

d.10 Document 10: Workshop (1): Preparation of framework for SWM M/P for each city

<p>Doc 10</p> <p><b>Workshop (1): Preparation of Framework for SWM M/P</b>                  for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC</p> <p>June 29, 2011                  JICA Expert Team                  For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City</p> <p style="text-align: right;">1</p>	<p><b>Outline of the Lecture</b></p> <p>□ From this lecture participants are requested to work for the formulation of their M/P. At first how to set up the following frameworks for your M/P:</p> <p><b>I. Site Selection for Future SWM Facilities' Sites (your case a future final disposal site)</b></p> <p><b>II. Socio-economic Frame</b></p> <p><b>III. Waste Amount and Composition</b></p> <p><b>IV. Waste Stream without M/P</b></p> <p style="text-align: right;">2</p>
<p><b>I. Site Selection for a Future Final Disposal Site</b></p> <p><b>1. Items to be considered for site selection</b></p> <p><b>2. Comparison of candidate sites</b></p> <p><b>3. Preliminary selection</b></p> <p style="text-align: right;">3</p>	<p><b>I-1. Items to be considered for site selection (1)</b></p> <p><b>1. Environmental Aspects:</b>                  Avoid the following sites: Ground/surface water use in downstream, Special fauna/flora living, Valuable landscape, Landslide area, Strong wind, etc.</p> <p><b>2. Social Aspects:</b>                  Avoid the following sites: Area close to habited area, cultural property, public facilities, etc.</p> <p style="text-align: right;">4</p>

## I-2. Comparison of Candidate Sites

- 1. Nominate Candidate Sites:**
  - Current disposal site is one of the candidate if it has enough space.
  - Find out some candidate site. Avoid the following sites: Ground/surface water use downstream, Special fauna/ flora living, area close to habited area, cultural property, public facilities, etc.
- 2. Collection of Data for each Site:**
  - Since new field investigation costs a lot, you need to find out existing and available data on the site.
- 3. Prepare a Comparison Table of Candidate Sites:**
  - Fill the table (Doc. 16: Comparison table of candidate sites for future disposal site).

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## I-1. Items to be considered for site selection (2)

- 3. Technical Aspects:**

Site size (available area), Current and future land use, Topography (Mining pit, valley, flat land), Geology, Distance to city center, Access road condition, Availability of utility, etc.
- 4. Economic Aspects:**

Cost for Site development (needs of enclosing bank, leachate protection liner, etc.), Operation (availability of soil, etc.)  
Collection & transportation cost, etc.

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## I-3. Preliminary Selection

- You will evaluate each aspect of each site by using existing data.
- Then you will make score on each aspect of each site: Excellent 3, Good 2, Fair 1, Poor 0
- If you could not have enough data for evaluation of the site, you may do after workshop (3) finish.
- Site selection work should be done as open to public as possible.
- Therefore, you are requested to complete this work after you back to your city.

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## II. Socio-economic Frame

- 1. Population forecast**
- 2. Economic Growth Rate**
- 3. Financial System**

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## II-1. Population Forecast (1)

- **Collection of Available Population Data:**
  1. Collection of available population data
  2. Data for district level is preferable for collection system planning
  3. Population forecast data is highly preferable.
- **Population Forecast:**
  1. If you get population forecast, you can use it.
  2. If not, calculate population growth rate (P\_GR) and future population by using calculation sheet (Doc 17: Calculation sheet for population forecast and future waste generation)

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## II-1. Population Forecast (2)

- **A.1 P GR (Population Growth Rate) Calculation:**
  1. Put Population Data according to the instruction of Doc 17
  2. Then (P\_GR + 1) is calculated by the following formula:
    - $(P\_GR + 1) = Y^{(1/X)}$
    - $Y = B/D$
    - B: Population of Latest Data,
    - D: Population of Older Data
    - $X = A - C$
    - A: Year of Latest Population Data
    - C: Year of Older Population Data

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## II-1. Population Forecast (3)

- **A.2 Calculation of Future Population:**
  1. Put Population Data according to the instruction of Doc 17
  2. Then Population in 20xx (Pxx) is calculated by the following formula:
    - $Pxx = P11 * (P\_GR + 1)^{(20xx - 2011)}$
    - Pxx: Population in 20xx

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## II-2. Others

- **Economic Growth Rate :**
  1. You may apply average GDP growth rate (GDPav) of the nation from 2001 to 2010: GDPav = 6.23 % (Source: Global Finance)
- **Financial System :**
  1. Sustainable financial system is essential for establishing proper MSWM.
  2. Issues and problems of current financial system may be discussed in the workshop.

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### III-1. Household Waste Generation Amount in Apartment Area in 20xx: HWAAXx

**Formula 1:**  $HWAAXx = GR\_HWAAXx * Pxx\_A$

- GR\_HWAAXx: Household Waste Generation Rate in Apartment Area in 20xx

**Formula 2:**  $GR\_HWAAXx = GR\_HWA11 * (1 + GR\_GR)^{(20xx - 2011)}$

- GR\_HWA11: Household Waste Generation Rate in Apartment Area in 2011
- => Apply UBC Data =>  $GR\_HWA11 = (297 + 264)/2 = 280g/person/day$
- GR\_GR: Household Waste Generation Rate Growth per Year except Ash from Ger Area

**Formula 3:**  $GR\_GR = 0.55 * GDPav (= 0.0623) = 0.034265 => Say 0.035$

- Consequently, Formula 2 simplify as follow:  
**Formula 2:**  $GR\_HWAAXx = 280 * (1 + 0.035)^{(20xx - 2011)}$

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### III. Waste Amount and Composition

#### 1. Household Waste Generation Amount in Apartment Area in 20xx: HWAAXx

#### 2. Household Ger Area Generation Amount in 20xx: HWGAXx

#### 3. Other Waste Amount in 20xx: OWAXx

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### III-3. Other Waste Amount in 20xx: OWAXx

- Other MSW waste include wastes from business establishments and public area cleaning.
- But it exclude wastes from construction, factory and medical institution.

**Formula 6:**  $OWAXx = (HWAAXx + HWGAXx) * 0.157$  (Figure from MUB Study)

**!! Let calculate MSW generation in your city by using calculation sheet Doc 17**

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### III-2. Household Waste Generation Amount in Ger Area in 20xx: HWGAXx

**Formula 4:**  $HWGAXx = GR\_HWGAXx * Pxx\_G$

- GR\_HWGAXx: Household Waste Generation Rate in Ger Area in 20xx
- Ger Area Waste is divided into two categories of wastes, i.e. Ash and Other Waste
- Ash generation rate is not changed, The rate of UBC (788g/person/day) be applied to.
- Generation rate of Other waste will increase the same as HWAAX.

**Formula 5:**  $GR\_HWGAXx = GR\_HWGa11 + GR\_HWGo11 * (1 + GR\_GR)^{(20xx - 2011)}$

- GR\_HWGa11: Ash Generation Rate in Ger Area in 2011, i.e. 788g/person/day.
- GR\_HWGo11: Other Waste than Ash Generation Rate in Ger Area in 2011
- => Apply UBC Data =>  $GR\_HWGo11 = (188 + 234)/2 = 211g/person/day$
- Consequently, Formula 5 simplify as follow:  
**Formula 5:**  $GR\_HWGAXx = (788/2) + 211 * (1 + 0.035)^{(20xx - 2011)}$

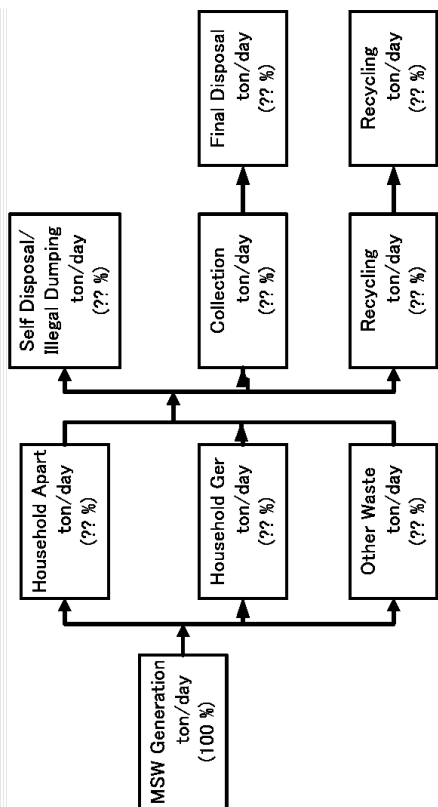
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## IV. Waste Stream without M/P

1. Waste Stream
2. Draw up waste stream in your city

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## IV-1. Waste Stream



## IV-2. Draw up Waste Stream in your City (1)

1. Fill the following figures by taking the results of calculation sheet of Doc 17-2
  - MSW Generation,
  - Household Waste Generation in Apartment Area
  - Household Waste Generation in Ger Area
  - Other MSW than Household Waste (excluding wastes from construction, factory and medical institution)

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## IV-2. Draw up Waste Stream in your City (2)

2. Calculation of Self Disposal & Illegal Dumping Waste:
  - SDID\_Axx**
  - Formula 1:  $SDID\_Axx = (Non-Ca * HWAAXx) + (Non-Cg * HWGAXx) + 0.157 * ((Non-Ca * HWAAXx) + (Non-Cg * HWGAXx))$
  - Non-Ca: Non-collection Population Rate of Apartment Area
  - Non-Cg: Non-collection Population Rate of Ger Area
  - Put the Non-Ca and Non-Cg
3. Calculation of Recycling Amount: REAxx
  - Formula 2:  $REAxx = RR * MSWxx$ .
  - REAxx: Recycling Amount in 20xx
  - RR: Recycling Rate; Apply the figure obtained in MUB study
4. Calculation of Collection and Final Disposal Amount:
  - CFDxx**
  - Formula 3:  $CFDxx = MSWxx - (SDIDYxx + REAxx)$

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**IV-2. Draw up Waste Stream in your City  
(3)**


- 5 Fill the remaining figures by taking the results of calculation sheet of Doc 17-2**
- 6 Complete the waste flow in 2011 and 2020 without M/P**

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**Thank you very much for  
your attention**

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d.11 Document 11: Workshop (2): Collection system planning for SWM M/P for each city

<p>Doc 11</p> <p><b>Collection System Planning for SWM M/P</b> for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC</p> <p>June 29, 2011 JICA Expert Team For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City</p> <p>1</p>	<p><b>Outline of the Lecture</b></p> <ol style="list-style-type: none"><li>1. Basic Considerations for Collection System Planning</li><li>2. Calculation of Required Number of Collection Vehicles</li></ol> <p>2</p>
<p><b>1. Basic Considerations for Collection System Planning</b></p> <ul style="list-style-type: none"><li>□ Compactor Truck for Apartment and Business Wastes<ul style="list-style-type: none"><li>■ 15m3 Compactor where road is wide.</li><li>■ 8m3 Compactor where road is narrow.</li></ul></li><li>□ Dump Truck for Ger Waste because of Ash</li></ul> <p>3</p>	<p>Photo for the Compactor Trucks</p> 

## Photo for Dump truck



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## 2. Methods of Calculation

1. Daily collection amount in each area (ton/day)
2. Allocation of type of trucks in each area
3. Adjusting daily collection amount by 6 days working in a week
4. Calculation of number of trips depends on the haulage distance to disposal site in each truck
5. Calculation of number of trucks

