and Nalaikh District as shown in the Location Map of the Study Area in the opening page.

[1] Ulaanbaatar City consists of 9 districts (Duureg), however the scarcely populated Baganuur Duureg and Bagakhangai Duureg are excluded from the study area in the Development Study. Thus in this report, UBC in the study refers to 7 districts (area 3,944km^2, population 867,000 (2005)) of if there is no indication like whole UBC, etc.

1.2.4 Target Waste

The target waste in the study is Solid Waste handled by the Municipality of Ulaanbaatar. As for hazardous/infectious medical waste and hazardous industrial waste, the study includes an estimation of the generation rate and proposes general recommendations on how to properly handle the waste based on existing information.

1.3 Description of the Study

1.3.1 Basic Policy of the Study

The ultimate aim of the study is to **construct capable / sustainable organizations for SWM in the study area** that implement an improvement plan for SWM in UBC and conduct suitable revisions of it (as mentioned in Goal 2 above). Consequently, proper collection and sanitary disposal (as mentioned in Goal 1 above) will be conducted in UBC.

In order to accomplish this, the study was conducted based on the following basic policies.

Basic Policy 1: Support Construction of Organizations to Resolve SWM Issues in the Ulaanbaatar City

The organizations related to SWM in UBC have to faithfully put into action the plan formulated in the study in order to achieve the above-mentioned overall goals. This is also the case for Japan and other developed nations. However, there are no absolute or permanent solutions for SWM, and new issues which continuously occur due to changes in socioeconomics must be resolved each time they occur. Therefore, the Master Plan (M/P), which will be formulated under the study, should be implemented and amended to respond to changes in socioeconomics. As the study period is limited, the organizations related to SWM in UBC will implement and amend the M/P. With this point in mind, the SWM related organizations in UBC, who will resolve SWM issues, have to be involved in the study and formulation of the M/P. Thus supporting construction of them was one of the basic policies of the study. This point is extremely important for SWM issues of UBC where there is significant social change.

Basic Policy 2: Support Formulation of a Practical SWM Plan

There are many restraining factors of Ulaanbaatar City's current SWM system. The plan to improve the SWM system has to face the constraints and be executable from a technical, institutional, socio-economic and environmental aspect. Furthermore, many related organizations take part in the SWM system in Ulaanbaatar City, and each organization has various interests in SWM. Unless the roles of these organizations are coordinated and agreement is reached to the greatest extent, there is little hope that the improvement plan will be put into practice. Thus, the second basic policy is to support the Municipality of Ulaanbaatar (MUB) as the main body in formulating a practical SWM plan.

1.3.2 Study Structure

a. Capacity Development

As mentioned in objective 2 of this study, it is essential to "support capacity development at an individual, organizational, institutional and societal level for SWM in Ulaanbaatar City" in order to "create organizations to resolve SWM issues in the study area". However, as capacity development comes from within and is gradual, and as the implementation period of

the study is limited, the targets for support have to be limited to a certain extent. Thus, the targets for capacity development are shown in the following diagram.

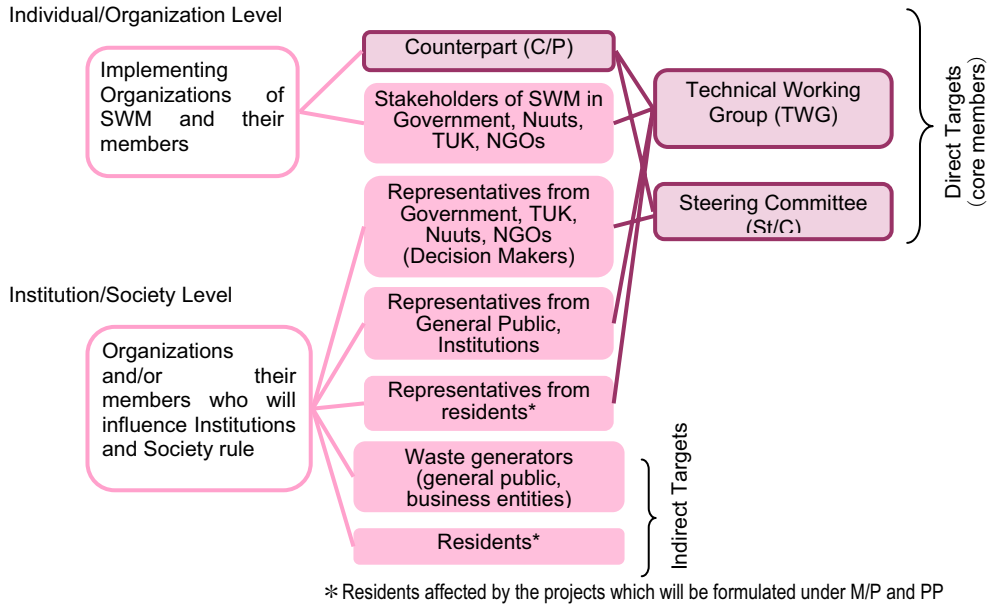


Figure 1-1: Targets for Capacity Development in the Study

b. Structure of the Study

Those with specific central roles in the study are regarded as "direct targets" for capacity development. The direct targets constitute the core members of the study implementation system and suitable organization of this is the first step towards capacity development. As shown in the diagram above, the core members are three organizations; the counterpart (C/P), the technical working group (TWG), and the steering committee (St/C), and the members and the functions are described in the following table. From these, TWG is responsible for executing the survey, the contents of the plan and implementation. In addition, taking into account the sustainability of the plan, TWG will also be the organization responsible for follow-up of the plan through working level liaison after termination of the study and amending the work when necessary securing the sustainability of the plan. The above system was proposed to the Mongolian side in a consultation when the Inception Report (IC/R) was submitted and with their consent, the members in the following table were appointed.

In the study, promotion of mutual communication and encouragement of indirect targets through the above mentioned direct targets was supported to increases the capacity.

Table 1-1: Core Members and Function

Organization	Member	Function
Counterpart (C/P) 5 persons	Municipality of Ulaanbaatar (MUB)	• Co-study member • Formulation and implementation of SWM plan • Request cooperation from other stakeholders • Coordination with St/C, TWG
Chief Counterpart	Chief of City Development Policy Planning Division (CDPPD)	
Members	One person from CDPPD	
	Three persons from City Maintenance and Public Utility Division (CMPUD)	
TWG: 21 persons	Officers in charge of SWM in each organization	• Core member for the study and formulation and implementation of the plan together with JICA ST. • Discussing details of the SWM plan through TWG meetings • There are permanent and temporary members. The former need to fully attend meetings and the latter will be called to attend whenever
Chairman	Chief Counterpart	
Permanent Members: 11 persons	Member of C/P	
	Officer of Sustainable Development and Environment in MOE	
	Officer in charge of Public Health in MOH	
	Inspector of City Specialized Inspection Agencies	
	President of Nuuts Co.	
	Vice president of Baigal-Erdene Fund (NGO)	
	Vice president of Mongolia Ecologist Society (NGO)	
Temporary Members: 10 persons	Officer of the Department of Industrial Policy Adjustment of Ministry of Industry and Trade	
	Chief of the Department of Nature and Environment of UB City	

	Director of the Institution of Urban Planning, Research and Design, Ulaanbaatar City Government	necessary. • TWG meetings will be held weekly.
	Senior Officer for Budget of the Department of Finance, Economy and Budget, Ulaanbaatar City Government	
	Chief of the Central Water Treatment Facilities of UB City	
	Director of TUK in Khan Uul	
	Head of the Department of Public Service and Utilities, Chingeltei District Government	
	Vice Chief of OSNAAG	
	Head of Information Technology Center of UB Development and Investment Department of the Ulaanbaatar City	
	Head of Land Information Center, Department of Land of Ulaanbaatar City	
Steering Committee 17 persons	Representative from each organizations (Decision Maker)	• Decision of Important Policy relating to the study • Coordination among stakeholders and request cooperation • Meetings held periodically whenever the study policy needs to be decided.
Chairman	State Secretly of Ministry of nature and Environment	
Vice Chairman	General Manager of UB City and Chairman of the Governor's Office	
Secretary	Head of CMPUD	
Members:	Head of the Department of Sustainable Development and Environment of MOE	
	Head of the Department of International Cooperation in MOE	
	Director General of the Department of Economic Cooperation Policy and Coordination of MOF	
	Head of Department of Construction and Public Service Policy Adjustment of MOCUD	
	Head of the Department of Industrial Policy Adjustment of MIC	
	Officer for Environmental Social Health Affairs of Policy Adjustment Department of MOH	
	Head of the Department of Environment, Geodesy and Cartography Inspection, State Specialized Inspection Agencies	
	Chief of City Development Policy Planning Division (CDPPD)	
	Chief of CSIA	
	Chief of the Education Department of MUB	
	Chief of OSNAAG	
	Chief of the Steering Committee of Apartment Owner's Unions	
	President of Baigal-Erdene Fund (NGO)	
	President of the Union of Mongolia Ecologist	

(Note) The members listed above were assigned after the signature of IC/R and, according to the progress of the study, actual members have been changed.

1.3.3 Study Schedule and Description of the Study

a. Overall Study Schedule

The original study schedule consists of the two phases and would end March 2006. As stipulated in the scope of work of the Study, which was discussed and agreed upon between the Municipality of Ulaanbaatar (MUB) and JICA on 13th September 2004, both MUB and JICA have agreed to conduct a Phase 3 study in order to monitor and follow-up the projects and programs to be proposed in the Study. Consequently the Study schedule has been revised as shown in the Figure below and consists of the following three phases:

Phase 1: Formulation of the Master Plan (M/P)

Phase 2: Feasibility Study for Priority Projects and Implementation of Pilot Projects

Phase 3: Monitoring and follow-up of the projects and programs to be proposed in the Study

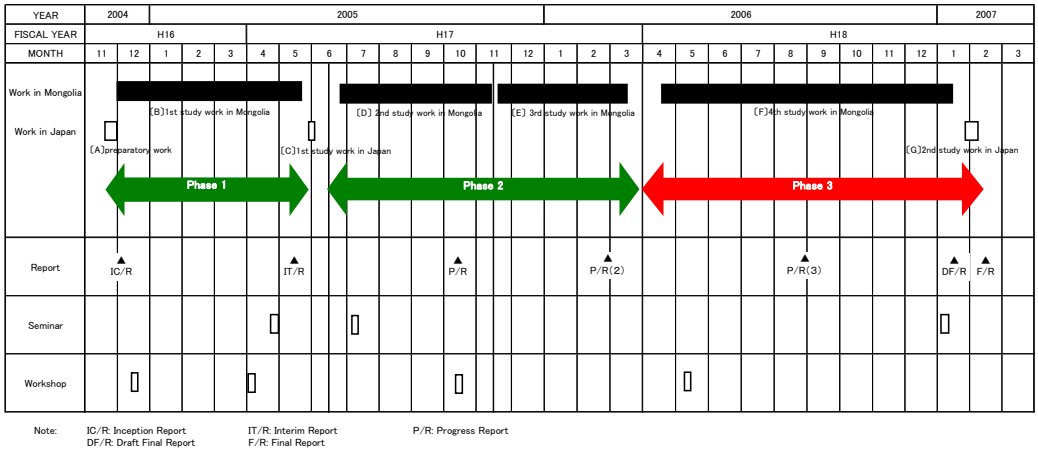


Figure 1-2: Study Schedule

b. Description of the Study

b.1 Phase 1 Study： Late November 2004 until Mid May 2005

Firstly, various kinds of field investigation including the Waste Amount and Composition Survey (winter) were carried out to ascertain the current conditions of SWM in Ulaanbaatar City. Based on the results of the investigation, the population and waste generation amount were estimated until the year 2020, alternatives were examined for improving the situation and the M/P (draft) was formulated with the aim of establishing an environmentally sound SWM system in 2020. Priority projects were selected based on the M/P (draft) and pilot projects were proposed.

In formulating the M/P (draft), essential site selection works for the future final disposal site were carried out with cooperation from the Mongolian side. As the disposal site is an inconvenient facility, it is important for site selection work to be as fair and transparent as possible. Therefore, as stated in chapter 3, the Mongolian side was the main actor in carrying it out and the study team has been concentrating on supporting the selection work. In addition, workshops and seminars were held to reflect the opinions of the people concerned as much as possible including the residents staying near the future disposal site. Furthermore, the procedures for site selection were communicated as much as possible to residents of Ulaanbaatar through mass media publicity. Site selection work, which commenced in December 2004, was carried out to select a future disposal site for the central 6 Duuregs (Districts) which dispose over 90% of the waste in Ulaanbaatar, and the Narangiin Enger candidate site was selected at the end of April 2005 from 16 candidate sites.

b.2 Phase 2 Study： Mid June 2005 until Mid March 2006

Alongside the Feasibility Study (F/S) carried out for the selected priority projects in the Phase 1 study, a Pilot Project (P/P) was conducted to examine the feasibility of the M/P and ascertain the issues and ways to resolve issues which would accompany the implementation of the M/P.

The priority projects which were the subjects of the F/S were i. improvement of collection system to provide all residents of Ulaanbaatar with a collection service, ii. Development of Narangiin Enger Disposal Site (NEDS) selected by the previously mentioned site selection work, and iii. Development of the Narangiin Enger Recycling Complex（NERC） which is adjacent to NEDS. Alongside the F/S, an Environmental Impact Assessment (EIA) has been

conducted for the relevant F/S from August 2005 and the Mongolian Ministry of Environment approved the EIA in February 2006. Moreover, regulations were established in November 2005 restricting land use in the nearby area in order to protect the current disposal site and the future NEDS from the expansion and development of the GER area.

Together with examining the feasibility of the M/P, improvement of the current Ulaan Chuluut Disposal Site (UCDS), production of refuse derived fuel (RRF) to be introduced at NERC and mixed combustion testing of RDF with coal at the existing heating plant, and trials of swapping waste for toilet paper (Chirigami-kokan), experienced widely in Japan after the oil crisis, were carried out in the P/P to obtain the data necessary for the previously mentioned priority project plan.

b.3 Phase 3 Study: Mid April 2006 until Mid February 2007

Based on a request from the St/C held on 26th October 2005, the Phase 3 Study was carried out for the follow-up and monitoring of the study, continuation and development of the P/P, promotion of the implementation of the M/P and F/S and continuation of capacity development (CD).

In addition to the continuation of the P/P implemented in the Phase 2 Study, i. Improvement of collection efficiency（in order to provide collection services to all the residents in UBC） by establishing discharge rules, ii. Experimental introduction of separate collection which is a prerequisite for commercialization of RDF and NERC, and iii. Restriction of the activities of waste pickers (WPs) in the NEDS disposal site and the necessary organization of the WPs has been carried out to promote the implementation of the priority projects which are the target of the F/S. On 13th April 2006, the Mongolian President of GOM inspected the conditions of the P/P improvement at UCDS and instructed the relevant persons to continue the P/P and improve the WP working conditions.

Following the suggestions of this study, in order to significantly strengthen the SWM system, the Mayor's order No.445 was issued on 13th September and some (5 out of 9 people) of the people in charge of SWM in the City Maintenance and Public Utilities Division (CMPUD) were removed, and it was re-established on 15th September 2006 as the City Maintenance and Public Utilities Agency (CMPUA) with jurisdiction over SWM. In addition to the new CMPUA having 45 municipal employees, they are fully authorized as an independent organization and can hire necessary staff members. Furthermore, in order to ensure the resources necessary for adequate SWM, on 24th August 2006 the Ulaanbaatar City Council voted on the amendment of the waste collection and disposal fee based on the financial evaluation in the Development Study, and this was executed on 1st September that year.

Moreover, in order to promptly reform the SWM system in Ulaanbaatar, the Mongolian Government made a request to the Government of Japan in June 2005 for grant aid for the F/S target work; ①Construction of Narangiin Enger Disposal Site (NEDS), ②Construction of Sorting Yard for Narangiin Enger Recycling Complex (NERC),③Equipment for Sanitary Landfilling, ④Waste collection trucks and ⑤Maintenance equipment for collection trucks. The Government of Japan accepted this request and sent a Basic Design Study Team in September 2006 and the possibility of the cooperation is currently under investigation (January 2007).

As mentioned above, together with the current study, reform of the current SWM system is being advanced from various fronts.

2. Current Solid Waste Management

2 Current Solid Waste Management

2.1 Profile of the Study Area

2.1.1 Nature

Ulaanbaatar City (UBC) is a basin with an elevation height of 1,350m surrounded by hills and mountains with an elevation variation of 500-700m.

Ulaanbaatar is the coldest capital city in the world, in the winter season it is bitterly cold with temperatures of minus 40 degrees (the average temperature in January is minus 21.8 degrees). Furthermore, it has a continental climate with an extremely large day/night and yearly temperature range, and in summer the temperature occasionally exceeds 30 degrees (the average temperature in July is 16.9 degrees). In addition, there is little rainfall; the average yearly precipitation amount is 230mm. Although the wind is not strong in the summer and winter seasons, there are strong gales at the turn of the seasons in April, May, September and October.

2.1.2 Society

a. Administration

Mongolia consists of 22 administrative regions, the capital Ulaanbaatar City and 21 Provinces (Aimags).

Ulaanbaatar City itself is made up of nine districts (Duuregs). The 123 Khoroos (Sub-districts) which are sub-districts of the districts are administrative organizations. There are 115 Khoroos in the seven districts in the study area. Under these Khoroos, there are several Khesegs made up of streets.

b. Population

The following table shows the population density in UBC. It can be seen from this table that in UBC most people live in the urban centre. From the viewpoint of SWM, it is privileged as the site of a waste treatment and disposal facility which is a very serious issue for SWM.

Table 2-1: Population of Ulaanbaatar City

District	Area (ha)	Household	Population in 2004	Population Density	Population in 2005*1
Bayangol	2,949	34,124	153,562	52.1	160,982
Bayanzurkh	124,412	40,106	172,824	1.4	178,809
Songinokhairkhan	120,063	38,572	182,153	1.5	185,634
Sukhbaatar	20,840	23,522	106,167	5.1	108,480
Khan-Uul	48,466	17,289	81,140	1.7	82,787
Chingeltei	8,930	27,218	122,483	13.7	124,640
Nalaikh	68,764	5,475	24,687	0.4	25,259
Study Area	394,424	186,306	843,016	2.1	866,591
Baganuur	62,020	5,881	23,249	0.4	23,954
Bagakhangai	14,000	747	3,647	0.3	3,770
MUB	470,444	192,934	869,912	1.8	894,315

(Source) "Ulaanbaatar - XX Century" Statistical Handbook, 2004
(Note) *1: Estimated by the Study Team

There is extreme population inflow from rural areas to UBC, and according to the 2000 population census, 64% of Mongolia's population migration from 1995 to 2000 consisted of people moving from rural areas to Ulaanbaatar City. In addition, the population growth rate of the City was 3.1% from 1990 to 2000 but this increased to 3.6% from 2000 to 2003.

c. Urban Structure

In view of the formation process, as a city the UBC is divided into two areas; i.e. the **Apartment area** (Planned area) and **Ger area** (Unplanned area). The Apartment area is established according to the city development plan while the Ger area grows without a plan by rapid migration from the country. The two areas differ significantly from each other not only by city view but also urban infrastructure such as roads, water supply, sewerages, heating system, and so on. As for SWM, the two areas also vary remarkably on waste storage, discharge and collection systems as well as waste collection charge system. Most business enterprises and urban facilities are located in the Planned area and the Apartment area. In addition to these areas in the summer season, there is the Summer House Area which is a district of resort houses on the outskirts, the features of which are shown in the following table.

Table 2-2: Apartment, Ger and Summer House Areas

Item	Apartment Area	Ger Area	Summer House Area
Urban Structure	Created based on town planning	Randomly created	Planned but some parts were randomly created
Building	Multistory	One-story	One-story
Water Supply	Equipped with Household water supply	Purchased from a water kiosk and transported by wheelbarrow	Obtained from a neighbourhood well/surface water or purchased from a water wagon
Toilet	Drainage sewers are installed	Toilet in the residence garden *1	Toilet in the residence garden or a shared toilet
Waste	100% Collection	Collection service is provided at the same time as fee collection	Collection service is provided at the same time as fee collection

Note) *1 : As the pumping service is not fully diffused, there is an issue with human waste being disposed together with waste in the cold months.

d. Land Use

According to the "Ulaanbaatar - XX Century" Statistical Handbook 2004, 60% of land use is for agriculture (mostly grassland), and even when combined with roads and railways, the residential land use accounts for only 7%. The remaining land is accounted for by forests and national preservation areas.

2.1.3 Economy and Finance

At the beginning of the 1990s the Mongolian economy shifted from a planned economic system to a market economy and a fundamental economic reform program was launched including privatization of state-run enterprises, introduction of foreign capital and reform of the tax and banking systems. Following this trend, the district cleansing corporation (TUK), which was carrying out cleaning activities in all of the districts in the study area, was privatized with the exception of Nalaikh District (Duureg).

Although the GDP became negative at the initial stage of the transition to a market economy system, since 1994 the GDP figures turned positive and growth is continuing. The industry

with the largest proportion of GRDP in Ulaanbaatar City is the manufacturing industry, accounting for 34% of the GRDP. In addition, the growth rate from 2000-2003 was 25%, the second highest following the education industry's growth rate of 45%.

The Mongolian Government is advancing a financial redistribution policy in order to promote equality in the distribution of financial resources in cities and rural areas. Thus, despite the city tax revenue for Ulaanbaatar City being 26.6 billion MNT in 2004, 13.5 million MNT was paid to the central government. In addition, no funding is allocated to Ulaanbaatar City for SWM operations from the central government budget.

2.2 Field Investigations

2.2.1 Outline of Field Investigations

Field investigations, as shown in the following table, were carried out in order to fully ascertain the present status of SWM in the study area.

Table 2-3: Outline of Field investigations

Survey Name	Objective
Waste amount and composition survey (WACS)	Carried out once in the summer and winter seasons to identify by origin the generated waste (MSW: municipal solid waste) amount and composition.
Time and Motion Survey (T & M)	Carried out once in the summer and winter seasons to identify efficiency and problems with the collection and transport system and issues.
Public Opinion Survey (POS)	To identify the residents` and companies` awareness of issues, level of satisfaction, payment and non-payment of the collection fee, willingness to pay, the waste discharge methods, etc.
Environmental survey on the conditions around final disposal site	To ascertain the nature of the existing disposal site and the social environment.
Survey on medical institutions	To understand the volume of waste discarded by medical institutions and the disposal system.
Factory survey	To understand the volume of non-hazardous and hazardous waste discharged from factories and the disposal system.
Survey on recycling market	To survey the people collecting valuables, recycling shops and recycling factories and identify the market trend for valuables and the potential demand.
Survey on final disposal amount	To carry out a survey of the collection vehicles of the three existing disposal sites in UB and identify the final disposal amount. In addition, to establish a truck scale at the Ulaan Chuluut disposal site and develop a managing system and understand the details of the final disposal amount.
Survey on construction waste	To identify the waste volume generated from the construction industry and the disposal system.

It can be understood that the above basic study is divided into the study to identify the large "waste flow" and the others. It is extremely important to ascertain the current "waste flow" upon formulating the Master Plan on SWM. In particular, in the same way as with Ulaanbaatar City, it is essential to formulate a plan for identifying the "waste flow" in the cities in which the collection service is not provided to all residents. Thus, here the results of the study to identify the "waste flow" will be mentioned and the current "waste flow" in Ulaanbaatar City ascertained from these results will be mentioned in the next section. Other survey results are detailed in the Main Report and the Annex Report.

2.2.2 Field Investigation to grasp Waste Flow

a. Waste Amount and Composition Survey

a.1 Generation Rate

The following table shows the generation rate obtained from this study and values obtained from other JICA studies. The generation rate of household waste varies largely in the winter and summer seasons. The generation rate in winter is 590 g/person/day which is the same as other economically comparable countries but this amount includes a lot of ash discharged from the Ger area. In contrast to this, the rate in summer is lowest at 216 g/person/day. The waste generated in the Ger area is a little less than four times that of the Apartment area because of ash generated in winter.

Table 2-4: Comparison of Waste Generation Rates

Country/City		Population (Person)	Study Year	GNP per Capita in 1998 (IDA)US$/Year	Generation Rate of Household Waste	Generation Rate of MSW*1
			Year	US$/Year	g/person/day	g/person/day
Mongol Ulaanbaatar	In winter	866,591	2005	552 in 2004	590 (256, 951)*2	640
	In summer	866,591	2005	552 in 2004	216 (228, 202)*2	286
Cambodia*4	Phnom Penh	1,199,414	2003	268	498	556
Poland*5	Poznan	590,500	1992	3,900	654 (470, 913)*3	NA
	Lublin	352,500	1992	3,900	399 (336, 542)*3	NA
Paraguay*6	Asuncion	510,500	1994	1,760	961	1,312
Nicaragua*7	Managua	834,400	1994	390	664	802
Tanzania*8	Dar es Salaam	2,030,000	1996	210	698	873
Philippines*9	Quezon	1,989,400	1997	1,050	423	524
Honduras*10	Tegucigalpa	848,859	1998	730	375	566
Azerbaijan*11	Baku	2,025,300	1999	849 in 2000	233	244
Turkey*12	Adana	1,196,620	1999	3,160	498	696
	Mersin	634,850	1998	3,160	473	703

（Note） *1: MSW : Municipal Solid Waste
*2: Figures in ()are generation rates from the apartment area and ger area respectively.
*3: Figures in ()are generation rates of households with and without central heat supplies

（Source）
*4: The Study on Solid Waste Management in the Municipality of Phnom Penh in the Kingdom of Cambodia, Final Report, March 2005
*5: The Study on the Solid Waste Management for Poznan City, the Republic of Poland, Final Report, May 1993
*6: The Study on the Solid Waste Management for the Metropolitan Area of Asuncion in the Republic of Paraguay, Final Report, August 1994
*7: The Study on the Improvement of The Solid Waste Management System for the City of Managua, May 1995
*8: The Study on the Solid Waste Management for Dar es Salaam City, Final Report, September 1997
*9: The Study on Solid Waste Management for Metro Manila in the Republic of the Philippines, March 1998
*10: The Study on Solid Waste Management of the urban area of Tegucigalpa's Central District in the Republic of Honduras, Final Report, March 1999
*11: The Master Plan Study on Integrated Environmental Management in Baku City in Azerbaijan Republic, March 2001
*12: The Study on Regional Solid Waste Management for Adana-Mersin in the Republic of Turkey, Final Report, January 2000

a.2 Waste Generation Amount

The generation amount of MSW for Ulaanbaatar City was calculated, as shown in the following table, based on the generation rates above.

Table 2-5: Waste Generation Amount in UBC （2006）

Generation Source		Number of Generation Source	Unit	Generation Ratio (g/day)		Daily Generation Amount (ton/day)	
				Winter season	Summer season	Winter season	Summer season
Household Waste	Apart	481,037	g/person/day	264	235	127.0	113.0
	Ger*1	409,772	g/person/day	956	208	391.8	85.2
	Total	**890,809**	**g/person/day**	**582**	**222**	**518.8**	**198.2**
Commercial Waste (Restaurant)		44,112	g/chair/day	258	278	11.4	12.3
Commercial Waste (Other Shop)		3,174	g/shop/day	1,236	1,689	3.9	5.4
Office Waste		111,172	g/employee/day	134	185	14.9	20.6
Market Waste		4,593	g/stall/day	876	1,772	4.0	8.1
School Waste		278,977	g/student/day	3.1	1.5	0.9	0.4
Hotel Waste		12,139	g/room/day	134	113	1.6	1.4
Business Total		-	-	-	-	**36.7**	**48.2**
Public Area Cleaning Waste		3,430,451	g/m2/day	**3.0**	**5.1**	**10.3**	**17.5**
Total						**565.8**	**263.9**

(Source)： JICA ST based on Field Investigations

a.3 Waste Composition

The household waste composition obtained from this study and the figures from JICA studies in other countries are listed in the following table. The waste from UB is characterized by having an extremely low percentage of kitchen waste. The percentage is 34.2% in the Apartment Area and it is 29.5% for the Ger area if generated ash is excluded. On the other hand, the percentage of plastic plus paper is extremely high at 35.7% in the Apartment Area and 28.6% for the Ger area if generated ash is excluded. It is thought that the reason the kitchen waste percentage is so low is because the eating customs of the local people do not include much fruit and vegetables. As the volume of kitchen waste is low, as mentioned above, the waste generation amount is the lowest figure. In contrast, it is thought that there is a lot of plastic and paper waste because many imported goods are discharged and these goods use a lot of paper and plastic packaging.

Table 2-6: Comparison of Household Waste Composition

Country / Physical Composition	Unit	Mongol Ulaanbaatar*1		Turkey	Cambodia	Poland		Paraguay	Philippines	Tanzania	Honduras
		Winter	Summer	Adana	Phnom Penh	Lublin		Asuncion	Manila	Dar es Salaam	Tegucigalpa
						With ash	Without ash				
Kitchen waste	%	32.7(4.9)	35.7(30.4)	75.53	63.6	45.25	65.26	36.60	45.82	42.00	47.20
Paper	%	12.7(2.4)	21.7(13.9)	9.88	4.6	13.67	11.11	6.40	15.39	3.10	11.50
Textile	%	4.6(1.0)	4.1(6.2)	1.77	2.5	2.10	3.77	1.30	4.33	1.20	2.80
Plastic	%	22.4(2.2)	14.5(16.3)	5.87	18.0	4.40	3.80	3.90	15.60	2.20	7.10
Grass & Wood	%	1.1(0.2)	5.3(3.9)	1.62	6.0	1.61	2.30	22.20	7.45	25.30	11.60
Leather & Rubber	%	0.7(0.1)	0.4(0.8)	0.29	0.1	2.67	1.83	0.70	0.80	0.90	2.20
Combustible Total		**74.2(10.8)**	**81.7(71.5)**	**94.96**	**94.8**	**69.7**	**88.07**	**71.1**	**89.39**	**74.7**	**82.4**
Metal	%	4.0(0.6)	1.8(6.4)	0.53	0.7	3.31	3.05	1.30	5.47	2.00	1.90
Bottle & Glass	%	12.4(3.0)	9.5(12.9)	3.33	0.6	5.23	6.51	3.10	2.69	3.50	3.50
Ceramic & Stone	%	4.4(0.9)	6.5(7.1)	1.14	1.6	21.74	2.38	2.50	1.26	0.40	12.10
Miscellaneous	%	5.0(1.8)	0.5(2.1)	0.04	2.3	-	-	22.00	1.19	19.40	0.10
Ash		0(82.9)	0(0)	-	-	-	-	-	-	-	-
Incombustible Total		**25.8(89.2)**	**18.3(28.5)**	**5.04**	**5.2**	**30.3**	**11.93**	**28.9**	**10.61**	**25.3**	**17.6**
Total	%	100.00	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
ASG	kg/l	0.11(0.27)	0.12(0.12)	0.19	0.25	0.18	0.215	0.22	0.19	0.39	0.20

（Note）*1: The figures outside () are for the Apartment area and those within are for the Ger area. The figures for the Apartment area include business waste.
（Source）JICA ST based on Field Investigations

b. Medical Waste

According to the Ministry of Health, there are a total of 550 medical institutions in Ulaanbaatar City. Interview surveys were conducted with 15 of the main medical institutions in order to ascertain the generation amount of waste discharged and the disposal systems. The generation rate per bed[2] was obtained based on the results of the survey, and by multiplying this by the total number of beds in medical institutions in Ulaanbaatar, the generation amount of medical waste (infectious and hazardous medical waste) and general waste were estimated as shown in the table below.

Table 2-7: Medical Waste and General Waste generated from medical institutions (2006)

Type of waste	Generation Rate (kg/bed/day)	Number of Beds	Generation amount (ton/day)
Medical Waste（Infectious・Hazardous waste）	0.207	7,937	1.6
General Waste	1.917	7,937	15.2

c. Industrial Waste

According to data from the Ministry of Environment, there are 4,521 factories in Ulaanbaatar City. From these factories, there are 1,133 which employ 11 or more workers. Eighteen of these factories[3] were visited and interview surveys were carried out to ascertain the amount of waste discharged by these factories and the disposal systems. The generation rate per worker was obtained from the survey and by multiplying this rate with the number of workers of the 1,133 factories, the non-hazardous industrial waste and hazardous industrial waste amounts discharged by factories in 2006 was estimated as shown in the following table.

- Non-HIW: 67.9 tons/day
- HIW: 0.1 tons/day[4]

d. Construction Waste

According to the Construction and Public Utilities Development Center (CPUDC) of the Ministry of Construction and Urban Development (MOCUD), a total of 717 construction companies are registered in Ulaanbaatar City. Out of these, 50 of the main construction companies were visited and interview surveys were conducted to ascertain the generated waste amount discharged from these companies and the disposal systems. The generation rate per construction work sum was obtained from the survey results and by multiplying this figure with the total construction work sum of 2006, the amount of construction waste generated in 2006 was estimated. At that time, construction work was actively carried out in the summer period (April to September), thus the generation of construction waste which was assumed double that of the winter period (October to March) was estimated as follows.

- Winter Generation Amount： 60.6 tons/day
- Summer Generation Amount： 123.0 tons/day

[2] The survey results show the bed occupancy rate was 100%. The generation amount was specially obtained based on the patients and workers but it was concluded that the number of beds is reliable.
[3] The Study Team considered the small factories of which employees are less than 11 discharged their wastes as MSW.
[4] This figure is very doubtful because only two factories among 10 factories generating HIW could reply amount. Please refer to the Section 2.6 of Annex Report.

e. Survey for Final Disposal Amount

The study team estimated the 2006 final disposal amount based on the survey results of the 4 final landfill sites in Ulaanbaatar.

Table 2-8: Final Disposal Amount for Disposal Site（2006）

Name of the Landfills	Disposal Amount (tons/day)	Disposal Amount (tons/day)
	Winter	Summer
UCDS	338.4	483.0
MDDS	18.5	26.1
NDS	11.3	16.1
KH21DS	3.8	5.5
Total	372.0	530.7

2.3 Current Solid Waste management

2.3.1 Waste Flow and Current SWM

The following figure shows the waste flow for 2006 identified based on the above mentioned field investigation. The following details regarding SWM in Ulaanbaatar City have become apparent from the waste flow.