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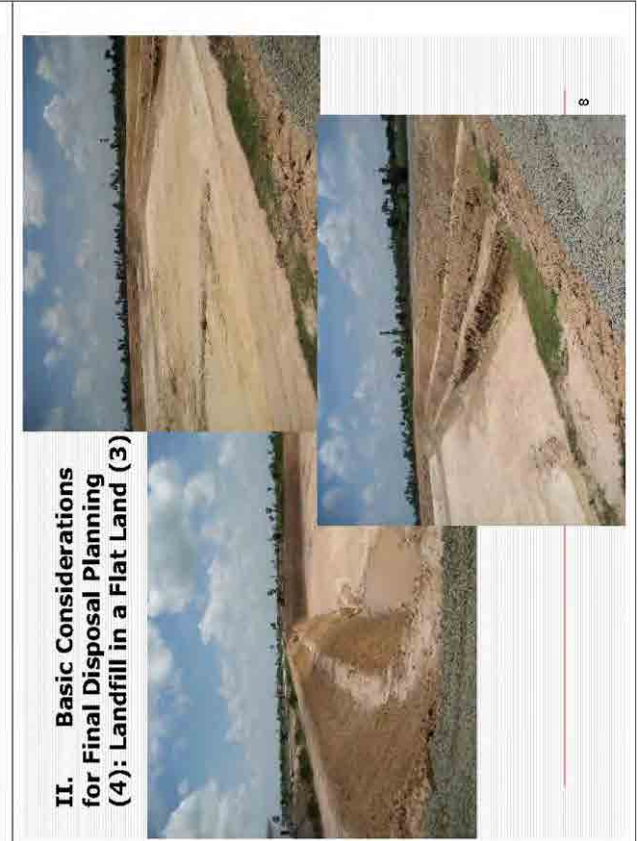
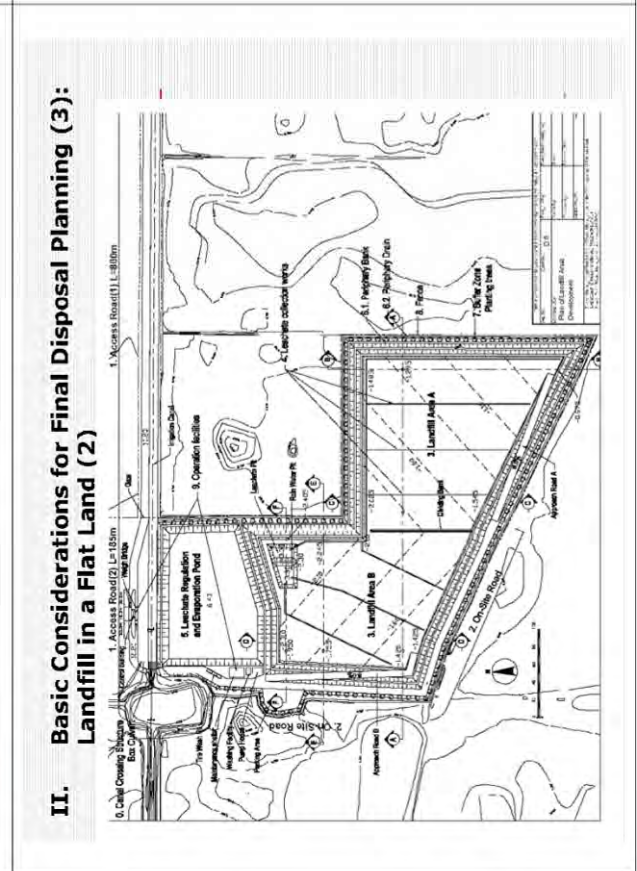
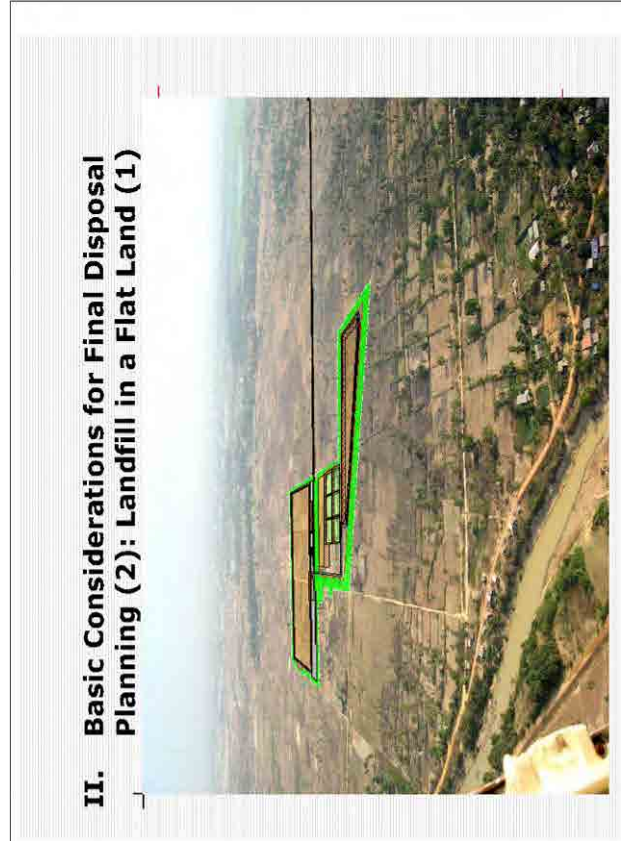
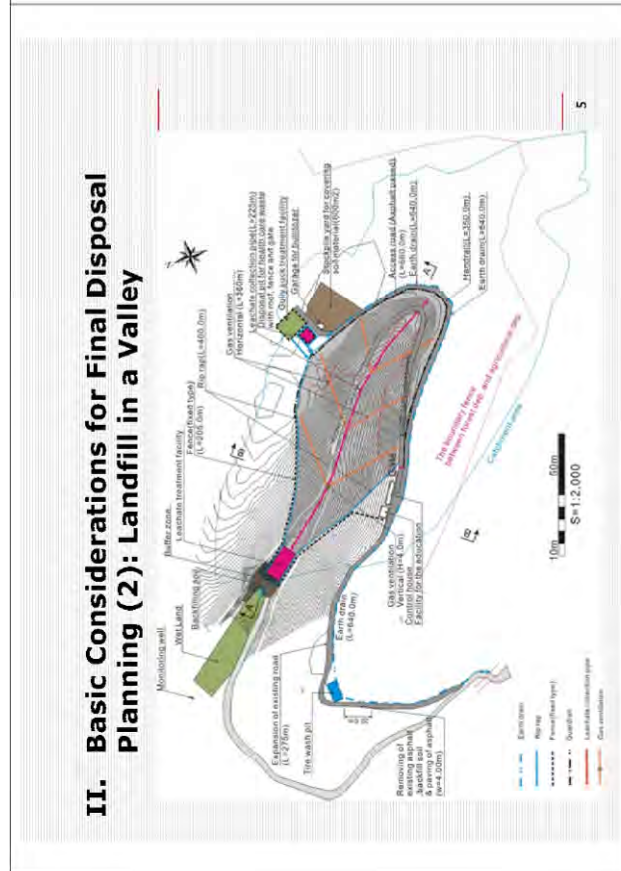
**Thank you very much for  
your attention**

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d.12 Document 12: Workshop (3): Final disposal system planning for SWM M/P for each city

<p>Doc 12</p> <p><b>Final Disposal System Planning for SWM M/P</b></p> <p>for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC</p> <p>June 29, 2011          JICA Expert Team</p> <p>For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City</p> <p>1</p>	<p><b>Outline of the Lecture</b></p> <ul style="list-style-type: none"> <li><b>I.</b> Advantages of Sanitary Landfill</li> <li><b>II.</b> Basic Considerations for Final Disposal Planning</li> <li><b>III.</b> Calculation of Required Landfill Volume</li> <li><b>IV.</b> Planning of a Final Disposal Site</li> <li><b>V.</b> Operational Planning</li> </ul> <p>2</p>
<p><b>I. Advantages of Sanitary Landfill</b></p> <p>The advantages of sanitary landfill are as follows.</p> <ul style="list-style-type: none"> <li>□ <b>Where land is available</b>, sanitary landfill is usually the most economical solid waste disposal method.</li> <li>□ Sanitary landfill is <b>not investment intensive</b> compared with other disposal methods, i.e., composting and incineration.</li> <li>□ In contrast to incineration and composting, sanitary landfill does <b>not require additional treatment or disposal operations for residue</b>, etc.</li> <li>□ A sanitary landfill can receive <b>all types of solid wastes</b>, eliminating the necessity for separate collections.</li> <li>□ A sanitary landfill is manageable; <b>increased quantities of solid wastes</b> can be disposed of with a minimum number of personnel and equipment.</li> <li>□ <b>Submerged land may be reclaimed</b> for use as parking lots, playgrounds, golf courses, botanical gardens, etc.</li> </ul> <p>3</p>	<p><b>II. Basic Considerations for Final Disposal Planning (1)</b></p> <ul style="list-style-type: none"> <li>□ <b>Location:</b> The following locations requires stricter environmental protection measure:             <ol style="list-style-type: none"> <li>1. Close to habited area: Buffer zone, etc.</li> <li>2. Water use in down stream: Leachate Protection of ground/surface water from leachate contamination</li> </ol> </li> <li>□ <b>Topography:</b> The enclosing facilities differ from flat land, valley and hole/ depression.</li> <li>□ <b>Size of Site:</b> Area should be enough for at least ten years landfill operation.</li> </ul> <p>4</p>



**II. Basic Considerations for Final Disposal Planning (5):  
 Landfill in a Flat Land (4)**



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**II. Basic Considerations for Final Disposal Planning (6): Landfill in a Hole of Soil/ Gravel Mining (1)**



Landowner (a construction company) excavated the land for use of soil/ gravel for construction. After the excavation the owner started to receive MSW for filling excavated land.

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**II. Basic Considerations for Final Disposal Planning (7): Landfill in a Hole of Soil/ Gravel Mining (2)**



**III. Calculation of Required Landfill Volume**

□ Landfill volume (YRLV<sub>xx</sub>) calculation  
 Formula:

$$YRLV_{xx} = ((YFD_{xx}/UWWL) * (1 + CSR))$$

YRLV<sub>xx</sub>: Yearly Required Lanfill Volume in 20xx (m<sup>3</sup>/year)

YFD<sub>xx</sub>: Yearly Final Disposal Amount in 20xx (ton/year)

UWWL: Unit Weight of MSW at the Landfill (ton/m<sup>3</sup>)

CSR: Cover Soil Rate to Landfilled Waste

□ Calculate ARLV by using Doc 18-1.

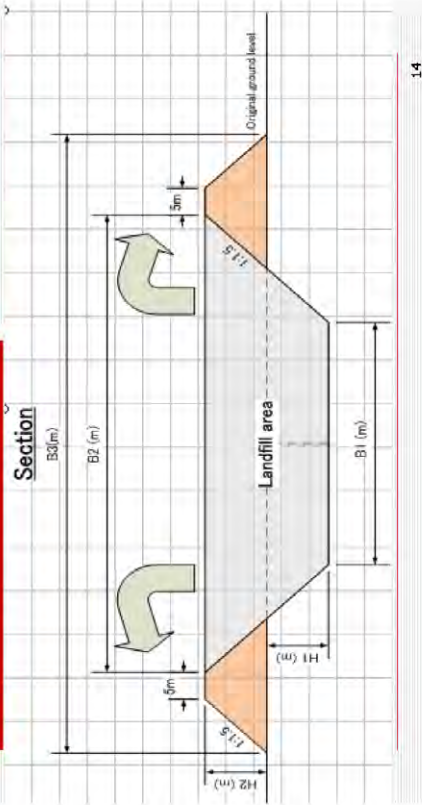
ARLV: Accumulated Required Landfill Volume<sub>2</sub> (m<sup>3</sup>)

### IV. Planning of a Final Disposal Site (1)

- Plan a disposal site of your city
- A sample design sheet for a Flat Area Landfill is provided in the Doc 18-2.

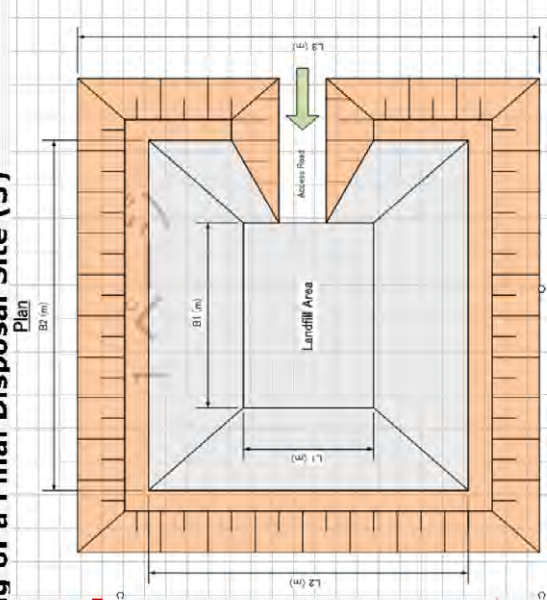
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### IV. Planning of a Final Disposal Site (2)



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### IV. Planning of a Final Disposal Site (3)



### IV. Planning of a Final Disposal Site (4)

**B. Calculation**  
 B1 Landfill volume calculation

To calculate landfill site volume to match with accumulated required landfill volume (ARLV)  
 Step 1: Input required landfill volume  
 Step 2: Input approximate land area (Width and length)

Formula	Value
1 Required landfill volume $V_{lr}$	30,000 m <sup>3</sup>
2 Planned bottom width 1 $B_1$	50.0 m
3 Planned bottom width 2 $L_1$	30.0 m
4 Calculated bottom area $A_1$	1,500 m <sup>2</sup>
$A_1 = B_1 \times L_1$	

Step 3: Input estimated height of landfill site

5 Proposed Height $H_1+H_2$	10.0 m
6 Calculated top width 1 $B_2$	80.0 m
7 Calculated top width 2 $L_2$	60.0 m
8 Calculated top area $A_2$	4,800 m <sup>2</sup>
9 Calculated landfill volume $V_{lc}$	31,500 m <sup>3</sup>