- At the 4 current final landfill sites, in addition to the municipal solid waste, construction waste, non-HIW and general waste from medical institutions are being brought in and disposed.
- The generation amount and disposal amount varies greatly according to the season. As ash is discharged from the Ger area, the waste generation amount in winter is 2.14 times that in summer. In contrast to this, the final disposal amount in summer is 1.43 times that in winter. This is due to collection activity and construction work becoming more active in summer and it is inferred that cleaning activities are carried out for waste which was illegally dumped in winter.
- As the collection system is insufficient, much of the waste generated from the Ger area is self-disposed or illegally disposed of in the surrounding area. In particular, it is speculated that most of the ash generated from heating facilities in the winter season is unlawfully dumped in the surrounding areas together with other wastes than ash. Activities to clean this waste are carried out in the summer season.

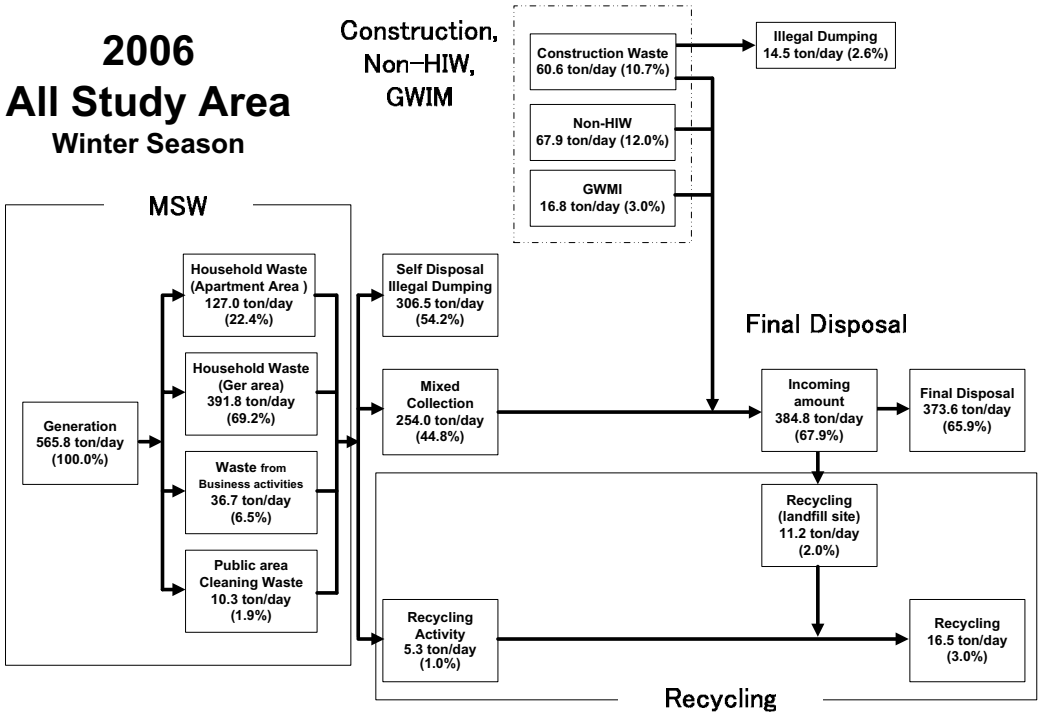


Figure 2-1: Waste Flow in UBC（2006　Winter）

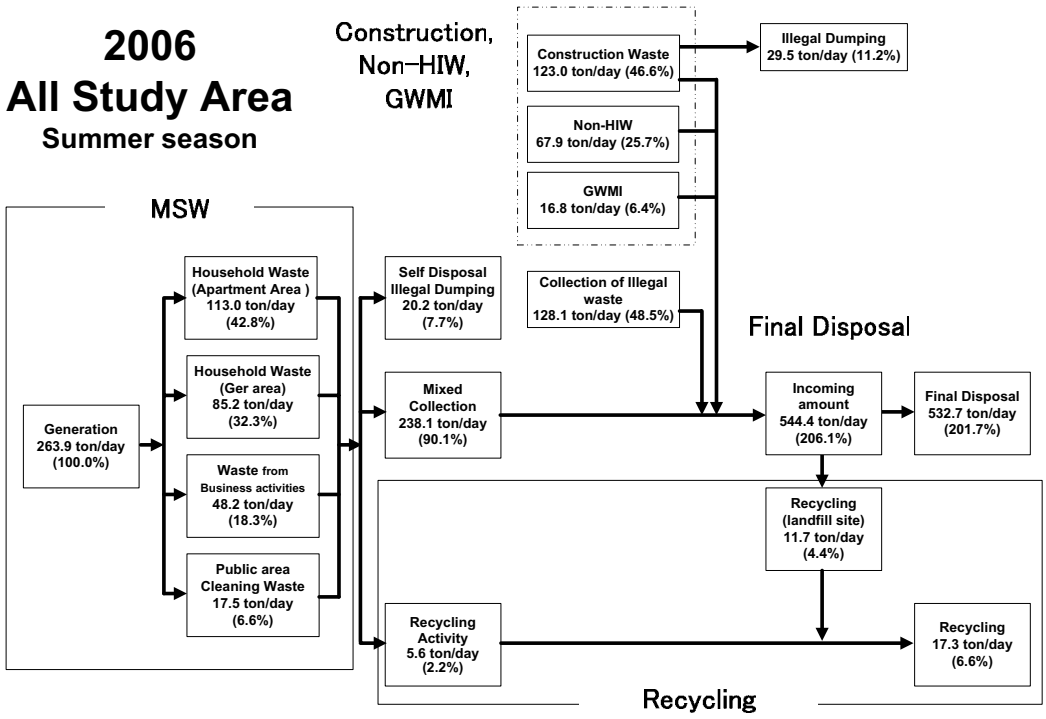


Figure 2-2: Waste Flow in UBC（2006 Summer）

2.3.2 Status and Issues of SWM

The condition of SWM in May 2005 (six months after commencement of the study) and issues relating to SWM are as follows. The details are described in chapter 4 of the Main Report.

3. Solid Waste Management Master Plan

3 Solid Waste Management Master Plan

3.1 Planning Framework

3.1.1 Site Selection for Final Disposal Site

a. Background

The solid waste management system formed a collection and haulage system to remove waste from the living space and a final disposal system to appropriately dispose of the removed waste. Save for the minimal recycling carried out by private bodies, the SWM system in Ulaanbaatar city is composed of these two systems. At present, as can be seen from the figure below, there are four approved disposal sites in Ulaanbaatar City. The site which disposes the most waste is Ulaan Chuluut Disposal Site (UCDS) which disposes over 90% of the waste generated in Ulaanbaatar City, however this site will reach capacity in a couple of years. Consequently, the selection of a future disposal site in place of UCDS became an urgent issue in the formulation of the Ulaanbaatar SWM Master Plan (M/P).

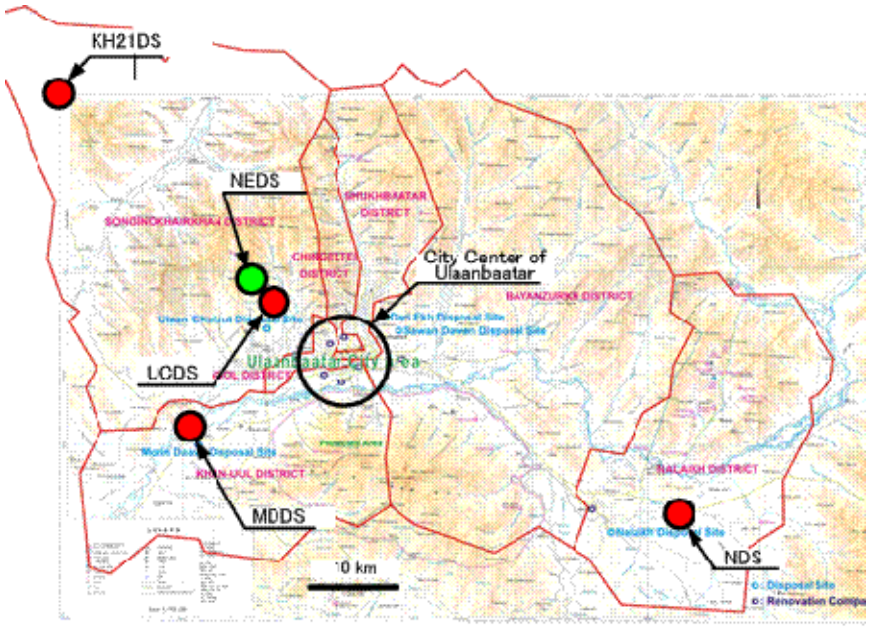


Figure 3-1: Location of Final Disposal Sites in Ulaanbaatar

b. Site Selection

The above mentioned sites are all typical open-dump sites and they have a large impact on the nearby environment due to fires, waste scattering, etc. Therefore, although the final disposal site is a facility which is indispensable to all citizens, the facility is an annoyance which citizens do not want to accept in their vicinity. Thus, site selection work was carried out by the following policies.

- Carried out by the C/P with the Mongolian parties as the main bodies.
- Work was carried out as fairly and transparently as possible.

Based on these policies, site selection work was carried out in the following stages.

Stage 1. The first steering committee (St/C) was held in December 2004 when Phase 1 of the study commenced and the procedures and schedule for carrying out site selection were determined.

Stage 2. By the end of February 2005, the Mongolian side had set up a task force consisted by the representatives from Ministry of Environment, Ministry of Construction and Urban Development, Ministry of Health, Mongolian National University, Municipality of Ulaanbaatar (MUB) Land Department, MUB IT Center, MUB City Development Policy Planning Division, MUB City Maintenance and Public Utilities Division and MUB Nuuts Co. The task force carried out examinations of 16 proposed sites.

Stage 3. Upon recommendation from the taskforce, at the second St/C held on 3rd March, the Mongolian side officially presented six potential sites to the study team as sites for examination.

Stage 4. With cooperation from the Mongolian National University, the Study Team carried out a preliminary environmental study of the six proposed sites, and compared each of the sites based on SWM work costs in the event that they are made into disposal sites, and compiled the consultation materials for the discussion at the second workshop.

Stage 5. The second workshop was held on 22nd April 2005, based on these materials, with 45 public and private parties present. The workshop attendees were divided into four groups to closely examine the six potential sites. Consequently, the workshop at large recommended Narangiin Enger and Tsagaan Daava as the two future disposal sites.

Stage 6. The conclusion was accepted and after a field investigation was conducted of the proposed sites, Narangiin Enger was officially selected as the future disposal site at the third St/C held on 20th April.

Stage 7. The details of selection and the decision of Narangiin Enger as the future disposal site was announced to as many related parties as possible, and the first seminar was held on 26th April in order to obtain understanding and agreement on the decision. One hundred people were invited to attend the seminar and excluding media representatives, a total of 61 people attended. Twelve of the attendants were residents and administrative officers from the Narangiin Enger vicinity. During the question and answer session in the seminar there were no objections voiced and the proposed Narangiin Enger site was confirmed as the central future disposal site for Ulaanbaatar City.

In acceptance of the above mentioned conclusion, three public hearings were held in order to reflect the opinions of the local residents in the plan, and in February 2006, the EIA for the construction plan for the future Narangiin Enger disposal site was approved by the Ministry of Environment.

In addition, as the three other disposal sites, excluding UCDS, are fully utilizable until the M/P target year 2020, improvement is scheduled for continuous use of the current disposal sites.

3.1.2 Social Framework

a. Population Forecast

The 2004 population forecast presented in the Ulaanbaatar City Urban Development Master Plan[5], which this solid waste management (SWM) master plan (M/P) has to follow, is substantially lower than the population forecast[6] based on the 2000 population census. Therefore, the population forecast in the SWM M/P was forecast based on the population forecast of the 2000 population census. In addition, the Urban Development Master Plan scheduled figures of 82:18 for the year 2020 were adopted as the future component ratio of the Apartment and Ger Areas, which largely impacts the contents of the plan. Consequently, the estimated future population of the Study Area is shown in the following table.

Table 3-1: Population Forecast for Study Area

Area	2006		2010		2015		2020	
	Ratio	Population	Ratio	Population	Ratio	Population	Ratio	Population
	(%)	persons	(%)	persons	(%)	persons	(%)	persons
Apartment Area	54	481,037	62	612,362	72	796,180	82	995,970
Ger Area	46	409,772	38	375,318	38	309,625	18	218,628
Study Area	100	890,809	100	987,680	110	1,105,805	100	1,214,598

b. Economic Growth Rate（GRDP）

As shown in section 5.2.2 of the Main Report, the GDP growth rate of Ulaanbaatar City is forecasted to fall from 13.0% in 2006 to 4.3% in 2020. However, a GDP growth rate of 5.5% was used to forecast the amount of waste generated in the study.

c. Financial Conditions

The waste service fund to be established by the "Household and Industrial Waste Management Law" enforced in July 2004, was used for formulating the M/P financial plan.

3.1.3 Forecast of Future Waste Flow

a. Forecast of Waste (MSW) Generation Amount

The future waste generation amount (WGA_x) was forecasted to increase in proportion to an increase in generation sources (the number of people in the case of household waste and for markets, the number of stores). Furthermore, based on the connection between the economic growth rate in Japan (the GDP growth rate) and the increase in waste generation amount, the future waste generation rate (GR_x) is considered to increase in proportion with economic growth. The future waste generation amount (WGA_x) was determined according to the following equations and conditions.

- $WGA_x = GR_x \times NGS_x$
- The number of future generation sources (NGS_x) for household waste, i.e. population, will increase according to the above table forecast. The number of future generation sources (NGS_x) for school waste, i.e. number of student, will increase according to the increase rate of the population.

[5] UBC Development Master Plan
[6] Population Projections of Mongolia, National Statistical Office of Mongolia, 2002

- The number of future generation sources (NGS_x) for the other waste than the above-mentioned two categories will increase by 5.5% per year in proportion to the economic growth rate of Ulaanbaatar City.
- Using the relational value (0.55) between the economic growth rate and generation rate sought from Japanese statistics, from the economic growth rate of Ulaanbaatar City (5.5%), the future generation rate (GR_x) will increase by 3.0% per year (5.5 x 0.55=3.025 => 3.0). However, the amount of public area cleaning waste and ash generated by the Ger area will not change.

The future waste generation amount in Ulaanbaatar City is forecasted and shown in the following table, based on the above mentioned equations and conditions.

Table 3-2: Forecast of Waste Generation Amount for the Study Area in Winter (2005-2020)

Unit: ton/day

Category	2005	2006	2010	2015	2020
Household Waste	511.0	518.8	548.3	585.4	625.0
General	(183.2)	(195.9)	(252.5)	(341.4)	(452.7)
Ash	(327.8)	(322.9)	(295.8)	(244.0)	(172.3)
Commercial Waste (Restaurant)	10.5	11.4	15.8	24.1	36.4
Commercial Waste (Other Shop)	3.6	3.9	5.5	8.3	12.6
Office Waste	13.7	14.9	20.7	31.5	47.8
Market Waste	3.7	4.0	5.6	8.5	12.9
School Waste	0.8	0.9	1.1	1.4	1.7
Hotel Waste	1.5	1.6	2.3	3.4	5.2
Road Cleaning Waste	10.0	10.3	11.4	12.8	14.0
Total	554.8	565.8	610.7	675.4	755.6

Table 3-3: Forecast of Waste Generation Amount for the Study Area in Summer (2005-2020)

Unit: ton/day

Category	2005	2006	2010	2015	2020
Household Waste	186.7	198.2	249.5	327.5	421.2
General	(186.7)	(198.2)	(249.5)	(327.5)	(421.2)
Ash	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Commercial Waste (Restaurant)	11.3	12.3	17.1	25.9	39.3
Commercial Waste (Other Shop)	4.9	5.4	7.5	11.3	17.2
Office Waste	19.0	20.6	28.8	43.6	65.9
Market Waste	7.5	8.1	11.3	17.2	26.0
School Waste	0.4	0.4	0.5	0.5	0.6
Hotel Waste	1.3	1.4	1.9	2.9	4.4
Road Cleaning Waste	17.0	17.5	19.4	21.7	23.8
Total	248.1	263.9	336.0	450.6	598.4

b. Forecast of Waste Composition

The future waste composition was forecasted using the waste composition data obtained in the study as a base and comparing the data with the data from other countries. The main assumptions in the forecast are as follows.

- Items with containers and packaging (paper, plastic, metal, bottles and glass) and food waste increases in proportion to the economic growth rate, in short it increases by over 3% per year.

- The generation amount of textile, leather and rubber which are extremely low in the current generation amount, are also assumed to rise in accordance with the economic growth rate. However, the growth rate is supposed as half that of the above mentioned waste.
- Furthermore, the generation amount of garden waste (grass and wood, ceramic and stone, soil etc.) will not change.

The future waste composition in Ulaanbaatar City is forecasted and shown in the following table, based on the above mentioned equations and conditions.