**OK**

$V_{lc}$  is bigger than  $V_{lr} \Rightarrow$  OK  
 If  $V_{lc}$  is smaller than  $V_{lr} \Rightarrow$  back to step 2

#### IV. Planning of a Final Disposal Site (5)

B2 Soil balance calculation

To calculate soil balance between excavation and embankment filling  
 Step 10: Input excavate height

10 Proposed excavate height H1= 5.90 m  
 11 Calculated embankment height H2= 4.10 m  
 12 Proposed excavate soil volume Vex= 13,951 m<sup>3</sup>  
 13 Required embankment soil volume Vev= 13,715 m<sup>3</sup>

$$V_{ex} = (A + B) \times (1 + 1.5 \times H1) \times L \times 2$$

$$V_{ev} = (5 + 5 + H2) \times (1.5 \times L2) / 2 \times H2$$

$$V_{ex} - V_{ev} = 0.236 \text{ m}^3 \Rightarrow \text{OK}$$

$$V_{ex} - V_{ev} > 0 \text{ m}^3 \Rightarrow \text{surplus}$$

$$V_{ex} - V_{ev} < 0 \text{ m}^3 \Rightarrow \text{Not enough}$$

OK  
 Surplus 237 m<sup>3</sup>

##### Dimension of landfill site

Required width	B=	102.3 m
Required length	L=	82.3 m
Required area	A=	8,419.3 m <sup>2</sup>
Receivable volume	Vic=	31,500 m <sup>3</sup>
Bottom width 1	B1=	50.0 m
Bottom width 2	L1=	30.0 m
Top width 1	B2=	80.0 m
Top width 2	L2=	60.0 m
Excavate depth	H1=	5.9 m
Embankment height	H2=	4.1 m

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#### V. Operational Planning (1)

- **Proper location** to avoid serious impacts to environment; i.e. distance from airport, not in the catchment area of drinking water source, etc.
- Waste should be disposed at **designated place**. => See UCDS in 2004 and MDDS in 2006
- Secure the **accessibility** for collection vehicle.
- Incoming vehicles should be controlled to **avoid hazardous waste disposal**.
- To avoid adverse impacts to the surrounding; i.e. not to cause fire, water contamination, odor, etc. => **Secure soil for cover, etc.**
- **Proper use of Landfill Equipment** may be instructed by CMPUA operator in NEDS.

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#### V. Operational Planning (1)



UCDS in 2004

MDDS in 2006



**Thank you very much for  
 your attention**

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d.13 Document 13: Workshop (4): Recycling system planning for SWM M/P for each city

<p>Doc 13</p> <p><b>Recycling System Planning for SWM M/P</b>                  for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC</p> <p>June 30, 2011                  JICA Expert Team                  For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City</p> <p>1</p>	<p><b>Outline of the Lecture</b></p> <ul style="list-style-type: none"> <li><b>I.</b> Basic Considerations for Recycling System Planning</li> <li><b>II.</b> Planning of a Recycling System</li> <li><b>III.</b> Completion of Future Waste Stream considering M/P which promotes 3Rs (Reduce, Reuse and Recycle)</li> </ul> <p>2</p>
<p><b>I. Basic Considerations for Recycling System Planning (1)</b></p> <ul style="list-style-type: none"> <li>□ <u>Recycling including reuse of waste is broadly divided into the following two in terms of place where it will be done;</u></li> <li><b>1.</b> <u>Recycling on-site</u> (generation sources)</li> <li><b>2.</b> <u>Recycling off-site</u> (after discharge of wastes)</li> <li>□ MSW includes many different materials and mixture of materials makes recycling difficult.</li> <li>□ <u>Recycling on-site, therefore, is more preferable than off-site.</u></li> </ul> <p>3</p>	<p><b>I. Basic Considerations for Recycling System Planning (2)</b></p> <ul style="list-style-type: none"> <li>□ <u>Recycling off-site is broadly divided into the following two in terms of activities;</u></li> <li><b>1.</b> <u>Valuables waste picking by waste pickers, etc.</u></li> <li><b>2.</b> <u>Recycling at intermediate treatment facility such as a sorting, composting, RDF production plants.</u></li> <li>□ In Mongolia almost all of recycling activities are item 1.</li> <li>□ The item 2 is only being conducted in MUB, a pilot scale sorting plant and a RDF plant will be constructed this year.</li> </ul> <p>4</p>

## I. Basic Considerations for Recycling System Planning (3)

- Problems of item 1 are;
- 1. Only a few final users of valuable waste are in MUB. In terms of country scale, i.e. population, final user is limited.
- 2. Most of final users of valuables are in China. => Recyclable items is very limited due to transportation costs.
- 3. Price of valuable waste fluctuates international market price. => Valuables are not constant.
- 4. Waste picking activities in a disposal site makes sanitary landfill operation difficult. <sup>5</sup>

## I. Basic Considerations for Recycling System Planning (4)

- Problems of item 2 are;
- 1. As far as we, JICA expert team, know, there is no facility operating without a tipping fee, i.e. not profitable.
- 2. For operation of a MSW recycling facility it requires a certain subsidies or tipping fee for the sake of landfill volume reduction. But if disposal system is open dumping, landfill volume reduction makes no contribution to landfill operation cost.
- 3. For proper operation of the intermediate facility, it requires separate collection for the waste to be treated. => It requires an additional cost for collection system. <sup>6</sup>

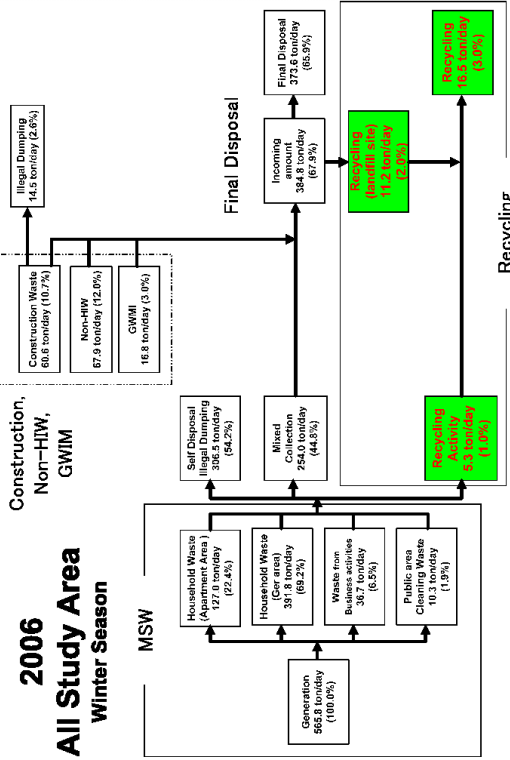
## II. Planning of a Recycling System(1)

- Recycling off-site is not recommended in your city due to some investment operational cost increase.
- Even if you prefer to treat and recycle plastics and paper wastes (which are problems for landfill operation, etc.) at least you have to know about the results of RDF plant operation in MUB.
- Recycling on-site is recommended but target wastes are limited.
- For valuable wastes recycling, you may inform people the price of them depends on the cleanliness and purity.
- On-site composting depends on the use of by-product such as gardening, farming, etc.

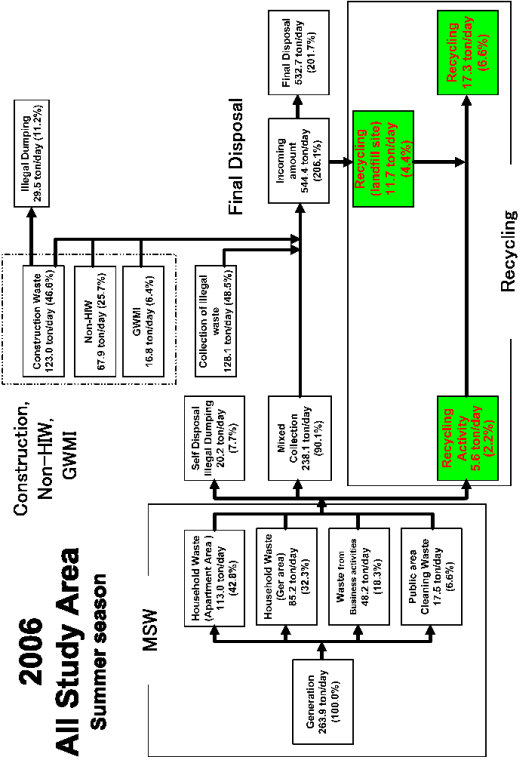
## II. Planning of a Recycling System(2) Sri Lanka



### III. Completion of Future Waste Stream (2): Waste Stream of MUB in winter in 2006



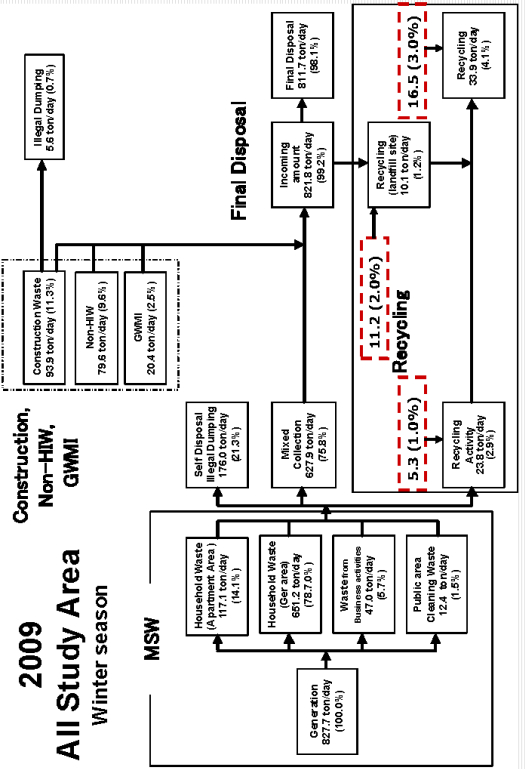
### III. Completion of Future Waste Stream (4): Waste Stream of MUB in summer in 2006



### III. Completion of Future Waste Stream considering M/P which promotes 3Rs (Reduce, Reuse and Recycle) (1)

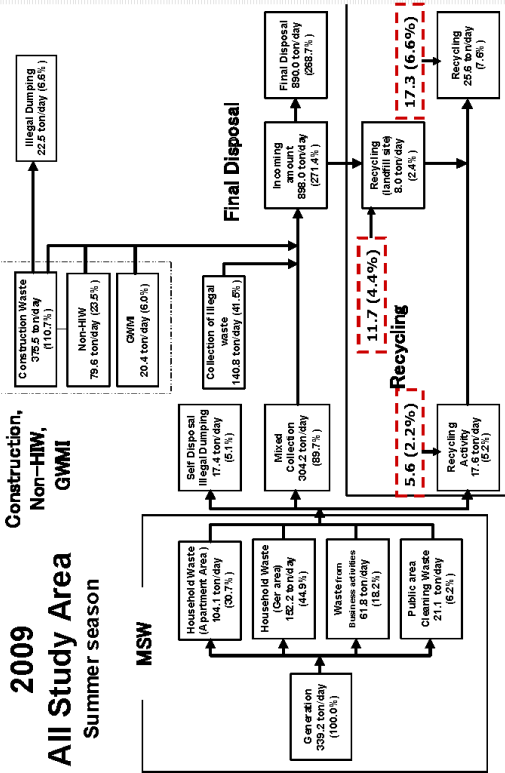
- For your reference waste streams of MUB in 2006 and 2009 is compared. The main findings are presented as follows:
  - Both in winter and summer total recycling amount/ rate in MUB increases, i.e. 2.1 and 1.5 times in amount 1.37 and 1.15 times in rate.
  - Both in winter and summer valuable wastes recycling on-site (generation) increases significantly, i.e. 4.5 and 3.1 times in amount. => Due to public education at However, valuable wastes recycling at disposal site decreases. => Active on-site recycling and Sanitary landfill operation?

### III. Completion of Future Waste Stream (3): Waste Stream of MUB in winter in 2009





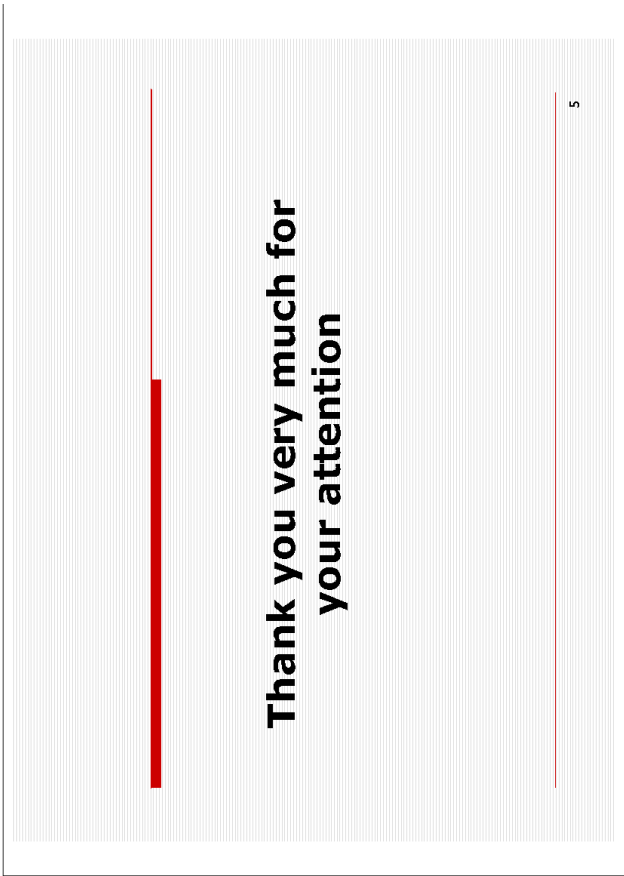
### III. Completion of Future Waste Stream (5): Waste Stream of MUB in summer in 2009



**Thank you very much for  
 your attention**

**d.14 Document 14: Workshop (5): Formulation of concept of SWM M/P for each city and an action plan (A/P) for formulation of the M/P**

<p>Doc 14</p> <p><b>Formulation of Concept of SWM M/P and Action Plan (A/P) for Formulation of the M/P for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC</b></p> <p>June 30, 2011              JICA Expert Team              For the Project for Strengthening the Capacity for SWM in Ulaanbaatar City</p> <p style="text-align: right;">1</p>	<p><b>Outline of the Lecture</b></p> <p><b>I. Contents of SMM M/P Concept</b></p> <p><b>II. Contents of A/P for Formulation of M/P</b></p> <p style="text-align: right;">2</p>
<p><b>I. Contents of SMM M/P Concept</b></p> <p>□ SMM M/P Concept shall include the following information:</p> <ol style="list-style-type: none"> <li>1. Current SWM in the City</li> <li>2. Current issues on SWM</li> <li>3. Framework for SWM M/P</li> <li>4. Concept of future technical system (collection, recycling and final disposal)</li> <li>5. Concept of institutional requirements (financial sources, organization, regulation, etc.) for improvement of technical system.</li> </ol> <p style="text-align: right;">3</p>	<p><b>II. Contents of A/P for Formulation of M/P</b></p> <p>□ The A/P shall include the following information based on the SMM M/P Concept :</p> <ol style="list-style-type: none"> <li>1. Who will complete the M/P?</li> <li>2. How to complete the M/P?</li> <li>3. Schedule for formulation and implementation of the M/P.</li> <li>4. Input and supports for completion of the M/P</li> </ol> <p style="text-align: right;">4</p>



d.15 Document 15: Presentation of the concept of SWM M/P and the A/P for formulation of the M/P by 10 cities

<p>Doc 15</p> <p><b>Presentation of the Concept of SWM M/P and the A/P for Formulation and Implementation of SWM Master Plan for Central Provincial Cities based on the Experience in UBC</b></p> <p>June 30, 2011          JICA Expert Team          For the Project for          Strengthening the Capacity          for SWM in Ulaanbaatar City</p> <p style="text-align: right;">1</p>	<p><b>Outline of the Lecture</b></p> <p>□ Describe the following aspects by using Power Point File:</p> <p><b>I. Concept of SMM M/P</b>  <b>II. A/P for Formulation of M/P</b></p> <p style="text-align: right;">2</p>
<p><b>I. Framework for SWM M/P</b></p> <p><b>1. Current issues on SWM</b>  <b>2. Framework for SWM M/P</b>  <b>3. Concept of future technical system (collection, recycling and final disposal)</b>  <b>4. Concept of institutional requirements (financial sources, organization, regulation, etc.) for improvement of technical system.</b></p> <p style="text-align: right;">3</p>	<p><b>I-1. Current issues on SWM</b></p> <p>□ <b>Technical system issues: for example</b></p> <ol style="list-style-type: none"> <li><b>1. Insufficient collection service =&gt; There are many non-collection area</b></li> <li><b>2. Open dumping makes serious adverse impacts on surrounding environment</b></li> <li><b>3. Others</b></li> </ol> <p>□ <b>Institutional system issues:</b></p> <ol style="list-style-type: none"> <li><b>1. Insufficient collection service fee collection in Ger area</b></li> <li><b>2. Lack of human resources</b></li> <li><b>3. Others</b></li> </ol> <p style="text-align: right;">4</p>

## I-2. Framework for SWM M/P

- Framework for SWM M/P : **for example**
- 1. Proposed future final disposal site: Name, location, area, etc.
- 2. Population forecast
- 3. Economic growth rate applied to the M/P
- 4. Future waste amount forecast
- 5. Future waste stream without M/P

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## I-3. Concept of future technical system

- Concept of proposed technical system : **for example**
- 1. Proposed collection system: Collection amount by Household waste from apartment area and Ger area and other generation sources, types and number of collection vehicles, etc.
- 2. Proposed recycling system: Improvement of on-site recycling by public education, etc.
- 3. Proposed final disposal system: Required landfill volume, sanitary landfill, etc.

6

## I-4. Concept of institutional requirements for improvement of technical system

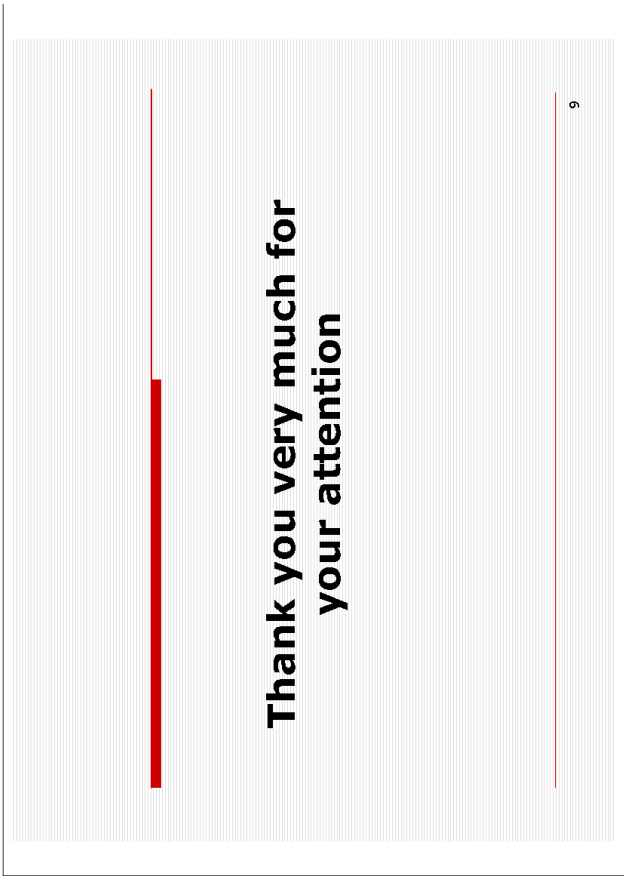
- Concept of institutional system improvement: **for example**
- 1. Strengthening organization
- 2. Improvement of fee and financial management system
- 3. Requirement of supporting regulations
- 4. Public education

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## II. A/P for Formulation of M/P

- A/P for Formulation of M/P :
- 1. Responsible organization and personnel for formulation of M/P
- 2. Method of M/P Formulation
- 3. Schedule for formulation and implementation of the M/P.
- 4. Required input and supports for completion of the M/P

8



**d.16 Document 16: Comparison table of candidate sites for future disposal site**

Aspects	Candidate A		Candidate B		Candidate C	
1. Environmental Aspects						
1.1 Ground water use in downstream						
1.2 Surface water use in downstream						
1.3 Existence special fauna & flora						
1.4 Valuable landscape						
1.5 Landslide area						
1.6 Strong wind						
1.7 Others (specify)						
2. Social Aspects						
2.1 Area close to habited area						
2.2 Area close to cultural property						
2.3 Area close to public facilities						
2.4 Other administration						
2.5 Others (specify)						
3. Technical Aspects						
3.1 Site size						
3.2 Current landuse						
3.3 Future landuse						
3.4 Topography						
3.5 Geology						
3.6 Distance to city center						
3.7 Access road condition						
3.8 Availability of utility						
3.9 Others (specify)						
4. Economic Aspects						
4.1 Site development cost						
4.2 Operation cost						
4.3 Collection & transportation cost						
4.4 Others (specify)						

**d.17 Document 17: Calculation sheet for population forecast and future waste generation**

Doc 17-1

Calculation Sheet for Population Forecast and Future Waste Generation (1)

**A. Population Forecast**

**A.1 P\_GR (Population Growth Rate) Calculation**

1. Year of Latest Population Data: A                    2008
2. Population of Latest Data: B                        15000
3. Year of Older Population Data: C                    2003
4. Population of Older Data: D                         12000
5. P\_GR Calculation Formula

(Formula)  $P\_GR + 1 = Y^{(1/X)}$

$Y = B/D$

$X = A - C$

Year	Population
2008	15000
2003	12000
P_GR + 1	1.046

6. P\_GR (Population Growth Rate)                    0.046

**A.2 Calculation of Future Population**

1. Population in 2011: P11                                17149
2. Population in 20xx: Pxx  
 (Formula)  $P_{xx} = P11 * (P\_GR + 1)^{(20xx - 2011)}$
3. Apart Area Population Rate: APR                    0.60
4. Ger Area Population Rate: GPR                    0.40
5. Apartment Area Population in 20xx: Pxx\_A  
 (Formula)  $P_{xx\_A} = P_{xx} * APR$
6. Ger Area Population in 20xx: Pxx\_G  
 (Formula)  $P_{xx\_G} = P_{xx} * GPR$
7. Calculation of Future Population

Year	Pxx	Pxx_A	Pxx_G
2011	17149	10289	6860
2012	17932	10759	7173
2013	18750	11250	7500
2014	19606	11763	7842
2015	20501	12300	8200
2016	21436	12862	8574
2017	22415	13449	8966
2018	23438	14063	9375
2019	24507	14704	9803
2020	25626	15375	10250



Doc 17-2

Calculation Sheet for Population Forecast and Future Waste Generation (2)

### B. Waste Amount Calculation

1. Household Waste Generation Amount in Apartment Area in 20xx: HWA<sub>Axx</sub>

(Formula 1)  $HWA_{Axx} = GR_{HWAxx} * P_{xx\_A}$

GR<sub>HWAxx</sub>: Household Waste Generation Rate in Apartment Area in 20xx

(Formula 2)  $GR_{HWAxx} = GR_{HWA11} * (1 + GR\_GR)^{(20xx - 2011)}$

GR<sub>HWA11</sub>: Household Waste Generation Rate in Apartment Area in 2011

=> Apply UBC Data =>  $GR_{HWA11} = (297 + 264)/2 = 280g/person/day$

GR<sub>GR</sub>: Household Waste Generation Rate Growth per Year

(Formula 3)  $GR\_GR_{xx} = 0.55 * GDP_{av} (= 0.0623) = 0.034265$  => Say **0.035**

Consequently, Formula 2 simplify as follow:

(Formula 2)  $GR_{HWAxx} = 280 * (1 + 0.035)^{(20xx - 2011)}$

2. Household Waste Generation Amount in Ger Area in 20xx: HWG<sub>Axx</sub>

(Formula 4)  $HWG_{Axx} = GR_{HWGxx} * P_{xx\_G}$

GR<sub>HWGxx</sub>: Household Waste Generation Rate in Ger Area in 20xx

Ger Area Waste is divided into two categories of wastes, i.e. Ash and Other Waste  
Ash generation rate is not changed, The rate of UBC (788g/person/day) be applied to.

Generation rate of Other waste will increase the same as HWA.

(Formula 5)  $GR_{HWGxx} = GR_{HWGa11} + GR_{HWGo11} * (1 + GR\_GR)^{(20xx - 2011)}$

GR<sub>HWGa11</sub>: Ash Generation Rate in Ger Area in 2011, i.e. **788g/person/day**.

GR<sub>HWGoxx</sub>: Other Waste than Ash Generation Rate in Ger Area in 2011

=> Apply UBC Data =>  $GR_{HWGo11} = (188 + 234)/2 = 211g/person/day$

Consequently, Formula 5 simplify as follow:

(Formula 5)  $GR_{HWGxx} = (788/2) + 211 * (1 + 0.035)^{(20xx - 2011)}$

3. Other Waste Amount in 20xx: OWA<sub>Axx</sub>

Other MSW waste include wastes from business establishments and public area cleaning.  
But it exclude wastes from construction, factory and medical institution.