Table 3-4: Forecast of Composition of MSW in the Study Area including Ash in Winter (2005-2020)

Waste Composition of MSW	2005 (%)	2006 (%)	2010 (%)	2015 (%)	2020 (%)
Kitchen Waste	12.6	13.2	16.3	20.7	25.7
Paper	5.2	5.4	6.7	8.5	10.6
Textile	2.0	2.1	2.4	2.9	3.3
Grass and Wood	0.5	0.5	0.6	0.6	0.6
Plastic	7.8	8.2	10.1	12.8	15.8
Leather and Rubber	0.2	0.3	0.3	0.3	0.4
Combustibles	**28.3**	**29.7**	**36.4**	**45.8**	**56.4**
Metal	1.5	1.6	2.0	2.5	3.1
Bottle and Glass	5.4	6.0	7.2	9.3	11.3
Ceramic and Stone	1.9	1.9	2.1	2.3	2.5
Miscellaneous	2.7	2.7	3.0	3.3	3.5
Non-combustibles excluding ash	**11.5**	**12.2**	**14.3**	**17.4**	**20.4**
Other Weight (%)	39.8	41.9	50.7	63.2	76.8
Ash Weight (%)	60.2	58.1	49.3	36.8	23.2
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 3-5: Forecast of Composition of MSW in the Study Area in Summer (2005-2020)

Waste Composition of MSW	2005 (%)	2006 (%)	2010 (%)	2015 (%)	2020 (%)
Kitchen Waste	33.8	33.9	34.5	35.2	35.8
Paper	18.9	19.0	19.3	19.7	20.0
Textile	4.8	4.8	4.6	4.3	4.1
Grass and Wood	4.8	4.7	4.2	3.7	3.3
Plastic	15.2	15.2	15.5	15.8	16.1
Leather and Rubber	0.6	0.6	0.6	0.6	0.5
Combustibles	**78.1**	**78.2**	**78.7**	**79.3**	**79.8**
Metal	3.5	3.5	3.6	3.6	3.7
Bottle and Glass	10.5	10.6	10.7	11.0	11.2
Ceramic and Stone	6.8	6.6	6.0	5.3	4.6
Miscellaneous	1.1	1.1	1.0	0.8	0.7
Non-combustibles excluding ash	**21.9**	**21.8**	**21.3**	**20.7**	**20.2**
Other Weight (%)	100.0	100.0	100.0	100.0	100.0
Ash Weight (%)	0.0	0.0	0.0	0.0	0.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

c. Forecast of Industrial, Medical and Construction Waste Generation Amount

The future generation amount of industrial, medical and construction waste was forecasted, as shown in the table below, based on the following assumptions.

- Generation rate does not change.
- Industrial waste will increase in proportion to the economic growth rate.
- Medical waste will increase in proportion to the population growth rate.
- Construction waste will increase in proportion to the economic growth rate.

Table 3-6: Forecast of Industrial Waste Generation Amount

Year	Non-HIW (ton/day)	HIW*1 (ton/day)	Total (ton/day)
2005	64.3	0.1	64.4
2006	67.8	0.1	67.9
2010	83.9	0.1	84.0
2015	109.6	0.1	109.7
2020	143.3	0.1	143.4

(Note)*1: The extremely low rate of 0.1 was used because when the factories were visited the responses were insufficient as the classification of hazardous waste is unclear and the persons responsible for factories lacked knowledge regarding waste. It is important to re-examine this when the classification of the waste has been established.

Table 3-7: Forecast of Waste Generation Amount from Medical Institutions

Year	Number of Bed Forecast	Medical Waste (ton/day)	General waste (ton/day)	Total (ton/day)
2005	7,721	1.6	14.8	16.4
2006	7,937	1.6	15.2	16.8
2010	8,802	1.8	16.9	18.7
2015	9,852	2.0	18.9	20.9
2020	10,825	2.2	20.8	23.0

Table 3-8: Forecast of Construction Waste Generation

unit : ton/day

	2004	2006	2010	2015	2020
Winter season	54.5	60.6	75.0	98.0	128.0
Summer season	110.6	123.0	152.2	198.9	260.0

d. Forecast of Future Waste Flow without 3Rs Promotion

The following hypothetical situations were set prior to the formulation of the Master Plan and the future waste flow without 3Rs promotion for the winter and summers seasons in 2020 was forecasted as shown below.

- The collection service is provided to all residents in Ulaanbaatar City.
- There is no public sector waste treatment or recycling facility, as is the present situation, and recycling is carried out by the private sector based on economic principles.
- Waste picking activities are prohibited at the disposal site because sanitary landfill is carried out.

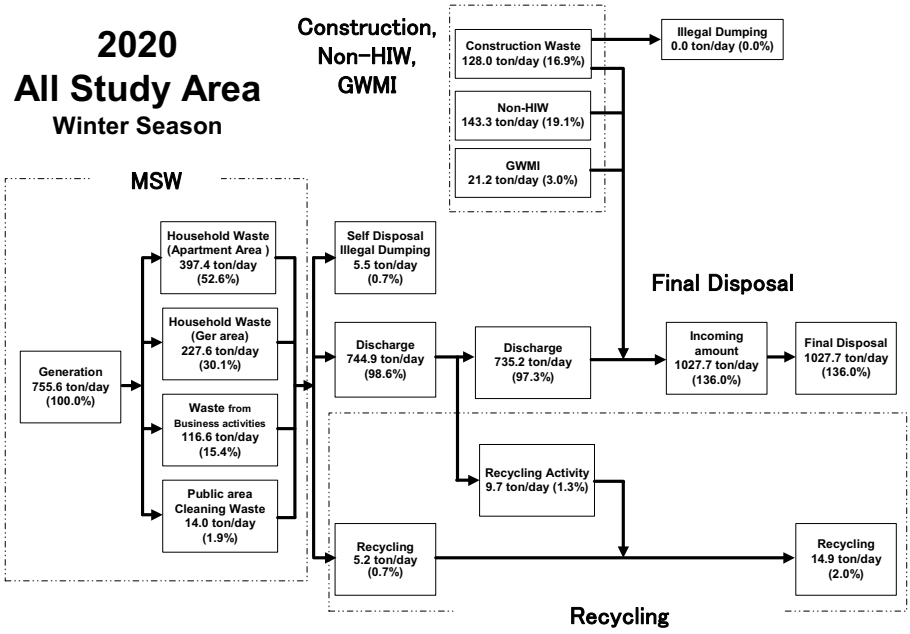


Figure 3-2: Waste Flow in Winter Season in 2020 without 3Rs Promotion

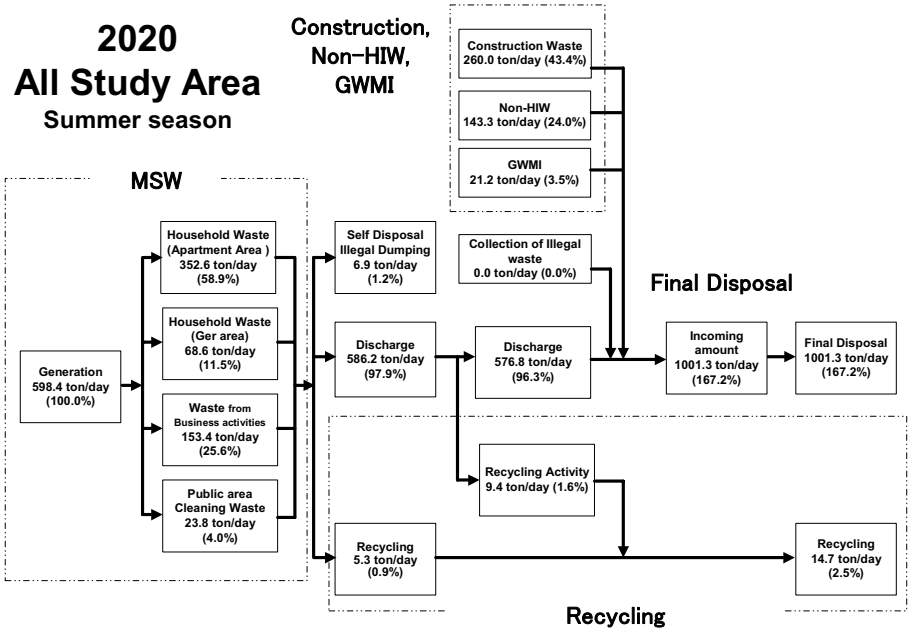


Figure 3-3: Waste Flow in Summer Season in 2020 without 3Rs Promotion

In regard to the above waste flow charts, the following details have to be taken into account when formulating the Master Plan.

- The city waste amount in 2020 is 1.34 times that of the winter season in 2006 and 2.27 that of the summer season. Furthermore, the difference in generation amounts in the winter and summer seasons are reduced. This is due to a reduction in the amount of ash generated due to a reduction in the rate of the Ger area.
- The final disposal amount in 2020 is 2.76 times that of the amount in winter 2006 and 1.89 times that of summer. In addition, there is almost no difference between the

final disposal amounts in summer and winter. This is due to a reduction in illegal dumping because all residents will be provided with the collection service and there will be no need to carry out cleaning activities for the discharged waste in summer.

- The recyclable amount of city waste will be 2.0% of the generated amount in winter and 2.5% in summer which is extremely low in comparison with neighbouring countries. Waste recycling by the private sector based on economic principles shows signs of ending.

3.2 Selection of Optimum Technical System

3.2.1 Selection Method

a. Policy of Master Plan

An SWM technical system consists of various technical subsystems of a Discharge and Storage system, Collection and Haulage system, Public Area Cleansing system, Intermediate Treatment and Recycling system, Final Disposal system, and Maintenance system for Vehicles and Equipment. There are many potential technologies in each sub-system. Consequently, a number of alternatives can be formed for an optimum technical system from a combination of these various subsystems.

In order to screen the potential technologies and select an optimum technical system, the C/P and JICA Study team have set up the policies of the M/P as described below.

- Collection service will cover all residents by 2010. The waste collected will be disposed of at the final disposal site by sanitary landfill in order to minimize the negative effects on the environment.
- The fundamental goal of the M/P for SWM in MUB (Municipality of Ulaanbaatar) is to establish an environmentally sound SWM system in MUB by the target year 2020. To achieve this goal, the 3Rs (Reduce, Reuse, Recycle) will be actively promoted firstly to reduce waste generation, then to reuse and recycle generated waste as a resource as much as possible in order to reduce the amount of solid waste to be disposed of at the landfills.

b. Policies for Selection

Taking the current situation and background of SWM in the study area into account, the policies for the selection of an optimum technical system are as follows:

- Technical system proposals have to contribute to the implementation of the above-mentioned M/P policy.
- The implementation of technical system proposals have to be afforded by MUB and District governments and be justified in terms of national economy.
- The systems and technologies to be adopted should be simple so that operation and maintenance will be easy and inexpensive.
- The foreign currency requirements for the purchase, operation and maintenance of systems should be minimized. The use of locally available materials and services should be maximized.
- The proposed technical system should be consistent with the existing conditions and existing practices, in order to easily cope with the system.

c. Method of Selection

The SWM system consists of a collection and haulage system to remove generated waste from the living area and a final disposal system to suitably dispose the removed waste. Incinerating and composting is part of a processing system, called the intermediary system, between the collection and haulage system and final disposal system in order to ① reduce volume (to reduce the final disposal amount), ② stabilize (to stabilize the final disposal waste), and ③ detoxify (to make the final disposal waste non-hazardous) the waste. In the event that sufficient capacity and a suitable location is secured for the final disposal site, it is possible to develop a sustainable SWM system even if there is no intermediary system.

An optimum discharge and storage system, and collection and haulage system are largely related in particular to the necessity of introducing separated collection and whether or not an intermediate treatment facility is introduced. Moreover, the necessity of introducing an intermediate treatment facility is greatly influenced by the capacity and location of the final disposal site. Therefore, the optimum system was selected in this study by the following process.

- Site selection work was carried out for the final disposal site and a disposal site was selected which can be used until the M/P target year of 2020. Accordingly, it was determined that the previously mentioned four disposal sites could be used until the year 2020.
- The necessity of introducing an intermediate treatment system was examined using the selected final disposal site as a base. Consequently, it was decided to plan the introduction of a valuables sorting yard and RDF production facility in order to promote the 3Rs for environmental conservation.
- As the introduction of a valuables sorting yard and RDF production facility was decided, optimum discharge and storage systems, and collection and haulage systems were examined for the introduction of separated collection necessary for the operation of the facility.

3.2.2 Selection of Optimum Technical System

a. Comparison of Alternatives

a.1 Selection of Final Disposal Site

The six potential disposal sites selected in the previously mentioned final disposal site selection work were presented in the St/C. Accordingly, the counterpart (C/P) and the study team compared the alternative six proposed disposal sites. In short, the waste collection and haulage including transfer station (T/S) and disposal cost was calculated for each site and the alternatives were assessed on how they fit in with the initial environment.

Table 3-9: Six Alternative M/P Technical Systems

Alternative (Site)	System
Alternative 1: Narangiin Enger disposal site (NEDS)	6 Districts => NEDS Nalaikh District => Nalaikh Coal Mining disposal site (NCMDS)
Alternative 2: XMK disposal site (XMKDS)	6 Districts => XMKDS Nalaikh District => NCMDS
Alternative 3: Morin Davaa disposal site (MDDS)	6 Districts => MDDS Nalaikh District => NCMDS
Alternative 4 : Tsagaan Davaa disposal site (TDDS)	6 Districts => TDDS Nalaikh District => NCMDS
Alternative 5: Bayangiin Khonkhor disposal site (BKDS)	6 Districts => Transfer Station (T/S) => BKDS Nalaikh District => BKDS
Alternative 6 BCMDS: Baganuur coal mining disposal site (BCMDS)	6 Districts => T/S => Railway => T/S => BCMDS Nalaikh District => NCMDS

From the results of the comparison of the alternative sites, the workshop participants assessed the pros and cons of the alternatives, based on the six proposed final disposal sites. The St/C decided upon the proposed Narangiin Enger site as the future disposal site for the main six districts of Ulaanbaatar City based on the results of the workshop investigation.

Therefore, waste generated in Ulaanbaatar City in 2020 is scheduled to be disposed of at the following four disposal sites.

Table 3-10: Final Disposal Site and Disposal Amount in 2020

Landfill site	Ratio (%)	Final Disposal Amount (ton/day)	
		Winter season	Summer season
NEDS	91	935.4	911.2
MDDS	5	51.3	50.1
NDS	3	30.8	30.1
KH21DS	1	10.3	10.0
Total	100	1027.8	1001.4

a.2 Introduction of Intermediate Treatment System

Comparative work for the intermediate treatment system was carried out in accordance with the selection policies and the details are described in the Annex Report. Introduction of a valuables sorting yard and RDF production facility was decided based on the results of the study and the main reasons for this decision are listed below.

a.2.1. Valuables Sorting Yard

- Waste Picker (WP) activity will be prohibited because sanitary landfill will be conducted at the new Narangiin Enger disposal site (NEDS). Therefore, the WPs who are making a living at the current Ulaan Chuluut disposal site (UCDS) will lose their livelihoods. Thus it is essential for securing their workplace.
- It will be possible to utilize the RDF production facility as a pre-processing facility.

a.2.2. RDF Production Facility

- Plastic and paper waste is a significant obstacle to the conservation of the environment of the final disposal site (waste scattering) and smooth operation (compaction).
- The proportion of plastic and paper waste in the municipal solid waste (MSW) of Ulaanbaatar City is extremely high. The combined percentage of plastic and paper waste in household waste in the Apartment area, which does not produce ash, is 36.1% in all year average and in the summer season it accounts for 34.1% of all MSW. As the density of this waste is low, the volume becomes several times higher than that of food waste and the above problems occur at the disposal site.
- On the other hand, the percentage of food waste which is generally a main cause of the deterioration of disposal site environments (generation of leachate and bad smells) is very low. It accounts for 37.3% of the household waste in the Apartment area, which does not produce ash, and in the summer season it does not account for more than 33.8% of all MSW. Furthermore, as cattle manure is discarded at the disposal site if the disposal fee is paid, it was decided that there is almost no demand for compost made from the MSW.

- There is extremely low domestic demand for plastic and paper waste materials and recycling and because most of the consumers are in China which is thousand of kilometers of transport away, it is limited to high cost PET bottles. Moreover, strict separation is essential for ensuring a prescribed quality for material recycling but it is difficult to implement separation.
- There is significantly high demand for waste to be used as fuel because the calorific value plastic and paper waste is extremely high (9,000 and 5,000 kcal/kg) and it is a cold climate. However, it is necessary to homogenize the size in order to use it as fuel, and the RDF production facility is an essential to do this.
- If the size is homogenized and it is possible co-combust with coal, it is possible to use the RDF produced from using plastic and paper waste at existing power plants or large-scale heat supply plants thus there is an enormous demand for it.

b. Selection of an Optimum Technical System

The optimum technical system was selected, as shown below, in accordance with the results of the comparison of alternatives.