(Formula 6)  $OWA_{Axx} = (HWA_{Axx} + HWG_{Axx}) * 0.157$  (Figure from MUB Study)

Year	P <sub>xx</sub>	P <sub>xx\_A</sub>	P <sub>xx\_G</sub>	HWA <sub>Axx</sub> (kg/day)	HWG <sub>Axx</sub> (kg/day)	OWA <sub>Axx</sub> (kg/day)	MSW <sub>Axx</sub> (ton/day)
2011	17149	10289	6860	2881	4150	1104	8.1
2012	17932	10759	7173	3118	4392	1179	8.7
2013	18750	11250	7500	3374	4650	1260	9.3
2014	19606	11763	7842	3652	4924	1346	9.9
2015	20501	12300	8200	3952	5216	1439	10.6
2016	21436	12862	8574	4277	5527	1539	11.3
2017	22415	13449	8966	4629	5858	1646	12.1
2018	23438	14063	9375	5010	6210	1762	13.0
2019	24507	14704	9803	5422	6586	1885	13.9
2020	25626	15375	10250	5867	6986	2018	14.9

Doc 17-3

Calculation Sheet for Population Forecast and Future Waste Generation (2)

**C. Waste Stream**

1. Calculation of Self Disposal & Illegal Dumping Waste: SDID\_Axx  
(Formula 1)  $SDID\_Axx = (Non-Ca * HWAxx) + (Non-Cg * HWGAxx) + 0.157 * ((Non-Ca * HWAxx) + (Non-Cg * HWGAxx))$   
Non-Ca: Non-collection Population Rate of Apartment Area  
Non-Cg: Non-collection Population Rate of Ger Area  
Put the Non-Ca and Non-Cg  
Non-Ca: 0.05  
Non-Cg: 0.5
2. Calculation of Recycling Amount: REAxx  
(Formula 2)  $REAxx = RR * MSWxx$   
REAxx: Recycling Amount in 20xx  
RR: Recycling Rate; Apply the figure obtained in MUB study  
RR: 0.03
3. Calculation of Collection and Final Disposal Amount: CFDxx  
(Formula 3)  $CFDxx = MSWxx - (SDID\_Axx + REAxx)$

Year	Pxx	Pxx_A	Pxx_G	HWAxx (kg/day)	HWGAxx (kg/day)	OWAxx (kg/day)	MSWxx (ton/day)	SDID_Axx (ton/day)	REAxx (ton/day)	CFDAxx (ton/day)
2011	17149	10289	6860	2881	4150	1104	8.1	2.6	0.2	5.3
2012	17932	10759	7173	3118	4392	1179	8.7	2.7	0.3	5.7
2013	18750	11250	7500	3374	4650	1260	9.3	2.9	0.3	6.1
2014	19606	11763	7842	3652	4924	1346	9.9	3.1	0.3	6.6
2015	20501	12300	8200	3952	5216	1439	10.6	3.2	0.3	7.0
2016	21436	12862	8574	4277	5527	1539	11.3	3.4	0.3	7.6
2017	22415	13449	8966	4629	5858	1646	12.1	3.7	0.4	8.1
2018	23438	14063	9375	5010	6210	1762	13.0	3.9	0.4	8.7
2019	24507	14704	9803	5422	6586	1885	13.9	4.1	0.4	9.4
2020	25626	15375	10250	5867	6986	2018	14.9	4.4	0.4	10.0

**d.18 Document 18-1: Calculation Sheet for Required Landfill Volume**

Doc 18-1

**Calculation Sheet for Required Landfill Volume**

Formula

$$YRLV_{xx} = ((YFD_{xx}/UWWL) * (1 + CSR))$$

YRLV<sub>xx</sub>: Yearly Required Lanfill Volume in 20xx (m3/year)

CFD<sub>xx</sub>: Collection and Final Disposal Amount in 20xx (ton/day)

YFD<sub>xx</sub>: Yearly Final Disposal Amount in 20xx (ton/year)

UWWL: Unit Weight of MSW at the Landfill (ton/m3)

CSR: Cover Soil Rate to Landfilled Waste

ARLV: Accumulated Required Landfill Volume (m3)

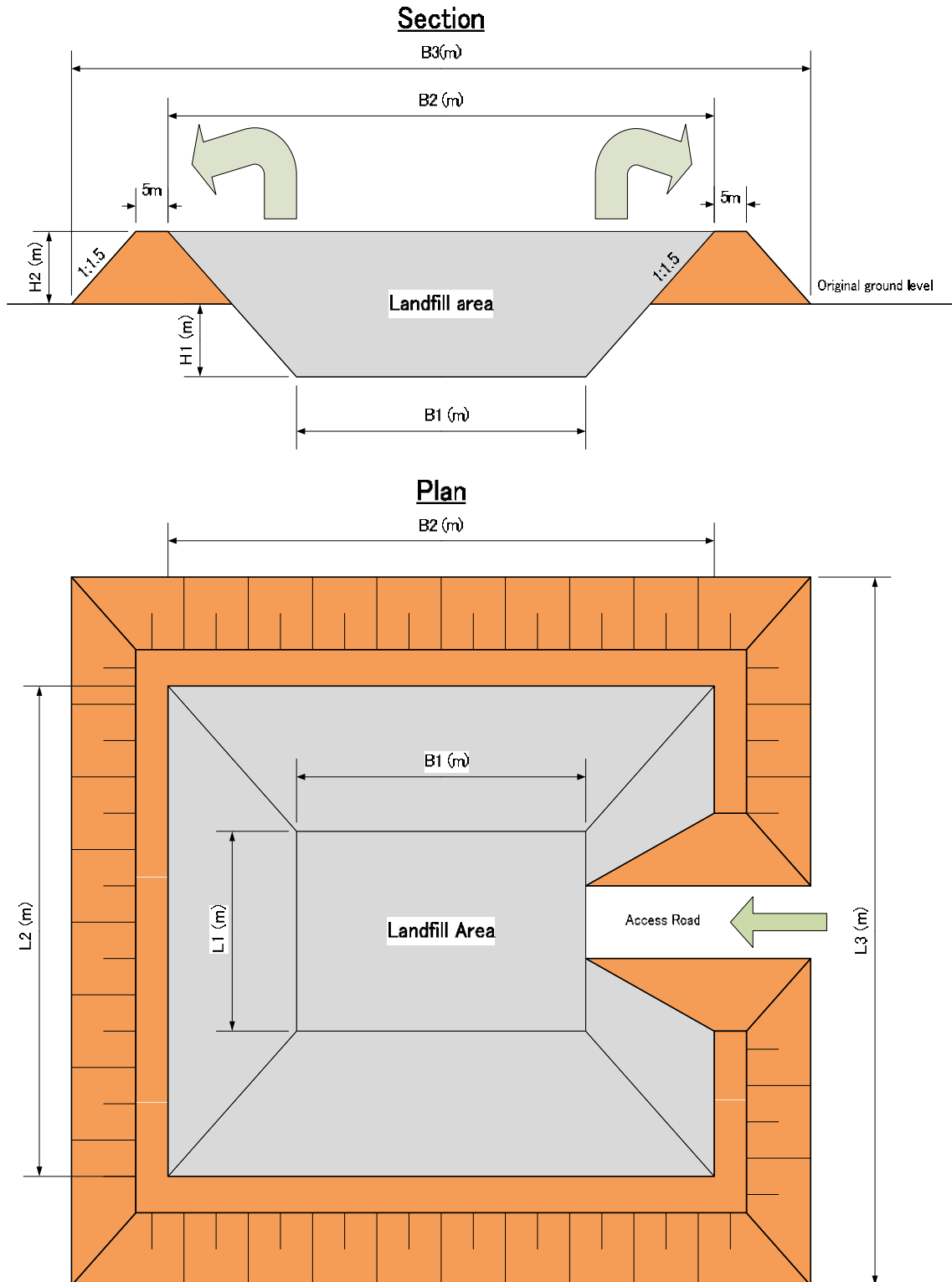
1.1
0.2

Year	CFDA <sub>xx</sub> (ton/day)	YFD <sub>xx</sub> (ton/year)	YRLV <sub>xx</sub> (m3/year)	ARLV (m3)
2011	5.3	1943.1	2119.7	2119.7
2012	5.7	2083.2	2272.6	4392.3
2013	6.1	2234.0	2437.1	6829.4
2014	6.6	2396.2	2614.1	9443.5
2015	7.0	2570.9	2804.6	12248.0
2016	7.6	2758.8	3009.6	15257.7
2017	8.1	2961.2	3230.3	18488.0
2018	8.7	3179.0	3468.0	21956.0
2019	9.4	3413.6	3723.9	25680.0
2020	10.0	3666.3	3999.6	29679.5

d.19 Document 18-2: Calculation Sheet for Disposal Site Volume

Doc 18-2 Calculation Sheet for Disposal Site Volume

A. Plan drawing



B. Calculation

B1 Landfill volume calculation

To calculate landfill site volume to match with accumulated required landfill volume (ARLV)

Step 1: Accumulated required landfill volume (ARLV)

Step 2: Input approximate land area (Width and length)

1	Required landfill volume	Vlr=	30,000	m <sup>3</sup>
2	Planned bottom length	B1=	50.0	m
3	Planned bottom width	L1=	30.0	m
4	Calculated bottom area	A1=	1,500	m <sup>2</sup>

**Formula**

$A1=B1 \times L1$

Step 5: Input estimated height of landfill site

5	Proposed Height	H1+H2=	10.0	m
6	Calculated top length	B2=	80.0	m
7	Calculated top width	L2=	60.0	m
8	Calculated top area	A2=	4,800	m <sup>2</sup>
9	Calculated landfill volume	Vlc=	31,500	m <sup>3</sup>

$B2=B1+5 \times 2+1.5 \times (H1+H2) \times 2$

$L2=L1+5 \times 2+1.5 \times (H1+H2) \times 2$

$A2=B2 \times L2$

$Vlc=(A1+A2)/2 \times (H1+H2)$

OK

Vlr is bigger than Vlc => OK  
If Vlr is smaller than Vlc => back to step 2

B2 Soil balance calculation

To calculate soil balance between excavation and embankment filling

Step 10: Input excavate height

10	Proposed excavate height	H1=	5.90	m
11	Calculated embankment height	H2=	4.10	m
12	Proposed excavate soil volume	Ves=	13,951	m <sup>3</sup>
13	Required embankment soil volume	Vev=	13,715	m <sup>3</sup>

$Ves=(A1+(B1+1.5 \times H1 \times 2) \times (L1+1.5 \times H1 \times 2))/2 \times H1$

$Vev=(5+5+H2 \times 1.5 \times 2)/2 \times H2 \times (B2+5+L2+5) \times 2$

OK

Surplus 237 m<sup>3</sup>

Ves-Vev=0~500 m<sup>3</sup> => OK  
Ves-Vev>501 m<sup>3</sup> => surplus  
Ves-Vev<0 m<sup>3</sup> => Not enough

**Dimension of landfill site**

Required width	B=	102.3 m
Required length	L=	82.3 m
Required area	A=	8,419.3 m <sup>2</sup>
Receivable volume	Vlc=	31,500 m <sup>3</sup>
Bottom length	B1=	50.0 m
Bottom width	L1=	30.0 m
Top length	B2=	80.0 m
Top width	L2=	60.0 m
Excavate depth	H1=	5.9 m
Embankment height	H2=	4.1 m

**d.20 Document 19: Calculation Sheet for Collection System Planning**

**Productivity**

<b>Compactor truck</b>									
Description		Unit	Compactor 15 m3			Compactor 8 m3			
A	Capacity in weight	t	10.00	10.00	10.00	6.00	6.00	6.00	6.00
B	Capacity in volume	m3	15.00	15.00	15.00	8.00	8.00	8.00	8.00
C	Half way distance	km	0.50	18.80	15.00	7.40	16.60	35.00	15.00
D=C*2	One trip distance	km	1.00	37.60	30.00	14.80	33.20	70.00	30.00
E	Velocity of vehicle	km/h	35.00	35.00	35.00	35.00	35.00	35.00	35.00
F	Specific gravity of waste	t/m3	0.20	0.20	0.20	0.20	0.20	0.20	0.20
G	Density of waste when hauled	t/m3	0.45	0.45	0.45	0.45	0.45	0.45	0.45
H	t1:Working hour	h	7.50	7.50	7.50	7.50	7.50	7.50	7.50
I	t2:Daily service time	min	30.00	30.00	30.00	30.00	30.00	30.00	30.00
J	t3:Loading time per trip	min	120.00	120.00	120.00	64.00	64.00	64.00	64.00
K	t4:Unloading time	min	5.00	5.00	5.00	5.00	5.00	5.00	5.00
L	E: Efficiency of loading capacity	-	0.90	0.90	0.90	0.90	0.90	0.90	0.90
M	f: Efficiency of working time	-	0.90	0.90	0.90	0.90	0.90	0.90	0.90
N	Nos of trips per day	times	2.98	2.00	2.14	4.01	3.00	2.00	3.14
O	Adjusted Nos of trips per day	times	3.00	2.00	2.00	4.00	3.00	2.00	3.00
P=BxOxL	Waste carried per trip	t/trip	6.08	6.08	6.08	3.24	3.24	3.24	3.24
Q=PxO	Waste carried per day	t/d	18.23	12.15	12.15	12.96	9.72	6.48	9.72

<b>Dump Truck</b>						
Description		Unit	Dump truck			Skipper
A	Capacity in weight	t	6.00	6.00	6.00	6.00
B	Capacity in volume	m3	10.00	10.00	10.00	5.50
C	Half way distance	km	0.40	18.50	74.00	10.00
D=C*2	One trip distance	km	0.80	37.00	148.00	20.00
E	Velocity of vehicle	km/h	35.00	35.00	35.00	35.00
F	Specific gravity of waste	t/m3	0.30	0.30	0.30	0.30
G	Density of waste when hauled	t/m3	0.30	0.30	0.30	0.30
H	t1:Working hour	h	7.50	7.50	7.50	7.50
I	t2:Daily service time	min	30.00	30.00	30.00	30.00
J	t3:Loading time per trip	min	120.00	120.00	120.00	5.00
K	t4:Unloading time	min	5.00	5.00	5.00	5.00
L	E: Efficiency of loading capacity	-	0.90	0.90	0.90	0.90
M	f: Efficiency of working time	-	0.90	0.90	0.90	0.90
N	Nos of trips per day	times	2.99	2.01	1.00	2.37
O	Adjusted Nos of trips per day	times	3.00	2.00	1.00	2.00
P=BxOxL	Waste carried per trip	t/trip	2.70	2.70	2.70	1.49
Q=PxO	Waste carried per day	t/d	8.10	5.40	2.70	8.91

$$N = (60 \times H - I) \times M / (D / E \times 60 + J + K)$$

**Equipment cost**

Exchange rate  
1\$  Tg

	Basic price	Basic price	Life year	Salvaged value	Depreciation	Depreciation	Maintenance cost rate	Maintenance cost	Maintenance cost
	USD	Tg	years	Tg	Tg/year	Tg/day	%	Tg/year	Tg/day
Compactor truck 15m3, 10tc	95,000	123,500,000	8	12,350,000	13,893,750	38,065	6%	7,410,000	23,685
Compactor truck 8m3, 6ton	80,000	104,000,000	8	10,400,000	11,700,000	32,055	6%	6,240,000	19,945
Dump truck 10m3, 6ton	65,000	84,500,000	8	8,450,000	9,506,250	26,045	6%	5,070,000	16,205
Skipper truck 5m3		0	8	0	0		6%	0	0
Wheel loader	130,000	169,000,000	12	16,900,000	12,675,000	34,726	6%	10,140,000	32,411
Wheel backhoe	100,000	130,000,000	12	13,000,000	9,750,000	26,712	6%	7,800,000	24,932

## Salary & Fuel cost

Salary	Nos of persons	Salary	Salary	Salary	Salary
	persons	Tg/person/month	Tg/month	Tg/day	Tg/year
Driver	1	200,000	200,000	6,667	2,400,000
Collection worker	2	150,000	300,000	10,000	3,600,000
Total				16,667	6,000,000

Note: The above condition is applied to all types of collection equipment used.

Fuel	Unit	Rate
Diesel	Tg/l	1400
Gasoline	Tg/l	1300

## O&M Cost

		Items	Unit	Compactor 15m3	Compactor 8m3	Dump truck
A	T&M Survey	Distance to Disposal Site	km	15.0	15.0	10.0
B	Catalogue	Diesel consumption per km for travelling	km/l	2	5	3
C	T&M Survey	Collection and discharge time	minutes	125	69	125
D	T&M Survey	Effeciency for working hours		0.9	0.9	0.9
E	Catalogue	Diesel consumption per minutes for collection	min/l	15	30	30
F	A*2/B	Diesel consumption for traveling	liter/trip	15	6	6.7
G	C*D/E	Diesel consumption for collection	liter/trip	7.5	2.07	3.75
H	F+G	Total consumption of diesel	liter/trip	22.5	8.07	10.4
I	Fuel Tab	Unit rate of diesel	Tg/liter	1400	1400	1300
J	H*I	Fuel cost per trip	Tg/trip	31,500	11,298	13,542
K	Productivity tab	Trip nos per day	Trip/day	2	3	2
L	J*K	Fuel cost per day	Tg/day	63,000	33,894	27,083
		Depreciation cost	Tg/day	38,065	32,055	26,045
		Maintenance cost	Tg/day	23,685	19,945	16,205
		Salary	Tg/day	16,667	16,667	16,667
		O&M cost per day	Tg/day	141,417	102,561	86,000
		Unit cost per ton of waste	Tg/ton	11,630	10,552	15,926

### Collection Truck

1. Waste Collection Amount per day

Type of area	Waste source	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Apartment	t/day										
	Business	t/day										
Ger	Ger	t/day										
	Total	t/day										

2. Waste Collection Amount per day by type of collection trucks

Type of Waste	Type of Truck	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Compactor	t/day										
Business	Compactor	t/day										
	CT Total	t/day										
Ger	Dump truck	t/day										
	DT Total	t/day										

3. Waste Collection Amount per day by type of trucks in case 1 day off in a week

Type of Truck	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	t/day										
Dump truck	t/day										
Total	t/day										

4. Selection of Capacity of Compactor

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	%	80%									
Compactor	8m3	%	20%									
Dump truck	10m3	%	100%									

5. Waste Collection Amount by Type and Capacity of Trucks

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	t/day										
Compactor	8m3	t/day										
Dump truck	10m3	t/day										

6. Average Trip per day by type of trucks

			Refer to "Productivity" Tab								
			Average trip no. per day			Average haulage amount per trip			Waste amount carried per day		
			trips/d	trips/d	trips/d	t/trip	t/trip	t/trip	t/v/d	t/v/d	t/v/d
	unit	Haulage distance	Compactor r 15m3	Compactor r 8m3	Dump truck	Compactor r 15m3	Compactor r 8m3	Dump truck	Compactor r 15m3	Compactor r 8m3	Dump truck
Apartment Area	km					6.08	3.24	2.70	0.0	0.0	0.0
Ger Area	km					6.08	3.24	2.70	0.0	0.0	0.0

7. Number of Trucks Required

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Nos										
Compactor	8m3	Nos										
Dump truck	10m3	Nos										

8 Roundup number of trucks required

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Nos										
Compactor	8m3	Nos										
Dump truck	10m3	Nos										
Total		Nos										

9. Number of trucks to be Procured in each year

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Nos										
Compactor	8m3	Nos										
Dump truck	10m3	Nos										
Total		Nos										

10. Investment Amount in each year refer to "Equipment Cost" tab

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Tg										
Compactor	8m3	Tg										
Dump truck	10m3	Tg										
Total		Tg										

11. Daily Operation and Maintenance Costs in each year refer to O&M tab

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Tg										
Compactor	8m3	Tg										
Dump truck	10m3	Tg										
Total		Tg										

12. Annual Operation and Maintenance Costs in each year.

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Tg										
Compactor	8m3	Tg										
Dump truck	10m3	Tg										
Total		Tg										



### Sample Calculation

#### 1. Waste Collection Amount per day

Type of area	Waste source	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Apartment	t/day	12.0	12.6	13.2	13.9	14.6	15.3	16.1	16.9	17.7	18.6
	Business	t/day	6.0	6.3	6.6	6.9	7.3	7.7	8.0	8.4	8.9	9.3
Ger	Ger	t/day	30.0	31.5	33.1	34.7	36.5	38.3	40.2	42.2	44.3	46.5
	Total	t/day	48	50.4	52.9	55.6	58.3	61.3	64.3	67.5	70.9	74.5

#### 2. Waste Collection Amount per day by type of collection trucks

Type of Waste	Type of Truck	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Compactor	t/day	12.0	12.6	13.2	13.9	14.6	15.3	16.1	16.9	17.7	18.6
	Business	t/day	6.0	6.3	6.6	6.9	7.3	7.7	8.0	8.4	8.9	9.3
Ger	CT Total	t/day	18.0	18.9	19.8	20.8	21.9	23.0	24.1	25.3	26.6	27.9
	Dump truck	t/day	30.0	31.5	33.1	34.7	36.5	38.3	40.2	42.2	44.3	46.5
	DT Total	t/day	30.0	31.5	33.1	34.7	36.5	38.3	40.2	42.2	44.3	46.5

#### 3. Waste Collection Amount per day by type of trucks in case 1 day off in a week

Type of Truck	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	t/day	21.0	22.1	23.2	24.3	25.5	26.8	28.1	29.5	31.0	32.6
Dump truck	t/day	35.0	36.8	38.6	40.5	42.5	44.7	46.9	49.2	51.7	54.3
Total	t/day	56.0	58.8	61.7	64.8	68.1	71.5	75.0	78.8	82.7	86.9

#### 4. Selection of Capacity of Compactor

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	%	80.0%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Compactor	8m3	%	20.0%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Dump truck	10m3	%	100.0%	100%	100%	100%	100%	100%	100%	100%	100%	100%

#### 5. Waste Collection Amount by Type and Capacity of Trucks

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	t/day	16.8	17.6	18.5	19.4	20.4	21.4	22.5	23.6	24.8	26.1
Compactor	8m3	t/day	4.2	4.4	4.6	4.9	5.1	5.4	5.6	5.9	6.2	6.5
Dump truck	10m3	t/day	56.0	58.8	61.7	64.8	68.1	71.5	75.0	78.8	82.7	86.9

#### 6. Average Trip per day by type of trucks

	unit	Haulage distance	Refer to "Productivity" Tab								
			Average trip no. per day			Average haulage amount per trip			Waste amount carried per day		
			trips/d	trips/d	trips/d	t/trip	t/trip	t/trip	t/v/d	t/v/d	t/v/d
Apartment Area	km	15.0	2	3		6.08	3.24	2.70	12.2	9.7	0.0
Ger Area	km	10.0			2	6.08	3.24	2.70	0.0	0.0	5.4

#### 7. Number of Trucks Required

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Nos	1.4	1.5	1.5	1.6	1.7	1.8	1.9	1.9	2.0	2.1
Compactor	8m3	Nos	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7
Dump truck	10m3	Nos	10.4	10.9	11.4	12.0	12.6	13.2	13.9	14.6	15.3	16.1

#### 8. Roundup number of trucks required

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Nos	2	2	2	2	2	2	2	2	3	3
Compactor	8m3	Nos	1	1	1	1	1	1	1	1	1	1
Dump truck	10m3	Nos	11	11	12	13	13	14	14	15	16	17
Total		Nos	14	14	15	16	16	17	17	18	20	21

#### 9. Number of trucks to be Procured in each year

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Nos	2	0	0	0	0	0	0	0	1	0
Compactor	8m3	Nos	1	0	0	0	0	0	0	0	0	0
Dump truck	10m3	Nos	11	0	1	1	0	1	0	1	1	1
Total		Nos	14	0	1	1	0	1	0	1	2	1

#### 10. Investment Amount in each year refer to "Equipment Cost" tab

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	1000Tg	247,000	0	0	0	0	0	0	0	123,500	0
Compactor	8m3	1000Tg	104,000	0	0	0	0	0	0	0	0	0
Dump truck	10m3	1000Tg	929,500	0	84,500	84,500	0	84,500	0	84,500	84,500	84,500
Total		1000Tg	1,280,500	0	84,500	84,500	0	84,500	0	84,500	208,000	84,500

#### 11. Daily Operation and Maintenance Costs in each year refer to "O&M Cost" tab

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	Tg	282,833	282,833	282,833	282,833	282,833	282,833	282,833	282,833	424,250	424,250
Compactor	8m3	Tg	102,561	102,561	102,561	102,561	102,561	102,561	102,561	102,561	102,561	102,561
Dump truck	10m3	Tg	1,128,167	1,128,167	1,230,728	1,333,289	1,333,289	1,435,849	1,435,849	1,538,410	1,640,971	1,743,531
Total		Tg	1,513,561	1,513,561	1,616,122	1,718,683	1,718,683	1,821,243	1,821,243	1,923,804	2,167,781	2,270,342

#### 12. Annual Operation and Maintenance Costs in each year.

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	1000Tg	103,234	103,234	103,234	103,234	103,234	103,234	103,234	103,234	154,851	154,851
Compactor	8m3	1000Tg	37,435	37,435	37,435	37,435	37,435	37,435	37,435	37,435	37,435	37,435
Dump truck	10m3	1000Tg	411,781	411,781	449,216	486,650	486,650	524,085	524,085	561,520	598,954	636,389
Total		1000Tg	552,450	552,450	589,885	627,319	627,319	664,754	664,754	702,188	791,240	828,675

### A.2.3 Outputs of the Workshop

The workshop was conducted according to the program mentioned above. The following photos present the workshop views:



Registration



Opening Speech by State Secretary of  
MONET



Lecture



Site Visit of NEDA/NERC



Site Visit to MDDS



Site Visit to 3R Promotion Sites



Works in the Workshop (1)



Works in the Workshop (2)



Presentation of Concept of SWM M/P and A/P



Handout of Workshop Certificate



Closing Speech by JICA Resident Representative



Participant and Lectures

**a. Questions and Answers**

In the workshop each program had a question & answer session. The records of question & answer sessions are presented below.