Table 3-11: Optimum Technical System

Sub-system	Plan System
Discharge and Storage	● Source Separation: Waste will be separated into recyclable and non-recyclable waste in the Apartment area but it will be mixed discharge in the Ger Area. ● Storage Container: Public containers for bulk dischargers and other individual containers (generally, plastic bags)
Collection	● Collection Frequency: Twice a week in the Apartment Area (non-recyclable waste), once a week (recyclable) and twice a month in the Ger area. ● Collection Method: Point collection (Entrance Collection) and curb sude collection in the Apartment Area. Door to door collection in the Ger Area. ● Collection Time: Daytime collection ● Collection Vehicle: Compactor truck in the Apartment Area and dump truck in the Ger Area. ● Haulage Method: Directly transported to each disposal site.
Public Area Cleansing	Combination of manual and machine use. Revised taking into consideration future costs and manpower from the viewpoint of the cost benefit of the proportion of manual labour and machinery.
Recycling	The following public participation recycling systems will be established. ● A plan will be established to promote and develop private sector recycling activities. One plan for this is to construct a recycling complex adjacent to NEDS in order to attract private enterprises. ● A separate discharge system will be established at the source and recycling of the separately discharged waste will be promoted.
Intermediate Treatment	A valuables sorting yard and RDF Production facility will be constructed and will operate within the Narangiin Enger Recycling Complex (NERC) to recycle the recyclable waste discharged separately from the Apartment Area.
Final Disposal	Suitable landfill will be carried out at the following 4 disposal sites. ● NEDS: Sanitary landfill ● Morin Davaa disposal site, Nalaikh disposal site, Khoroo 21 disposal site: semi-sanitary landfill.
Maintenance for Vehicles	● Carry out preventative maintenance and establish a small-scale repair shop and entrust large-scale repairs to private companies.

3.3 Outline of the Master Plan

3.3.1 Goal

The fundamental goal of the M/P for SWM in MUB is:

“To establish an environmentally sound SWM system in MUB by the target year 2020”.

The establishment of such a system will:

- Maintain the urban environment and public health of MUB, which is the center of economic and industrial activities in Mongolia and has 40% of the national population, and to contribute to the sound development of urban life.
- Motivate foreign investment and tourism whereby the economic development of Mongolia will be promoted.

In the environmentally sound SWM system, the 3Rs (Reduce, Reuse and Recycle) of waste are promoted and the following situation should be established.

- Waste reduction is encouraged at the generation source such as households and business enterprises.
- Waste generated after the attempt of waste reduction is reused or recycled as much as possible.
- Waste is properly collected only after the efforts of waste reduction, reuse or recycling at the generation source, and recycled/treated, then finally disposed of in a proper manner without negative environmental impacts.
- Such a SWM system will be established by requiring the governmental sector, private sector and general public to bear adequate responsibilities under a transparent and fair rule is achieved.

3.3.2 Quantitative Targets

The aforementioned goal will be achieved progressively and the Master Plan is divided into the three stages listed below for the goal to be realized.

- Phase 1 Short Term Improvement： from 2006 to 2010（F/S target year）
- Phase 2 Medium term Improvement： from 2011 to 2015
- Phase 3 Long Term Improvement： from 2016 to 2020

The targets for the components of the main technical system are proposed below in order to attain the M/P fundamental goal.

Table 3-12: M/P Quantitative Targets for Ulaanbaatar SWM

Items	Present (2006)	First Phase (2010)	Second Phase (2015)	Third Phase (2020)
Waste Collection Rate (%)				
Apartment Area	100	100	100	100
Ger Area	42*1	100	100	100
Percentage of self-disposal and improper disposal in generation amount (%)				
Winter	54.2	1.2	1.0	0.7
Summer	20.2	2.6	1.9	1.2
Separate collection in apartment area				
Separate collection rate (%)	0	15	40	70
Covered population (person)	0	83,587	289,809	634,432
Percentage of separate collection in generation amount (%)*2				
Winter	0	4.9	17.7	40.4
Summer	0	8.5	25.4	48.9
Percentage of intermediate treatment in generation amount (%)*3				
Winter	0	2.2	8.0	18.5
Summer	0	3.6	11.1	21.8
Percentage of recycling in generation amount (%)*4				
Winter	3.0	4.8 (1.0)	9.3 (3.8)	16.9 (8.9)
Summer	6.6	8.4 (1.7)	13.6 (5.3)	20.5 (10.5)
Final Disposal Method				
NEDS	Open Dumping		Sanitary Landfill Level 4	
Other 3 disposal sites	Open Dumping		Sanitary Landfill Level 2	

(Note): *1: Service fee collection rate identified by the Questionnaire survey to the Khoroo governors in ger area in August 2006
*2: This rate includes recyclable and non-recyclable wastes separated.
*3: This rate means it of recyclable waste which will be processed at the sorting yard and RDF facility.
*4: Figures in （ ）are rate of RDF production.

3.3.3 Strategy

In order to achieve the Master Plan goal, there are strategies for each of the three stages of the plan as shown as follows.

Table 3-13: Strategy for Implementing SWM M/P

Item	Activity
First Phase (2006-2010)	
Technical Perspective	**Eliminate Improper Disposal:** • Improper disposal at source, for example illegal dumping and improper self-disposal, will be eliminated by 2010 through an intensive citizen education campaign and enforcement of regulations (sufficient provision of the collection service is a prerequisite).
	Improve Collection System: • Necessary funds will be secured including overseas support, existing outdated collection vehicles will be gradually renewed and new vehicles will be purchased which is essential for providing the collection service to all residents. • The use of dust chutes will be prohibited, waste discharge rules demonstrated in this study's Pilot Project (P/P) will be spread to all residents in the Apartment Area, waste scattering will be prevented in the town area and the collection rate will be substantially improved. • Waste discharge rules will be established in the Ger Area and the waste collection service will be provided to all residents in that area. • Separate discharge of recyclable and non-recyclable waste will begin in 2007 in accordance with the results of the P/P. Separated collection will be carried out in 2010 15% of residents in the Apartment Area. • Necessary funds will be secured, a central workshop will be established and a maintenance system will be put in place. • The current public area cleaning system is conducted focused on manual labor and this will be maintained. The resident education campaign and regulations will be strongly promoted so that waste is not scattered within the city. **Recycling and Intermediate Treatment:** • A public sector participated 3Rs system will be commenced by starting source separation in order to re-use and recycle municipal waste and recover resources, while promoting waste reduction at generation sources. • A system will be established to develop and maintain private sector recycling activities. One of the policies for this will be to construct a recycling complex (NERC) adjacent to the Narangiin Enger disposal site (NEDS) and attract private enterprises investment for recycling. • A detailed design (the F/S project of this study) will be carried out for the sorting yard and the RDF production facility. The necessary funds will be secured and the sorting yard (4,620ton/year) and the RDF production facility (3,920ton/year) will be constructed in the NERC. The plant will operate from January 2010. The recycled percentage of the generated waste amount will rise from 3.3% (winter) and 7.4% (summer) in 2006 to 4.8% in winter (RDF shares 1.0%) and 8.4% in summer (RDF shares 1.7%) in 2010. **Final Disposal:** • The P/P that is being carried out at the current Ulaanbaatar disposal city (UCDS) will be continued, sanitary landfill will be carried out and organization of waste pickers will be promoted. UCDS will be used until operation commences at NEDS. • Necessary funds will be secured and a detailed design (F/S project of this study) will be conducted for the new Narangiin Enger disposal site (NEDS). NEDS will be constructed and heavy machinery, vehicles and equipment will be purchased. The final disposal site is scheduled to commence operation from the first quarter of 2009. • An improvement plan will be formulated for the other disposal sites and an EIA will be received in 2007. In 2008, the improvement plan will be executed, essential heavy machinery, vehicles and equipment will be secured and semi-sanitary landfill will be implemented. **Medical Waste and Hazardous Industrial Waste Management:** • Source separation, source treatment and separated discharge/collection will be ensured for medical waste (infectious/hazardous waste). Medical waste management will be strictly carried out at the disposal site and improper disposal will be eliminated by 2008. General waste (non-infectious/hazardous waste) from medical institutions is continued to be disposed of at municipal landfills. • Through international cooperation, classifications and management criteria will be legally defined for Hazardous industrial waste. In addition, waste generation, treatment and disposal will be studied to grasp the current situation in order to formulate a suitable treatment and disposal plan. Furthermore, in conjunction with medical waste a suitable treatment and disposal plan will be formulated. The possibility of using an existing cement factory as a treatment facility for some of the hazardous industrial waste will be examined. • Necessary funds will be secured and construction of a hazardous industrial and medical waste treatment and disposal facility will be promoted. Source treatment and source storage will be fully introduced until the construction of the treatment and disposal facility has been completed.

Item	Activity
Institutional Perspective	• The roles, jurisdiction and responsibilities of Municipality of Ulaanbaatar (MUB), districts and Khoroos will be revised in accordance with the proposed technical system, namely the provision of the collection service to all residents, thorough discharge rules, separate collection, public sector participated 3Rs system, and sanitary landfill, and the current waste administration system will be improved. • The current organization of the city and districts responsible for SWM will be strengthened both quantitatively and qualitatively in order to properly operate and manage the proposed technical system, namely the provision of the collection service to all residents, thorough discharge rules, separate collection, sorting yard/RDF production plant. • The introduction of private companies will be promoted not only for the future cleaning service but also for the proposed new technical system with careful regard to the capability of those private companies. A suitable contracting method will be created with the aim of introducing private companies through international cooperation, etc. • Systematic monitoring and an information management system for SWM will be established for both the city and districts. Firstly, the operating costs will be identified in order to assess the cost/benefits, cost/efficiency and cost/effectiveness. In parallel with this, a database will be constructed for all activities relating to SWM and it will be possible to continuously check the quality and costs of both public and private cleaning services. • A personnel capacity development program will be developed to train specialists for SWM. The program will include support activities from specialists to laborers, aimed at involving all affiliated persons from management to operations. • The current laws, regulations and ordinances will be revised and strengthened as necessary in order to properly operate the proposed new technical system. • A waste service fund will be established for the city and districts and a system will be constructed to appropriately collect and manage the waste fee. The waste service fund will act as a cross-subsidy to provide the service to the Ger Area. A database will be constructed with the city and districts to clearly and fairly manage the waste service fund.
	• Practical regulations (Code of Practice) will be formulated for proper medical waste management. • The current SWM structure will be strengthened to establish a suitable regulation/enforcement system for medical waste and hazardous industrial waste.
Second Phase (2011-2015)	
Technical Perspective	• The separate collection system will be extended to cover 40% of the Apartment area by 2015. The classification of separately discharged waste will be revised taking into account demands from the operation of the sorting site/RDF production facility. • Labor costs will rise and if road conditions are improved then the rate of mechanical road cleaning will increase. If employment and road conditions allow it, then the main road cleaning system will be replaced by a mechanical system. • Waste reduction at generation will be further promoted, and a public sector participated 3Rs system will be strengthened to increase the rate of source separation for re-use, recycling and recovery of valuables. • The necessary funds will be secured and the capacity of the sorting yard and the RDF production facility will be build up to 18,890 ton/year and 16,060 ton/year respectively. The recycling rate will rise to 9.3% in winter (RDF shares 3.8%) and 13.6% in summer (RDF shares 5.3%) in 2015. • Inappropriate treatment and disposal of hazardous industrial waste and medical waste will be regulated. Treatment and disposal of hazardous industrial waste and medical waste will be carried out at the constructed hazardous industrial waste and medical waste treatment facility and disposal site.
Institutional Perspective	• The SWM administration system including the roles of the city, districts and Khoroos will be reviewed and improved to respond to changes in demand arising from an increase in the Not in My Back Yard Syndrome (NIMBY). • The administrative and management capacities for municipal waste, as well as hazardous and industrial waste, of the organizations responsible for SWM will be strengthened. • The participation of private companies will be further promoted and more efficient and lower cost SWM will be realized. The government will promote private participation even for the construction of SWM treatment facilities such as the sorting yard/RDF production facility. • The database for SWM will be maintained and managed. The cost comparison data obtained from the database and other evaluation data will be used to assess the efficiency of the service, appropriate management and decision-making. • All staff related to SWM, including employees from private companies, will undertake training and the specialist training program. Occupational qualifications will be created as a means to assess the capabilities of the people responsible for operations of SWM equipment and facilities. • A thorough public education and campaign will be carried out to boost public cooperation in order to extend separate collection, recovery of valuables and recycling.
Third Phase (2016-2020)	
Technical Perspective	• The separate collection system will be expanded and in 2020 it will cover 70% of the Apartment Area population. The separate discharge and collection system will be improved to correspond to changes in social and economic conditions in order to achieve the goal of the Master Plan.
	• Employment and road conditions will be carefully examined for adopting the most appropriate rate of mechanic and manual road cleaning work. • The public sector participated 3Rs system will be fully established and the M/P goal will be realized. • The necessary funds will be secured and the capacity of the sorting yard and the RDF production facility will be build up to 49,400 ton/year and 41,990 ton/year respectively. The recycling rate will rise to 16.9% in winter (RDF shares 8.9%) and 20.5% in summer (RDF

Item	Activity
	shares 10.5%) in 2020. • It will be possible to use NEDS until 2020. Site selection for the next disposal site after the closure of NEDS, preliminary design, F/S study and EIA will be carried out. Furthermore, necessary funds will be secured and a detailed design will be carried out for the next disposal site. The next disposal site will be constructed and heavy machinery, vehicles and equipment will be purchased. • Inappropriate treatment and disposal of Hazardous industrial waste and medical waste will be regulated. Treatment and disposal will be carried out at the constructed hazardous industrial waste and medical waste treatment and disposal site.
Institutional Perspective	• The administration and organization of the recycling oriented society for SWM will be completely established. • Private companies will fully participate in the operation of the cleaning service as well as construction of facilities such as the sorting yard/RDF production facility, and hazardous waste and medical waste treatment/disposal facility. The administration will appropriately control and monitor the activities of the private companies. • The database for SWM will be fully functioning and it will be possible to instantly elicit data essential for operation, policy decisions, control/monitoring, residential policies and financial management. • Continuous public education and campaign will be carried out and resident cooperation will be promoted to realize the recycling oriented society. • By 2020 the waste fund will cover 100% of the SWM costs.

3.3.4 Future Waste Flow

The waste flows for winter and summer in Ulaanbaatar City in 2010, 2015 and 2020 are shown in the following figure.

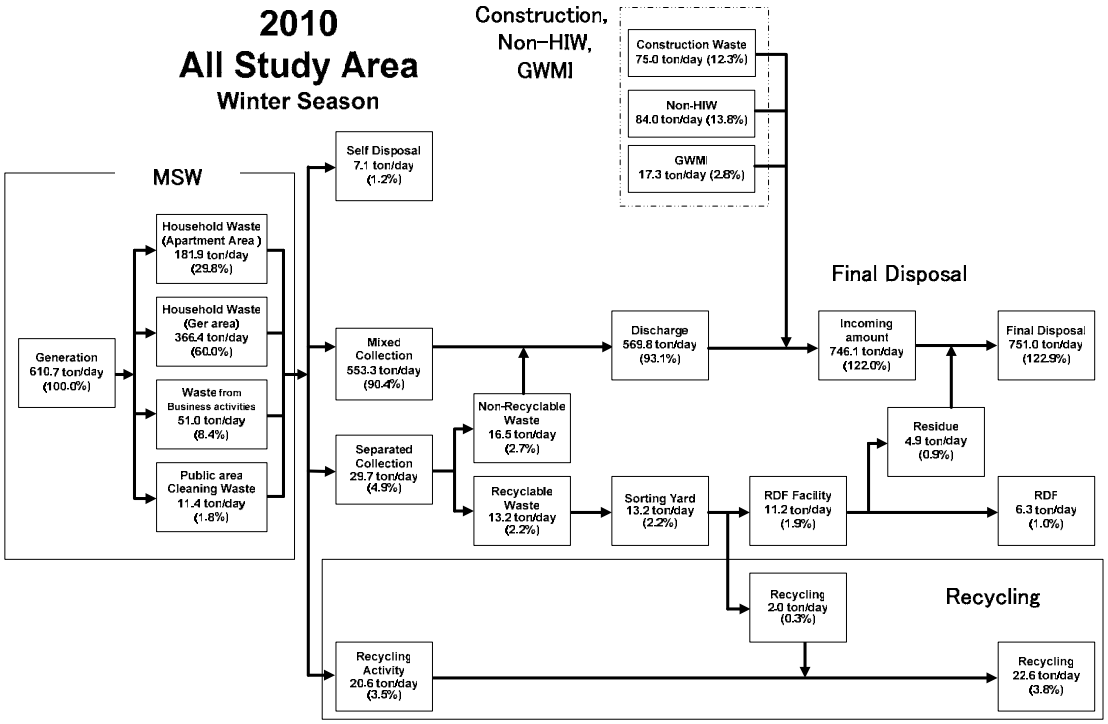


Figure 3-4: Waste Flow in Winter Season in 2010

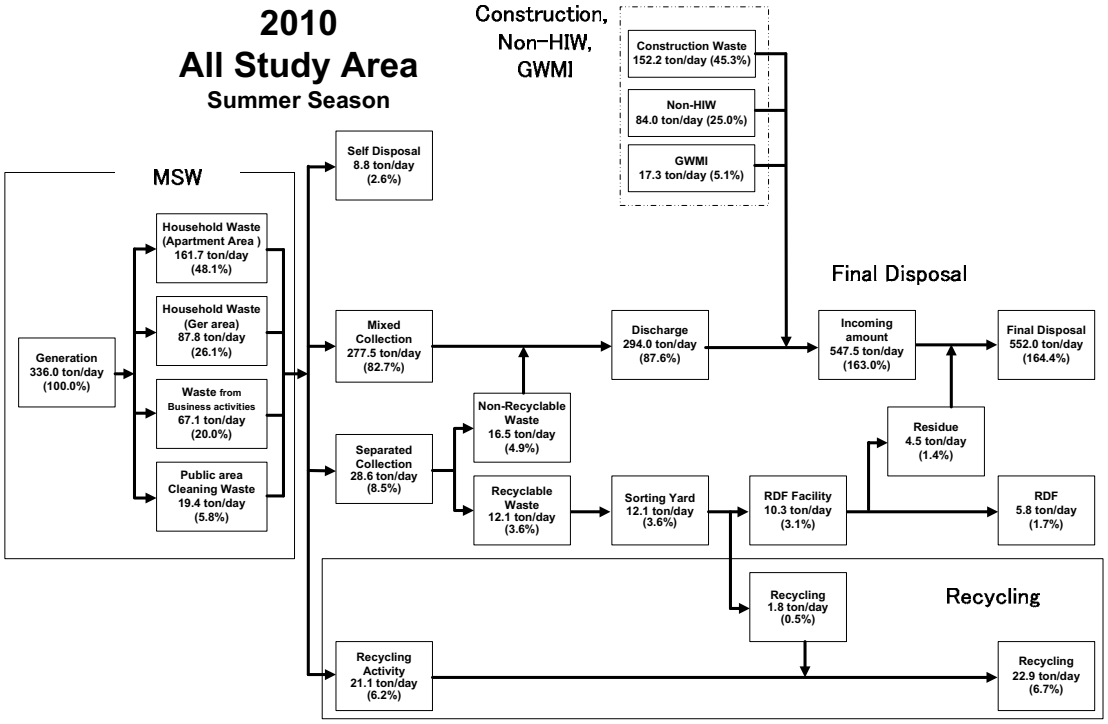


Figure 3-5: Waste Flow in Summer Season in 2010

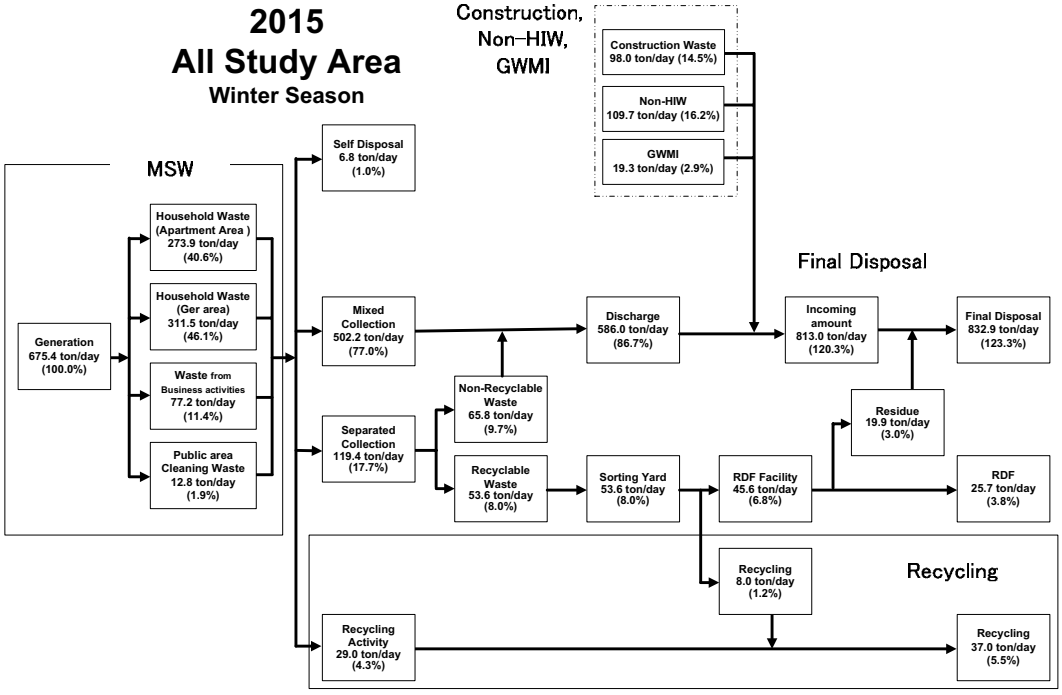


Figure 3-6: Waste Flow in Winter Season in 2015

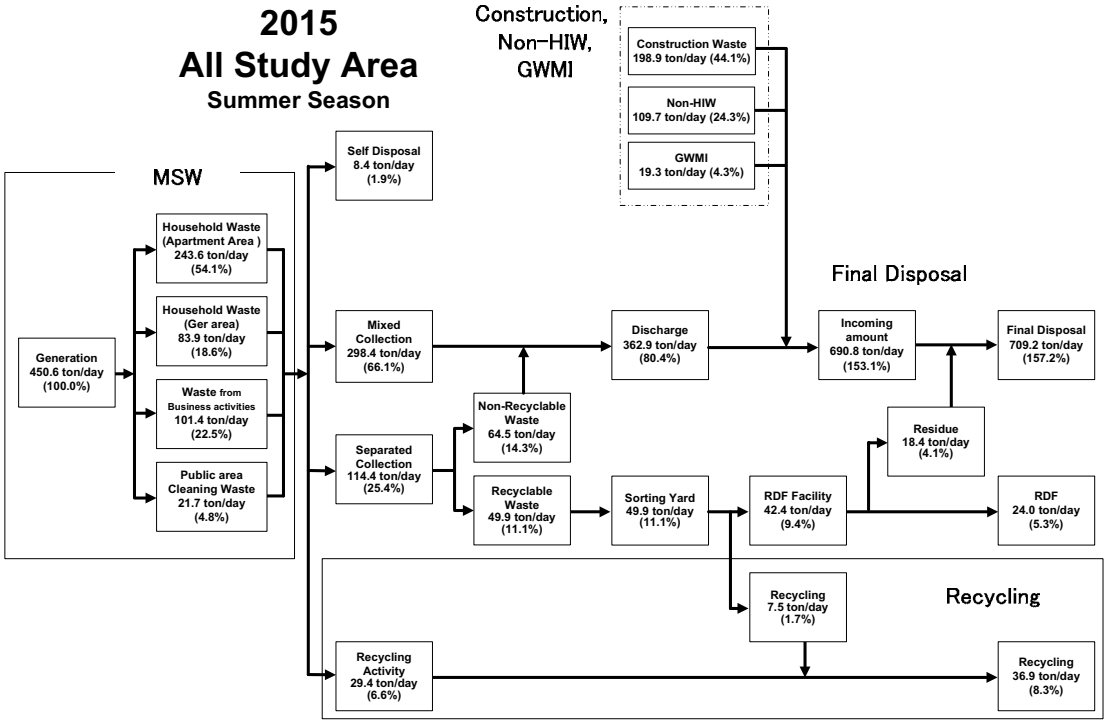


Figure 3-7: Waste Flow in Summer Season in 2015

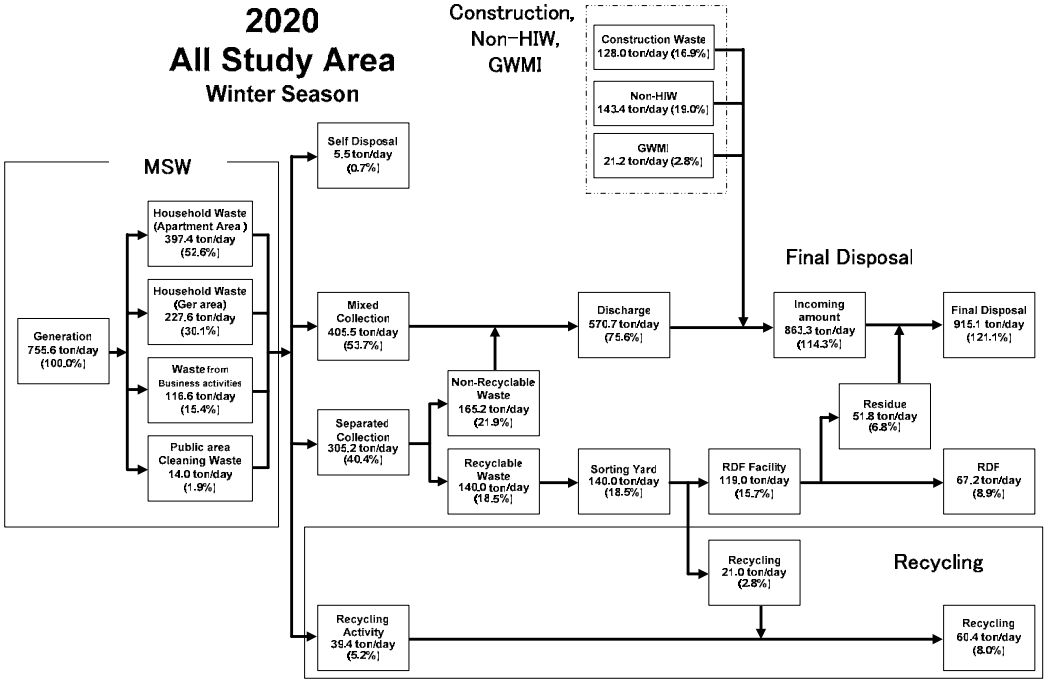


Figure 3-8: Waste Flow in Winter Season in 2020

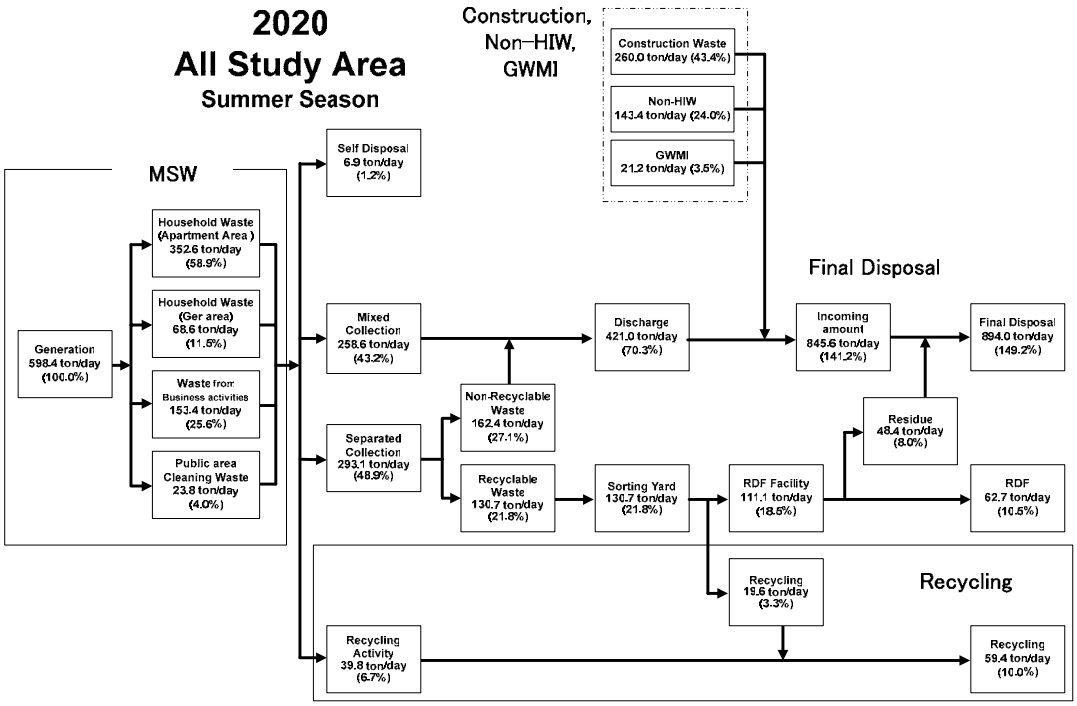


Figure 3-9: Waste Flow in Summer Season in 2020

3.3.5 SWM Master Plan for UBC

Table 3-14: SWM Master Plan for UBC

Phase / Components	Present (2006)		Phase 1 (2010)		Phase 2 (2015)		Phase 3 (2020)	
	winter	summer	winter	summer	winter	summer	winter	summer
1. Generation of MSW								
Population (7 District)	Apart Area: 481,037 Ger Area: 409,772 Total: 890,809		Apart Area: 612,362 Ger Area: 375,318 Total: 987,680		Apart Area: 796,180 Ger Area: 309,625 Total: 1,105,805		Apart Area: 995,970 Ger Area: 218,628 Total: 1,214,598	
Generation of MSW (ton/day)								
Total:	565.8	263.9	610.7	336.0	675.4	450.6	755.6	598.4
• Apart Area:	174.0	178.7	244.3	248.2	363.9	366.7	528.0	529.8
• Ger Area:	391.8	85.2	366.4	87.8	311.5	83.9	227.6	68.6
Waste Composition of Apart Area: (%)								
• Recyclable	43.9	42.7	44.2	42.6	45.1	43.6	45.8	44.6
• Non-Recyclable	56.1	57.3	55.8	57.4	54.9	56.4	54.2	55.4
Waste Composition of Ger Area: (%)								
• Recyclable	6.6	42.8	7.0	43.4	8.2	44.2	9.5	45.2
• Non-Recyclable	93.4	57.2	93.0	56.6	91.8	45.8	90.5	54.8
2. Collection and Transportation								
Collection Cover Rate in Population (%)								
• Apart Area:		100		100		100		100
• Ger Area:		42		100		100		100
Improper Disposal Rate in Generation Amount (%)								
• Apart Area:	0	0	0	0	0	0	0	0
• Ger Area:	27.0	6.5	0	0	0	0	0	0
Separate Collection Rate in Generation Amount (%)								
• Apart Area:	0	0	15	15	40	40	70	70
• Ger Area:	0	0	0	0	0	0	0	0

Phase / Components	Present (2006)		Phase 1 (2010)		Phase 2 (2015)		Phase 3 (2020)	
	winter	summer	winter	summer	winter	summer	winter	summer
Amount of Separated Waste (ton/day)								
• Apart Area:	0	0	29.7	28.6	119.4	114.4	305.2	293.1
• Ger Area::	0	0	0	0	0	0	0	0
Collection Frequency								
• Apart Area:	* Range from everyday to once a month		* Twice a week for non-recyclable once a week for recyclable		* Twice a week for non-recyclable once a week for recyclable		* Twice a week for non-recyclable once a week for recyclable	
• Ger Area:	* Once a month in average		* Twice a month		*Twice a month		*Twice a month	
Collection System	Apart Area Point collection Bell collection Dust chute collection Public container coll. Curb side collection Ger Area Door to door coll.		Apart Area Point (Entrance) Coll. Curb side collection Ger Area Door to door		Apart Area Point (Entrance) Coll. Curb side collection Ger Area Door to door		Apart Area Point (Entrance) Coll. Curb side collection Ger Area Door to door	
Collection Vehicle (Unit)								
CT: Compactor truck	CT :	38	CT (15m3):	23	CT (15m3):	31	CT (15m3):	45
DT: Dump truck	DT:	98	CT (8m3):	7	CT (8m3):	10	CT (8m3):	12
SL: Skip loader truck	SL:	12	DT (6ton):	113	DT (6ton):	108	DT (6ton):	98
Nos of Collection Worker	444		429		447		465	
Transportation System	Direct haulage		Direct haulage		Direct haulage		Direct haulage	
Executing Body	• 7 TUK • Khoroo (very few)		• MUB/CMPUA • 7 TUK		• MUB/CMPUA • 7 TUK		• MUB/CMPUA • 7 TUK	
Unit Cost (MNT/ton)	13,514 in 2004		15,376		14,192		13,321	
3. Public Area Cleaning								
Method	Mainly manual labor and machinery		Mainly manual labor and machinery		Mainly manual labor and machinery		Machinery and manual labor	
Service Area (m^2)	3,430,451		3,801,370		4,254,938		4,674,808	
Executing Body	Budget of district Service done by TUK		Budget of district Service done by private contractor		Budget of district Service done by private contractor		Budget of district Service done by private contractor	
Nos of Cleaning Worker	382		424		474		520	
Unit Cost (MNT/m^2)	18		50		50		50	
4. Recycling and Intermediate Treatment								
Sorting Yard								
Location	None		NERC		NERC		NERC	
Incoming Amount (ton/year)	0		4,620		18,890		49,400	
Recover Amount (ton/year)	0		700		2,830		7,410	
Unit Cost (MNT/ton)	None		13,645		7,527		5,756	
RDF Production Facility								
Location	None		NERC		NERC		NERC	
Incoming Amount (ton/year)	0		3,920		16,060		41,990	
RDF Amount (ton/year)	0		2,210		9,070		23,710	
Unit Cost (MNT/ton)	None		57,914		31,827		24,353	
Recycling Amount at Generation (ton/day)	16.5	17.3	22.6	22.9	37.0	36.9	60.4	59.4
Recycling Rate in Total	3.0%	6.6%	4.8%	8.4%	9.3%	13.6%	16.9%	20.5%
Recycling System	No government initiated recycling but mainly done by private sector		Government initiated recycling system be established.		Government initiated recycling system be expanded.		Government initiated recycling system be expanded.	
5. Final Disposal								
Operation Method	Open dumping		NEDS: Sanitary Landfill (SLF) Level 4 Others: SLF Level 2		NEDS: Sanitary Landfill (SLF) Level 4 Others: SLF Level 2		NEDS: Sanitary Landfill (SLF) Level 4 Others: SLF Level 2	
Location	UCDS MDDS NDS KH21DS		NEDS MDDS NDS KH21DS		NEDS MDDS NDS KH21DS		NEDS MDDS NDS KH21DS	
Distance from City Center (km)	UCDS: 13 MDDS: 23 NDS: 38 KH21DS: 60		NEDS: 14 MDDS: 23 NDS: 38 KH21DS: 60		NEDS: 14 MDDS: 23 NDS: 38 KH21DS: 60		NEDS: 14 MDDS: 23 NDS: 38 KH21DS: 60	
Executing Body	UCDS: Nuuts MDDS: Nuuts NDS: NaD KH21DS: Khoroo 21		NEDS: CMPUA MDDS: CMPUA NDS: NaD KH21DS: Khoroo 21		NEDS: CMPUA MDDS: CMPUA NDS: NaD KH21DS: Khoroo 21		NEDS: CMPUA MDDS: CMPUA NDS: NaD KH21DS: Khoroo 21	