**a.1 Program 4.1 Formulation of M/P for MUB (1): Site Selection (By Mr. Ariguun)**

Mr. Gantumur (Bulgan): In our province, waste has been open dumped in a valley (between two mountains) located near a river for more than 20 years. The area of the waste is more than 80 ha. However, the amount of the waste is not so much in comparison with the area since it has been just discharged everywhere and scattered around the disposal area. Most of the waste is ash and wood chips. Household waste does not occupy much share in the total waste. The province has been planning to introduce landfill technology in new location and bury the current disposal site (the waste mentioned above). Would you tell me how to calculate the volume of works when we bury the current disposal site?

Mr. Kono (JET): I understood that you have asked how to calculate the volume of a landfill site when planning it in flat areas such as Bayangiin khonkhor, one of the candidates for the final disposal site for UBC. In order to calculate the volume, you have to set the boundary for the landfill site where waste should be disposed. Then, enclosing embankment should be constructed. Unless you follow these steps, waste will be disposed everywhere around the site. Actually, similar problems existed in former UCDS in UBC.

Mr. Gantumur (Bulgan): I would like to know how to protect the river from possible water contamination that might be resulted by the accumulated waste open-dumped in the valley. When discarding the current site after construction of the new landfill site, we will have to take this kind of measures. Is transportation of the accumulated waste to the new site possible?

Mr. Ariguun (EPWMD): Transporting the accumulated waste to a new landfill site is not efficient. Since the waste is open-dumped in the valley, environmental pollution must have occurred in some extent as the waste is located in upstream from the river. Specialized organizations should conduct evaluation of environmental pollution. When doing this, samples should be prepared from soil and water in surrounding area. If the results are within acceptable levels, the waste can be buried. However, the most preferable measure is to dig a hole in the middle of the waste, put a leachate protection liner in the bottom of the hole and bury the waste into it.

Mr. Kono (JET): In order to solve the issue, you need to prepare M/P. In case you are considering that the location of the current disposal site is not proper, then, you should start plan to construct new disposal site. So please be aware of the importance of a M/P. As the M/P was formulated for UBC between 2005 and 2007, NEDS was constructed based on it and started operation in 2009.

As for provincial cities, the MONET is going to support introduction of landfill technology. So you need to formulate M/P to secure the sustainability of landfill operation in your cities. We, the JET, are willing to give advice on possible solutions for the waste open dumped in your current site. Although constructing a sanitary landfilling facility at a final disposal site is a task for your aimag, you have to formulate M/P first in order for you to realise sanitary landfill operation.

#### **a.2 Program 4.2 Formulation of M/P for MUB (2): Planning of 3R System (By Mr. Odjargal)**

After the presentation, the participants requested him to provide them with two regulations on recyclables that have been in force in UBC. The regulations are (1) Regulation on Waste Separation and (2) Regulation on Selling and Purchasing Recyclables.

Mr. Odjargal promised to provide the participants with soft copies of the regulations on the

second day of the workshop.

**a.3 Program 5 Plan and Operation of NEDS and NERC (By Mr. Vandanmagsar)**

Participants: Is protection dams need to be steep?

Mr. Vandanmagsar (CMPUA): It is suitable to construct a protection dam inclining.

Participants: How often is waste separation conducted at NERC?

Mr. Vandanmagsar (CMPUA): Waste separation is being conducted once a week (Mr. Timuujin explained the purpose, progress and implementation method of the pilot project)

Mr. Gantumur (Bulgan): Were there any households who had been residing on the land where the current landfill site (NEDS) is?

Mr. Timuujin (JET): Yes, there were. MUB relocated the households for constructing the site.

Participants: Did the households have official permissions to reside on the land? If so did MUB pay to the households for their relocation?

Mr. Vandanmagsar: We do not know how MUB solved the issue.

**a.4 Program 7 M/P Framework: Forecast of Waste Amount and Composition, etc (By Mr. Shimura)**

Mr. Gantumur (Bulgan): We found that there are three types of generation rates: for apartment waste, for ger waste and for MSW. What is the generation rate for MSW?

Mr. Shimura (JET): The generation rate for MSW is the total generated waste in a city including that from businesses (but not those generated by construction works, factories and medical institutions) divided by the total population.

**a.5 Program 8 Plan and Operation of Collection System (Mr. Altangerel)**

In relation to the slide reflected the chart of SWM in Ome city, Japan, some of the participants wanted to know what treatment was done with the hazardous substances that was discharged from incineration plants with smoke. Mr. Altangerel answered that numerous filters were installed inside this kind of facilities as well as on top of chimneys. Therefore, no hazardous waste is discharged with the smoke.

In addition to this question, one of the participants asked how much waste had been disposed at MDDS when the improvement activity was commenced. Mr. Altangerel stressed that the amount of the waste was not possible to measure since no weighbridges had been installed at the site.

The other questions by the participants and the respective replies by Mr. Altangerel were as follows:

Participants: How much does CMPUA pay to its drivers and collection workers?

Mr. Altangerel (CMPUA): Drivers and collection workers are paid based on the number of trips they conducted. The wage rate is 10,500 Tg/trip for either drivers or collection workers.

Participants: Does the amount of the transportation payment differ from district to district?

Mr. Altangerel (CMPUA): Yes, it does. The BZD-WSF pays CMPUA 65,000 to 75,000 Tg for a trip depending on types of trucks. The average transportation distance from BZD is around 30 km.

Participants: How is the relationship between the disposal site and CMPUA?

Mr. Altangerel (CMPUA): CMPUA operates the final disposal sites (NEDS and MDDS).

In addition to the above, the participants wanted to know the way of implementing penalties in UBC against illegal dumping and violations of the Law on Household and Industrial Waste. In reply to the question, Mr. Altangerel mentioned that the only organization allowed to take penalty measures is Specialized Inspection Agency and its branches.

**b. Outputs of the Workshop**

As mentioned in the objective of the workshop all participants have elaborated their concepts of SWM M/Ps and A/Ps for formulation of the M/P. Those are presented below.

**b.1 Arkangai Aimag**

<p style="text-align: center;"><b>Arkhangai Aimag</b></p> <p style="text-align: center;">M/P General Concept and Action Plan Overview</p>	<p style="text-align: center;"><b>Current issues (for M/P)</b></p> <p>Tsetserleg city has 5 bags, 4000HH and more than 150 business entities. The followings are the current issues of solid waste collection operation:</p> <ul style="list-style-type: none"> <li>- Some HHs are unattended when collection truck comes</li> <li>- Waste collection equipment is used for quite long period of time with frequent breakdowns that enable to provide collection on schedule</li> <li>- Number of current collection equipment is not enough</li> <li>- Fuel provided by a budget is not sufficient for waste collection and disposal operations</li> </ul>
<p style="text-align: center;"><b>Current issues of SWM</b></p> <ul style="list-style-type: none"> <li>- Illegal dumping of construction waste</li> <li>- Open dumping of waste generated from meat processing plant</li> <li>- Waste fee paid as one HH even there are 2-3 HHs in one khashaa</li> <li>- There are not enough work force to distribute PR tools on waste awareness and to load waste thus it is impossible to employ another staff to separate waste</li> <li>- Insufficient number of professional workers</li> </ul>	<p style="text-align: center;"><b>Framework of SWM M/P</b></p> <p>Final disposal site, Ongony Jalga, is located 10-12 km from the city center in BagNo.5 of Erdenebulgan sum. There are human settlements and water sources nearby the disposal site.</p>

### Population and waste generation amount forecast (Table)

Year	Pxx	Pxx_A	Pxx_O	HWAxx (kg/day)	HWAxx (kg/day)	OWAxx (kg/day)	MSWAxx (ton/day)
2011	32197	4186	28012	1172	16947	2845	21.0
2012	36533	4749	31783	1376	19464	3272	24.1
2013	41452	5389	36063	1616	22360	3764	27.7
2014	47033	6114	40919	1898	25695	4332	31.9
2015	53367	6938	46429	2229	29535	4987	36.8
2016	60553	7872	52681	2618	33958	5742	42.3
2017	68706	8932	59774	3074	39055	6614	48.7
2018	77958	10134	67823	3610	44929	7621	56.2
2019	88455	11499	76956	4240	51702	8783	64.7
2020	100365	13048	87318	4979	59513	10125	74.6

### Population growth

Year	Pxx	Pxx_A	Pxx_G
2011	32197	4186	28012
2012	36533	4749	31783
2013	41452	5389	36063
2014	47033	6114	40919
2015	53367	6938	46429
2016	60553	7872	52681
2017	68706	8932	59774
2018	77958	10134	67823
2019	88455	11499	76956
2020	100365	13048	87318

### 7. Required number of collection vehicles

Type of Truck	Capacity unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor 15m3	Nos	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Compactor 8m3	Nos	7.0	1.8	2.1	2.4	2.8	3.2	3.8	4.4	5.0	5.8
Dump truck 10m3	Nos	9.9	11.3	13.0	15.0	17.2	19.3	22.8	25.8	30.2	34.7

### Population and waste generation amount forecast (Waste flow)

Year	Pxx	Pxx_A	Pxx_G	HWAxx (kg/day)	HWAxx (kg/day)	OWAxx (kg/day)	MSWAxx (ton/day)	SDWAxx (ton/day)	REWAxx (ton/day)	OFDAxx (ton/day)
2011	32197	4186	28012	1172	16947	2845	21.0	11.8	0.6	8.6
2012	36533	4749	31783	1376	19464	3272	24.1	13.5	0.7	9.9
2013	41452	5389	36063	1616	22360	3764	27.7	15.5	0.8	11.4
2014	47033	6114	40919	1898	25695	4332	31.9	17.9	1.0	13.1
2015	53367	6938	46429	2229	29535	4987	36.8	20.5	1.1	15.1
2016	60553	7872	52681	2618	33958	5742	42.3	23.6	1.3	17.4
2017	68706	8932	59774	3074	39055	6614	48.7	27.1	1.5	20.1
2018	77958	10134	67823	3610	44929	7621	56.2	31.2	1.7	23.2
2019	88455	11499	76956	4240	51702	8783	64.7	35.9	1.9	26.8
2020	100365	13048	87318	4979	59513	10125	74.6	41.4	2.2	31.0



7. Number of Trucks Required

Truck Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Compactor	15-3	N/S	0	0	0	0	0	0	0	0	0	0	0
Compactor	8m3	N/S	0	19	2	2	2	2	2	2	2	2	2
Compactor	10-9	N/S	9	11	11	11	11	11	11	11	11	11	11
Total			9	19	13	13	13	13	13	13	13	13	13

8. Number of Trucks Required

Truck Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Compactor	15-3	N/S	0	0	0	0	0	0	0	0	0	0	0
Compactor	8m3	N/S	0	2	2	2	2	2	2	2	2	2	2
Compactor	10-9	N/S	10	12	14	15	16	17	18	19	20	21	22
Total			10	14	16	17	18	19	20	21	22	23	24

9. Number of Trucks Required

Truck Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Compactor	15-3	N/S	0	0	0	0	0	0	0	0	0	0	0
Compactor	8m3	N/S	7	0	0	0	0	0	0	0	0	0	0
Compactor	10-9	N/S	10	2	2	2	2	2	2	2	2	2	2
Total			17	2	2	2	2	2	2	2	2	2	2

10. Investment Amount in each year refer to "Equipment Cost" table

Truck Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Compactor	15-3	Tg	0	0	0	0	0	0	0	0	0	0	0
Compactor	8m3	Tg	728,000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compactor	10-9	Tg	5,450,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00
Total		Tg	6,178,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00	185,000.00

11. Daily Operation and Maintenance Costs in each year refer to O&M table

Truck Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Compactor	15-3	Tg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compactor	8m3	Tg	819,311.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compactor	10-9	Tg	1,170,371.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00
Total		Tg	1,989,682.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00	243,000.00