Phase / Components	Present (2006)		Phase 1 (2010)		Phase 2 (2015)		Phase 3 (2020)	
	winter	summer	winter	summer	winter	summer	winter	summer
Disposal Amount (ton/day) *1	UCDS: 340 (485) MDDS: 19 (26) NDS: 11 (16) KH21DS: 4 (6)		NEDS: 683 (502) MDDS: 38 (28) NDS: 23 (17) KH21DS: 8 (6)		NEDS: 755 (643) MDDS: 43 (37) NDS: 26 (22) KH21DS: 9 (7)		NEDS: 825 (806) MDDS: 50 (49) NDS: 30 (29) KH21DS: 10 (10)	
Nos of Worker	UCDS: 9 MDDS: 1 NDS: None KH21DS: None		NEDS: 22 MDDS: 3 NDS: 1 KH21DS: 1		NEDS: 23 MDDS: 3 NDS: 1 KH21DS: 1		NEDS: 23 MDDS: 3 NDS: 1 KH21DS: 1	
Unit Cost (MNT/ton)	UCDS: 703 in 2004 MDDS: NA NDS: NA KH21DS: NA		NEDS: 2,231 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 1,685 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 1,436 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2	
Tipping Fee (MNT/ton)	UCDS: 100MNT/m^3 MDDS: 00MNT/m^3 NDS: - KH21DS: -		NEDS: 2080 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 2080 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2		NEDS: 2080 MDDS: 970*2 NDS: 970*2 KH21DS: 970*2	
Main Landfill Equipment	**UCDS:** Bulldozer 2, Water tank truck 1, Dump truck 2 **MDDS:** None **NDS:** None **KH21DS:** None		**NEDS:** Bulldozer 3, Excavator 1, Water tank truck 1, Dump truck 2 One Wheel Shovel with Excavator for **MDDS, NDS and KH21DS**		**NEDS:** Bulldozer 4, Excavator 1, Water tank truck 1, Dump truck 2 One Wheel Shovel with Excavator for **MDDS, NDS and KH21DS**		**NEDS:** Bulldozer 4, Excavator 1, Water tank truck 1, Dump truck 2 One Wheel Shovel with Excavator for **MDDS, NDS and KH21DS**	
6. Maintenance for Equipment								
Preventive Maintenance and Small-scale Repair	By driver of TUK		By Central Workshop of CMPUA		By Central Workshop of CMPUA		By Central Workshop of CMPUA	
Large-scale Repair	By driver of TUK		By private workshop		By private workshop		By private workshop	
Executing Body	TUK		CMPUA		CMPUA		CMPUA	
Staff of Central Workshop	A few staff in each TUK		Manager: 1 Technician: 1 Mechanic, etc.: 6 Store keeper, etc.: 2 Office clerk, etc.: 2		Manager: 1 Technician: 1 Mechanic, etc.: 6 Store keeper, etc.: 2 Office clerk, etc.: 2		Manager: 1 Technician: 1 Mechanic, etc.: 6 Store keeper, etc.: 2 Office clerk, etc.: 2	
7. Financial Matters on SWM excluding Public Area Cleaning (The figure of the present is it in 2004.)								
Unit Cost (MNT/ton) except it for Public Area Cleaning	13,384		19,908		20,703		20,298	
Revenue Source (million MNT)	* Collection service fee: 1,506 * District budget: 0		* Collection service fee: 4,005 * District budget: 0		* Collection service fee: 5,541 * District budget: 0		* Collection service fee: 6,221 * District budget: 0	
	* MUB budget: 28 * Tipping fee: 18		* MUB budget: 25 * Tipping fee: 53*3 * RDF: 22		* MUB budget: 56 * Tipping fee: 53*3 * RDF: 91		* MUB budget: 10 * Tipping fee: 53*3 * RDF: 237	
Total Revenue (million MNT) *4	1,553		4,405		5,941		6,621	
Fee Collection Rate • Household (Apart): • Household (Ger): • Business:	86 % 17 % NA		90% 33.1 % 100 %		97 % 53.2% 100 %		97 % 53.2 % 100%	
Percentage of Fee Collected in Total Revenue for SWM	97.0 %		94.1%		95.7%		96.1 %	
Percentage of Intermediate Treatment Cost to Total Revenue for SWM	0 %		4.5 %		3.7 %		3.3 %	
Percentage of Final Disposal Cost to Total Revenue for SWM	3.0 %		11.8 %		8.0 %		7.2 %	
Total Revenue per Capita (MNT/year)	1,743		4,278		5,237		5,328	
Budget of MUB (million MNT) *5	13,100		17,555		22,405		28,596	
Percentage of SWM Budget in MUB Budget	0.21 % *6		?? %		?? %		?? %	
8. Medical Waste Management								
Generation Amount (ton/day)	General Waste: 15.2 Medical Waste: 1.6		General Waste: 16.9 Medical Waste: 1.8		General Waste: 18.9 Medical Waste: 2.0		General Waste: 20.8 Medical Waste: 2.2	
Treatment at generation	General Waste: Collection by TUK Medical Waste: Partly incinerated at generation sources		General Waste: Collection by private company Medical Waste: Treat at generation or entrust to treatment outside		General Waste: Collection by private company Medical Waste: Treat at generation or entrust to treatment outside		General Waste: Collection by private company Medical Waste: Treat at generation or entrust to treatment outside	

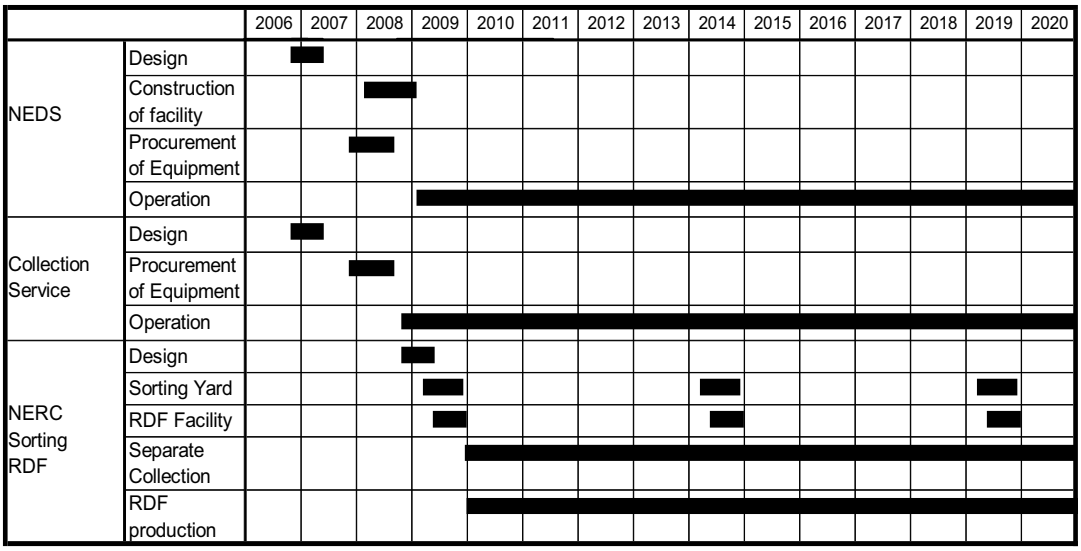
Phase / Components	Present (2006)		Phase 1 (2010)		Phase 2 (2015)		Phase 3 (2020)	
	winter	summer	winter	summer	winter	summer	winter	summer
Final Disposal	General Waste: Open dumping Medical Waste: Untreated waste at generation is burnt at disposal site		General Waste: Sanitary landfill Medical Waste: Untreated waste is prohibited to enter disposal site		General Waste: Sanitary landfill Medical Waste: Untreated waste is prohibited to enter disposal site		General Waste: Sanitary landfill Medical Waste: Untreated waste is prohibited to enter disposal site	
Executing Body of Final Disposal Site	Nuuts		CMPUA		CMPUA		CMPUA	
9. Industrial Waste								
Generation Amount (ton/day)	Non-HIW: 67.8 HIW: 0.1 *7		Non-HIW: 83.9 HIW:: 0.1 *7		Non-HIW: 109.6 HIW: 0.1 *7		Non-HIW: 143.4 HIW: 0.1 *7	
Treatment and Final Disposal	Non-HIW: Final disposal at municipal landfills HIW: Unknown		Non-HIW: Final disposal at municipal landfills HIW: Storage at generation until HW treatment and disposal facility open.		Non-HIW: Final disposal at municipal landfills HIW: Treated and disposed at the HW treatment and disposal facility		Non-HIW: Final disposal at municipal landfills HIW: Treated and disposed at the HW treatment and disposal facility	
Executing Body	Non-HIW: Nuuts HIW: Unknown		Non-HIW: CMPUA HIW: Discharger until HW treatment and disposal facility open.		Non-HIW: CMPUA HIW: Operator of HW treatment and disposal facility (probably private company)		Non-HIW: CMPUA HIW: Operator of HW treatment and disposal facility (probably private company)	
10. Construction Waste								
Generation Amount (ton/day)	60.6	123.0	75.0	152.2	98.0	198.9	128.0	260.0
Final Disposal	Most of the waste (80% by the Team estimate) was not disposed of at municipal landfills, i.e. illegally dumped.		Control of the waste will be established by regulating submission of waste management plan when a construction work applies for permission, and checking incoming waste amount at municipal landfills comparing the waste amount informed in the plan..		Strengthening enforcement of illegal dumping.		Strengthening enforcement of illegal dumping.	

(Note)
*1: The figure outside ( ) is for winter and it inside ( ) is summer.
*2: The unit cost of UCDS in 2006 is applied.
*3: The figure is calculated assuming that current disposal amount by private enterprises will not change and tipping fee will change from 100MNT/m^3 to 2,080MNT/ton.
*4: Since present (2004) budget from a District includes not only for public area cleaning but also for sludge collection, city decoration, etc., it is difficult to identify the budget for public area cleaning. Therefore the budget from the District is not counted.
*5: The figures of year 2010, 2015 and 2020 are calculated supposing the budget will increase in accordance with GDP increase (5.5%).
*6: In 2006 the MUB budget for the disposal site was increased more than 5 times from 28 million to 150 million MNT.
*7: This figure should be re-examined by future study.
*8: Unit cost in this table does not include depreciation cost of facility and equipment.

3.3.6 Implementation Plan of the M/P

Schedule for implementation of M/P is shown as follows.

Table 3-15: Implementation Plan of M/P



3.3.7 Financial Analysis of M/P

a. Project Cost

Based on the above implementation schedule, Project costs for the M/P since 2008 to 2020 are presented at following table.

Table 3-16: Project Cost for the M/P

Unit: 1,000,000MNT

			2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Collection	Collect. Truck	Invest.	13	4,123	0	342	210	228	0	534	342	3,658	228	673	534
		O&M	0	0	3,775	3,807	3,915	4,044	4,086	4,258	4,411	4,533	4,517	4,609	4,683
Intermediate Treatment	Sorting, RDF	Invest.	0	588	0	0	0	0	3,245	0	0	76	0	1,580	0
		O&M	0	0	191	191	191	191	196	431	431	431	431	441	862
Final Disposal	Equip. & Facility	Invest.	209	4,936	0	0	0	0	0	0	0	289	0	0	0
	Landfill	O&M	0	0	501	517	530	463	589	463	469	565	463	610	463
Total		Invest.	222	9,647	0	342	210	228	3,245	534	342	4,023	228	2,253	534
		O&M	0	0	4,467	4,515	4,636	4,698	4,871	5,152	5,311	5,529	5,411	5,660	6,008
		Total	222	9,647	4,467	4,857	4,846	4,926	8,116	5,686	5,653	9,552	5,639	7,913	6,542

Following financial analysis was done based on the condition that initial investment in year 2008 and 2009 is covered under grant aid and no investment is required.

b. Cost for SWM

Cost of each component for SWM excluding depreciation in each stage of the M/P is presented as follows.

Table 3-17: Cost for SWM in the M/P

Component	Current	2010	2015	2020
Collection	13,514MNT/ ton *1	15,376MNT/ton	14,192 MNT/ ton	13,321 MNT/ ton
Cleansing	18 MNT/m2*2	50 MNT/m2*3	50 MNT/m2	50 MNT/m2
Sorting	–	13,645MNT/ ton	7,527 MNT/ ton	5,756 MNT/ ton
RDF plant	–	57,914MNT/ ton	31,827 MNT/ ton	24,353 MNT/ ton
Final Disposal	100MNT/m3	2,231MNT/ ton	1,685 MNT/ ton	1,436 MNT/ ton

(Note)
*1: collection cost in 2004
*2: contract rate between TUK and Duureg in 2004
*3: contract rate set on Sep 2006

c. Revenue

The following revenues for SWM are considered:

- Waste collection fee
- Revenue from MUB and/or Duureg government
- Tipping fee at a disposal site
- Sales income of RDF and Valuables from sorting yard

d. Waste Collection Fee

Waste collection fee and its fee collection rate are presented as follows.

Table 3-18: Waste Collection Fee and Fee Collection Rate

Area	Current		2010		2015		2020	
	Fee	Collection rate	Fee	Collection rate	Fee	Collection rate	Fee	Collection rate
Apartment Area	200 MNT/ person/ month	86%	1,200 ～ 2,000*2 MNT/ household/ month	90%	1,200 ～ 2,000 MNT/ household/ month	97%	1,200 ～ 2,000 MNT/ household/ month	97%
Ger Area	1,000 ～ 1500 MNT/ household/ month	12%*1	2,000 ～ 2,500*2 MNT/ household/ month	30%*3	2,000 ～ 2,500 MNT/ household/ month	53%*4	2,000 ～ 2,500 MNT/ household/ month	53%
Business	4,750 MNT/t	NA	8 750*2 MNT/ton	100%	8 750 MNT/ton	100%	8 750 MNT/ton	100%

(Note)
*1 : This figure was obtained by the JICA ST in 2004 by the interview survey to each TUK. It was 41.6% in 2006 when JICA ST interviewed to each Khoroo Government.
*2 : Waste fee which was revised in Sep 2006
*3 : Effective Collection Rate in 2010 (percentage of the people who can afford to pay) was set to 45%. The rate of the household who will be able to pay for the fee is 67 % according to the Statistical Handbook "Ulaanbaatar-XX Century".
*4 : Effective Collection Rate in 2015 was set to 80%

e. Revenue from MUB and Duureg Governments' Budget for SWM

Revenue from MUB and Duureg Government relating to SWM is presented as follows.

Table 3-19: Revenue from MUB and Duureg Government

Unit: 1,000MNT

City or District	Current	2010	2015	2020
MUB	150,000*1	375,000	306,000	160,000
Duureg	870,766*2	—	—	—

(Note)
*1: Budget of Nuuts Co. for operating disposal site in 2006. There are a few budget allocated CMPUD but it is very small. So that it is not included in the Revenue.
*2: District budget for cleansing in 2004: Cleansing of road, park, extraction of sludge, renovation works were covered under this budget. Assume that expense and income were balanced, and these amount were excluded in this financial analysis.

f. Final Disposal Fee

Final disposal fee at each stage of the M/P is presented below.

Table 3-20: Disposal Fee at each stage of M/P

Unit:1,000 MNT

	Current	2010	2015	2020
Disposal Fee	100MNT/m3	2,080 MNT/ton*1	2,080 MNT/ton	2,080 MNT/ton
Expected Income	50,484*2	153,088*3	153,088*3	153,088*3

(Note)
*1 : Revised fee in Sep 2006.
*2 : Budget for landfill operation of Nuuts Co. in 2004, 55% of this amount is from MUB.
*3 : Disposal fee times disposal amount at NEDS and MDDS. The disposal amount is assumed the same as it of the private enterprises who paid tipping fee at UCDS and MDDS.

g. Income from Valuables at Sorting Yard and Sales of RDF

Income from sales of valuables at sorting yard and RDF production facility is presented below.

Table 3-21: Income from Sales of Valuables at Sorting Yard and RDF at RDF Production

Unit : 1,000 MNT

Item	Current	2010	2015	2020
Valuables	-	57,720	248,960	708,448
RDF	-	22,090	90,700	237,070

Since incomes of the sales of valuables will be used for the salary of workers (waste pickers), the incomes and costs will be balanced out in financial analysis. The current coal price is 12,000MNT/ton and transportation cost is assumed 2,000MNT/ton. Consequently the sales price of RDF is set 10,000MNT/ton in financial analysis.

h. FIRR and Cash Flow

FIRR is calculated as 1.4 % based on the above conditions.

There will be a continuous deficit from 2010 till 2011 but there will be annual profit from 2012 onward.

Big investment in 2014 for NERC development and in 2017 for replacement of collection trucks will be necessary and appropriate financial arrangement such as overseas soft loan will be required.

Table 3-22: Cash Flow of the M/P

Unit : 1,000,000MNT

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Investment	0	342	210	228	3,245	534	342	4,023	228	673	534
O&M	4,467	4,515	4,636	4,698	4,871	5,152	5,311	5,529	5,411	5,660	6,008
Revenue	4,405	4,649	4,897	5,149	5,406	5,941	6,078	6,233	6,381	6,545	6,621
Profit & Loss	-62	-208	51	223	-2,710	255	425	-3,319	742	212	79

i. Conclusion

The Master Plan for SWM in Ulaanbaatar City targeted for year 2020 is feasible financially based on the conditions set above.

3.3.8 Institutional Development Plan

Institutional development plan such as improvement of collection fee system, strengthening the CMPUD as an executing agency and development of the legal system and standards for establishing an appropriate SWM are indispensable to smoothly implement a master plan for SWM in the municipality of Ulaanbaatar.

a. Legal System

a.1 Development of Detailed Solid Waste Classification

The Law on Household and Industrial Waste classifies solid waste (SW) into non-hazardous waste (non-HW) and hazardous waste (HW) and the classification is reasonable. However, more detailed classification is necessary for proper SWM. The Study team has proposed a detailed classification of SW for the study as shown in the table below in order to establish a proper SWM system. Because proper management for each waste differs each other, i.e. collection, treatment, disposal, management fee, responsible body, etc. The Team recommends responsible officers of the MOE to refer the table for the establishment of detail classification.

Table 3-23: Solid Waste Classification

Category in the Law	Waste Category by Source	Sub-Waste Category	Detailed Waste Category or Description
Non Hazardous Waste (Non-HW))	Municipal Waste	Domestic Waste	1. Household waste 2. Institutional (school, government office, etc.) waste 3. Public area (road, drain, etc.) cleaning waste
		Commercial Waste	4. Commercial (shop, office, restaurant, hotel, etc.) waste 5. Market waste
	General Waste from Medical Institution	General Medical Waste	6. Non-infectious and non-hazardous medical waste
	Industrial (Factory) Waste	Non-hazardous Industrial Waste (Non-HIW)	7. Non-HIW from non-production sources 8. Non-HIW from production process
	Construction waste		9. Construction waste
Hazardous Waste (HW)	Municipal Waste*1	Hazardous Municipal Waste	10. Domestic HW 11. Commercial HW
	Industrial (Factory) Waste	Hazardous Industrial Waste (HIW)	12. Hazardous factory waste
	Medical Waste	Medical Waste	13. Infectious waste 14. Hazardous medical waste
	Construction Waste*1	Hazardous Construction Waste	15. Hazardous construction waste

(Note) *1: This study does not cover these wastes. The amount of these wastes is very limited.

a.2 Guidelines for SWM

MOE is establishing several guidelines for proper SWM, the following guidelines need to be gradually prepared in collaboration with relevant organizations:

- Technical guidelines for landfill design and operation
- Technical guidelines for treatment and disposal of hazardous waste
- Detailed regulations and guidelines for the collection and treatment of medical waste
- Detailed regulations and guidelines for the management of hazardous waste other than medical waste
- Guidelines for environmental impact analyses and public hearings

The Team recommends MOE and other responsible organizations to ask for foreign technical cooperation for the preparation of the above guidelines.

b. SWM of Municipality of Ulaanbaatar

In order to smoothly implement the M/P Municipality of Ulaanbaatar (MUB) needs to execute the following institutional development:

- Strengthening responsible organization for SWM in MUB;
- Improvement of financial system for SWM

b.1 Strengthening Responsible Organization

In order to strengthen the current organization for SWM in Ulaanbaatar, the mayor of the city issued the Capital City Mayor Order No. 445 which instructed to establish a new organization, CMPUA (City Maintenance and Public Utility Agency) from September 15, 2006.

In response to the Order, CMPUA commenced to build up a new organization structure for it according to the figure below. The CMPUA plans to employ the following staffs.

Schedule	Staffs to be Employed and Paid by MUB	Staffs to be Employed and Paid by CMPUA	Total
By the end of 2006	30	To be advised by the JICA B/D Study Team	NA
By the end of 2008	45	To be advised by the JICA B/D Study Team	NA

b.2 Improvement of Financial System for SWM

b.2.1. Waste Management Service Fee

Based on the financial analysis made by the study, the waste management service fee was revised and enacted from September 1, 2006. The table below presents previous and revised fee tariff.

Table 3-24: Waste Management Service Fee

Service Items	Previous Tariff	New Tariff
Collection of Business Waste	19,000 MNT per a truck or 4ton	35,000 MNT per a truck or 4ton
Collection of Household Waste in Apartment Area	200 MNT/person/month (equivalent to 600 -1,000 MNT/household/month)	1,200 -2,000 MNT/household/month (depending on the District)
Collection of Household Waste in Ger Area	1,000 -1,500 MNT/household/month (depending on the District)	1,500 -2,500 MNT/household/month (depending on the District)
Collection of Household Waste in Summer House Area	2,000 MNT/household/month	2,500 MNT/household/month
Public Area Cleaning	18 MNT/1m2	50 MNT/1m2
Final Disposal	100 MNT/1m3	2,080 MNT/ton

b.2.2. Waste Service Fund

With reference to the Article 28.1 and 28.3 of the "Law on Administration, Territorial Division, and its Management", and the Article 21.1 of the "Law on Household and Industrial Waste", and the Decree 248 of the "Approval of the Waste Service Fund Regulation" issued by the Presidium of the Capital Citizen's Representatives, on 30th November 2006 the Mayor of the Ulaanbaatar ordered to establish the Waste Service Fund as follows:

- Establish the city waste service fund at the Mayor's Office of MUB, and districts' waste service fund at District's Governments.
- Oblige the Ulaanbaatar City General Manager and District Governors to prepare necessary measurers for the organization of the Waste Service Fund according to the approved Regulation, and to start the operation of the Fund from 1 January 2007, and to ensure the monitoring.

Based on the Waste Service Fund the MUB/CMPUA plans to improve the current financial system for SWM as shown in the following Figures. The following issues are main differences between old and new system.

- The Waste Service Fund is established in the City and Districts named as City Waste Service Fund (CWSF) and District Waste Service Fund (DWSF).
- Instead of TUKs staff of the DWSF will collect waste collection fee from Business establishment.
- Instead of TUKs officers of Khoroo or Kheseg will collect waste collection fee from household in the Ger Area.
- Waste Collection Section or Unit of CMPUA will be able to provide waste collection service according to the order of District and be paid for the service by DWSF.
- Instead of Nuuts Co., Disposal Site Operation and Management Section of CMPUA will conduct operation of the disposal sites.

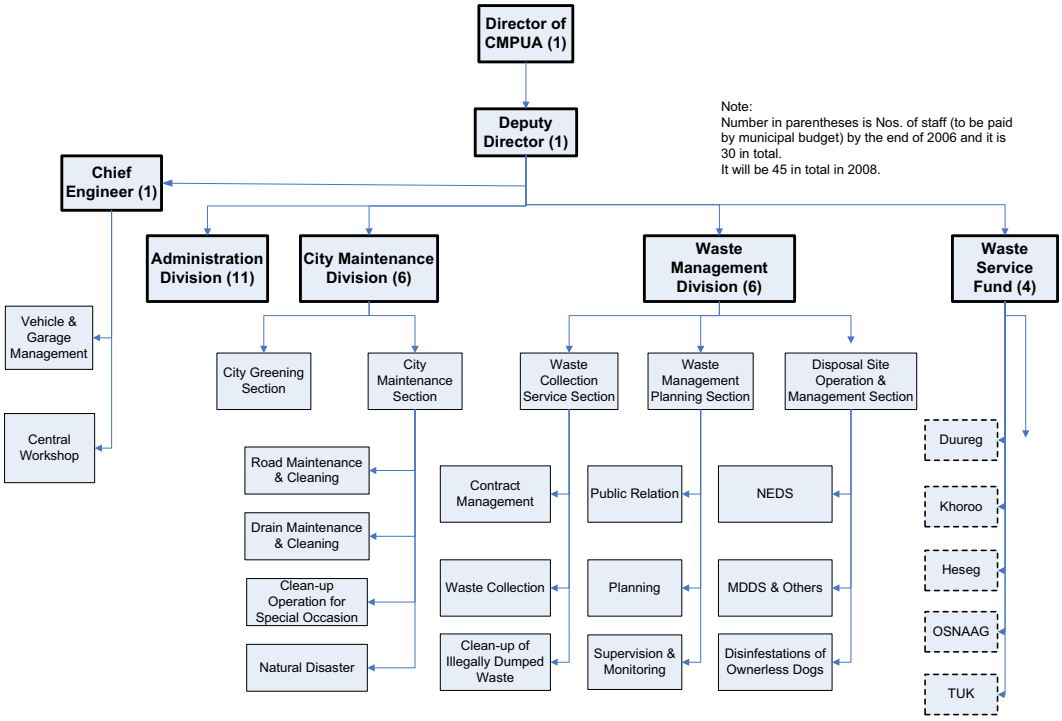


Figure 3-10: Organization Chart of CMPUA

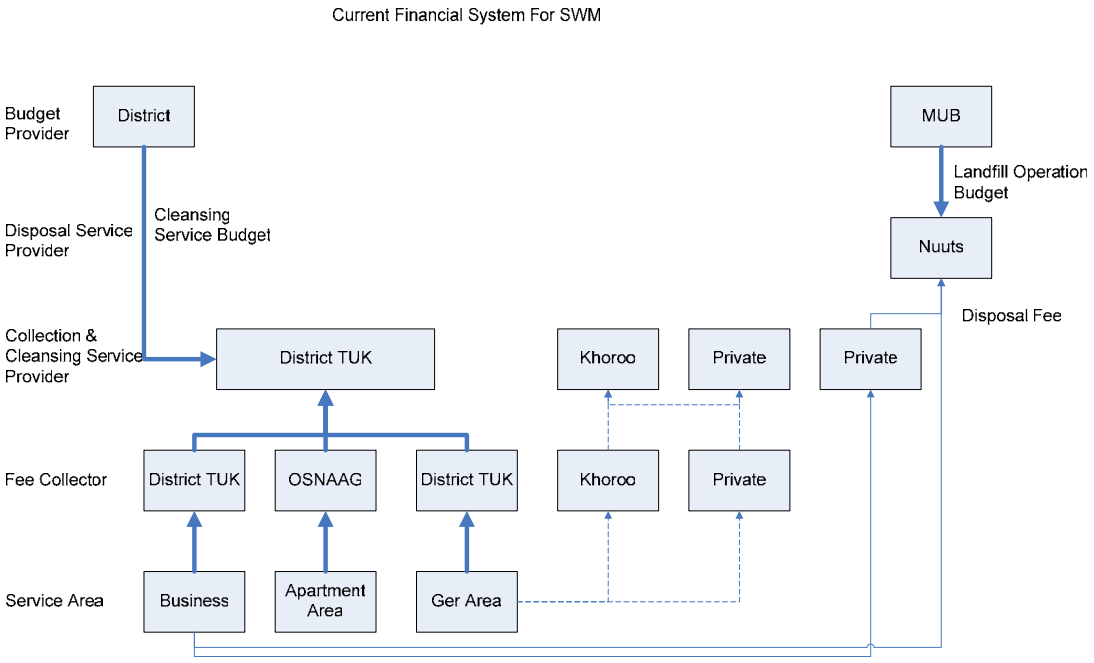


Figure 3-11: Current Financial System for SWM

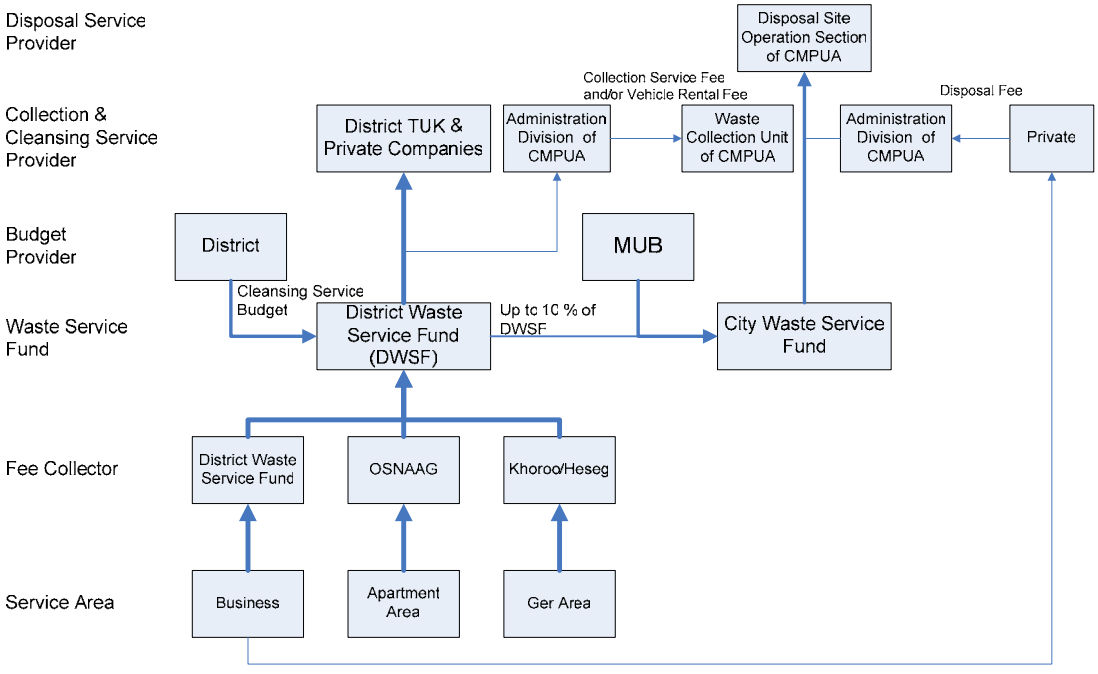


Figure 3-12: Future Financial System for SWM

c. Contract Management for Private Companies

Duureg Governments need to entrust waste service to private companies. Therefore, it is very important for them to conduct proper contract management for private companies. The following issues are important issues for the management.

c.1 Basic Consideration

The justifications for engaging the private sector to carry out SWM services, and the reasons for this are:

- Open and transparent competitive bidding and pricing of the contracted services lead to lower costs for the users.
- Service performance and costs of the private contractor's work is contested and monitored by the municipal cleansing department, encouraging the contractor to maintain high service standards and low costs.
- The contractor will be accountable to the client and customers for the standards and manner in which his service is provided. The customers' satisfaction will influence the service charges that can be levied on the customers, and he will be fined for not meeting the contract performance specifications, which encourages the contractor to meet the performance specifications.
- Finally, auditing of the contractor's account by an accredited independent auditing firm will ensure transparency and avoid corrupt practices.

However, most of the basic conditions for the justifications for engaging the private sector are not secured under the current SWM.

c.2 Contract Management for Private Companies

As described in the above, the supply of SWM services will be contracted out to the private sector through a transparent, open and fair bidding procedure. Services should be carried out under conditions of competition and contestability. The roles and responsibilities of the private sector will be to supply the services in accordance with the contractual conditions, applicable laws, regulations and obligations. Therefore, the tender document specifies:

- Service regulations (Municipal Regulation on SWM, etc.) and rules
- Contents of the services such as service area, target wastes, population to be served, cleansing service length and/or area, frequency of the services, etc.
- Payments and penalties against breach of contract
- Others necessary

Once the contract is made, the public sector (CSIA/CMPUD/District Govenments) shall establish a system to monitor and control the performance of the private companies in accordance with the conditions set in the contract.

d. Capacity Building

Capabilities of officers responsible for SWM in UBC have been developed significantly through the study. However, it is still not enough for the establishment of environmentally sound SWM in UBC, especially the following issues:

- Prepare, conduct and disseminate waste discharge rules
- Plan, prepare, conduct and disseminate separate collection
- Plan, prepare, operate a sorting yard and PDF production facility
- Plan, prepare, operate a sanitary landfill
- Plan, prepare, operate a hazardous waste treatment and disposal facility

The Study Team recommends MUB in cooperation with other organizations to ask for foreign technical cooperation for the Capacity Development of the above issues.