12. Annual Operation and Maintenance Costs in each year

Truck Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Compactor	15-3	Tg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compactor	8m3	Tg	259,183.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compactor	10-9	Tg	4,272,288.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00
Total		Tg	4,531,471.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00

13. Annual Operation and Maintenance Costs in each year

Truck Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Compactor	15-3	Tg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compactor	8m3	Tg	259,183.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Compactor	10-9	Tg	4,272,288.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00
Total		Tg	4,531,471.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00	573,000.00

**b.2 Bulgan Aimag**

<p><b>Problems existing in SWM in Bulgan province</b></p> <p><u>Technical system-related:</u></p> <ol style="list-style-type: none"> <li>1. The area of the waste disposed at the final disposal site is too large</li> <li>2. Insufficient collection equipment</li> <li>3. The amount of the open-dumped waste has reached to a level at which the accumulated waste results in environmental pollution</li> <li>4. Waste separation and recycling have not been introduced</li> <li>5. The performance by the City Maintenance Company is not sufficient</li> </ol>	<p><u>Institutional system-related:</u></p> <ul style="list-style-type: none"> <li>• Low fee collection rate</li> <li>• Public awareness about SWM activities is not sufficient.</li> <li>• PR activities about SWM are not conducted</li> </ul>
1	2

**Framework for SWM M/P**

- Location of the final disposal site: In the south east of Bulgan soum, the provincial center
- **The longitude and latitude of the final disposal site**
- North-west point N 480 471 44.111  
E 1030 341 28.511
- North-east point N 480 471 34.111  
E 1030 341 49.511
- East point N 480 471 10.711  
E 1030 351 01.011
- South-east point N 480 461 43.711  
E 1030 341 02.911
- South-west point N 480 461 50.211  
E 1030 331 31.911
- West point N 480 471 15.311  
E 1030 331 53.111

- **Framework for M/P:**
- The final disposal site of Bulgan province is located in a distance of 8 km in the south-east from the provincial city. We have planned to introduce landfill technology at this site.

3

4

# Population of Bulgan soum

Year	Population
2006	12099
2007	12128
2008	12323
2009	12396
2010	12408

# Forecasted Population

Year	Forecasted total population	Forecasted apartment population	Forecasted ger population
2011	12486	3746	8741
2012	12565	3770	8796
2013	12645	3793	8851
2014	12725	3817	8907
2015	12805	3842	8964
2016	12886	3866	9020
2017	12968	3890	9078
2018	13050	3915	9135
2019	13132	3940	9193
2020	13215	3965	9251

5

6

# Forecasted waste generation amount

Year	Pox	Pox_A	Pox_G	HW/ASX (kg/day)	HW/GXX (kg/day)	OW/ASX (kg/day)	MSW/XX (ton/day)
2011	12486	3746	8741	1049	6288	895	7.3
2012	12565	3770	8796	1082	6386	1017	7.5
2013	12645	3793	8851	1133	6488	1040	7.7
2014	12725	3817	8907	1185	6593	1064	7.8
2015	12805	3842	8964	1234	6702	1089	8.0
2016	12886	3866	9020	1286	6815	1115	8.2
2017	12968	3890	9073	1339	6931	1141	8.4
2018	13050	3915	9135	1395	7051	1169	8.6
2019	13132	3940	9193	1453	7176	1196	8.8
2020	13215	3965	9251	1513	7305	1227	9.0

P- Population  
HW- Household waste of apartment area  
HW/A- Household waste of apartment  
OW/A- Other household waste of apartment

7

8. Number of families counted

Type of settlement	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Unit	231	231	231	231	231	231	231	231	231	231
Apartment	Family	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342

9. Number of families to be counted (by types of settlement)

Type of settlement	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Unit	231	231	231	231	231	231	231	231	231	231
Apartment	Family	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342

10. Annual increase/decrease, by year

Type of settlement	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Unit	231	231	231	231	231	231	231	231	231	231
Apartment	Family	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342

11. Single unit cost, by year


Type of settlement	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Unit	231	231	231	231	231	231	231	231	231	231
Apartment	Family	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342

12. Single unit cost, by year

Type of settlement	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Unit	231	231	231	231	231	231	231	231	231	231
Apartment	Family	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	Ger	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342
Apartment	During the year	1342	1342	1342	1342	1342	1342	1342	1342	1342	1342

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**b.3 Dornogobi Aimag**

<p style="text-align: center;"><b>GENERAL CONCEPT OF THE SWM M/P FOR DORNOGOVI PROVINCE AND ACTION PLAN</b></p>	<p style="text-align: center;"><b>General information</b></p> <ul style="list-style-type: none"> <li>• Population: 21,750</li> <li>• Population growth rate: 15%</li> <li>• Territory: 234,600 ha</li> <li>• Households: 6,229             <ul style="list-style-type: none"> <li>– Apartment: 3,610</li> <li>– Ger: 2,619</li> </ul> </li> <li>• GDP growth: 13%</li> <li>• Waste generation amount: 18,000 ton/year</li> <li>• Area of the final disposal site: 225 ha</li> <li>• Total area of illegal dump sites: 1,275 ha</li> </ul>
<p style="text-align: center;"><b>Problems in SWM</b></p> <ul style="list-style-type: none"> <li>• Dismantled military bases (of former-Soviet army) occupy 770 ha.</li> <li>• Waste resulted from dismantled occupies 502.8 ha.</li> <li>• No enclosing embankment was constructed around the landfill area. Waste is open dumped in considerable areas.</li> <li>• Illegal dumping onto undesignated areas is very active.</li> <li>• Public awareness about SWM activities is at low level.</li> <li>• Waste at ODPs in the city center is combusted frequently.</li> <li>• Waste pickers often scatter waste in the city center.</li> <li>• Collection vehicles and equipment is not sufficient (Waste transporting organization collects waste from only 40% of total generation source, 18% of the generation sources transport by themselves and the rest dump illegally)</li> <li>• Vehicles and equipment has become obsolete. Investment in equipment must be done.</li> <li>• No hazardous waste treatment facility exists.</li> <li>• Fee collection rate is low.</li> <li>• Budget for purchase of fuel and lubricants is not sufficient.</li> </ul>	<p style="text-align: center;"><b>Location of the final disposal site</b></p> 

### Forecasted population of Sainshand city

Normal growth 1,5%

Years	P <sub>xx</sub>	P <sub>xx_A</sub>	P <sub>xx_G</sub>
2011	21456	12445	9012
2012	21770	12627	9143
2013	22088	12811	9277
2014	22411	12998	9413
2015	22739	13188	9550
2016	23071	13381	9690
2017	23408	13577	9832
2018	23751	13775	9975
2019	24098	13977	10121
2020	24450	14181	10269

Rapid growth 5,6%

Years	P <sub>xx</sub>	P <sub>xx_A</sub>	P <sub>xx_G</sub>
2011	35506	19347	13948
2012	36171	20398	14772
2013	37140	21541	15599
2014	38220	22748	16472
2015	41416	24022	17385
2016	43736	25367	18369
2017	46185	26787	19398
2018	48771	28287	20484
2019	51502	29871	21631
2020	54387	31544	22842

### Forecasted waste generation amount

Years	P <sub>xx</sub>	P <sub>xx_A</sub>	P <sub>xx_G</sub>	HW <sub>xx</sub> kg/day	OW <sub>xx</sub> kg/day	MSW <sub>xx</sub> kg/day
2011	21456	12445	9012	2489	8958	1797
2012	21770	12627	9143	2543	9128	1832
2013	22088	12811	9277	2599	9301	1868
2014	22411	12998	9413	2656	9478	1905
2015	22739	13188	9550	2714	9659	1942
2016	23071	13381	9690	2773	9843	1981
2017	23408	13577	9832	2834	10030	2020
2018	23751	13775	9975	2895	10222	2059
2019	24098	13977	10121	2959	10417	2100
2020	24450	14181	10269	3024	10616	2141

Normal growth  
1,5%

Rapid  
growth  
5,6%

P: Population  
HW<sub>xx</sub>: Household waste of apartment area  
OW<sub>xx</sub>: Household waste of ger area  
MSW<sub>xx</sub>: Other waste amount

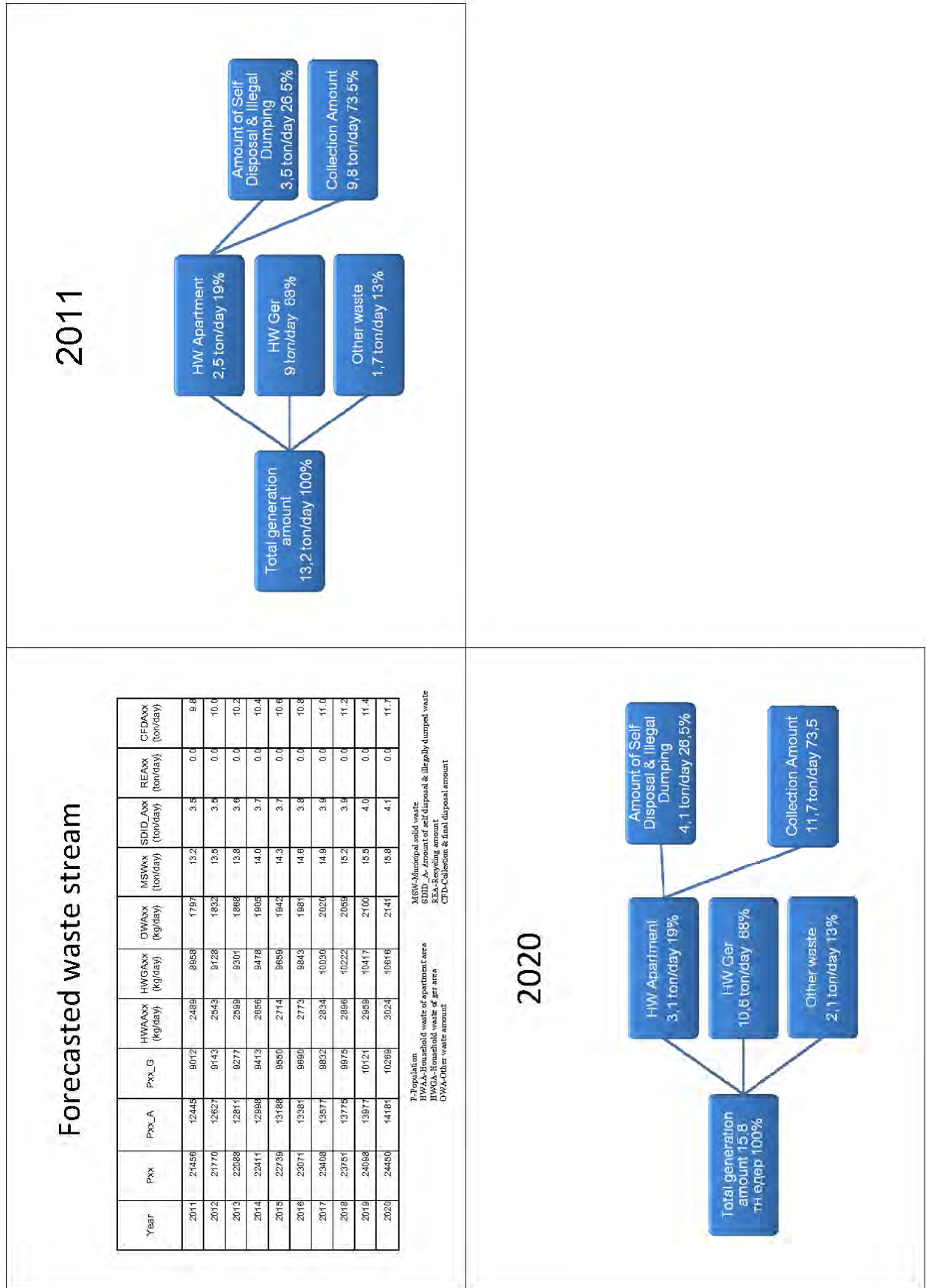
Years	P <sub>xx</sub>	P <sub>xx_A</sub>	P <sub>xx_G</sub>	HW <sub>xx</sub> kg/day	OW <sub>xx</sub> kg/day	MSW <sub>xx</sub> kg/day
2011	33306	19317	13988	3863	13904	2790
2012	35171	20399	14772	4223	14993	3017
2013	37140	21541	15599	4615	16172	3264
2014	39220	22748	16472	5044	17448	3531
2015	41416	24022	17395	5513	18830	3822
2016	43736	25367	18369	6026	20327	4137
2017	46185	26787	19398	6596	21949	4480
2018	48771	28287	20484	7198	23707	4852
2019	51502	29871	21631	7867	25613	5256
2020	54387	31544	22842	8596	27679	5686

### In case no M/P is implemented:

- 15,8 ton/day
  - Collection amount will be 9,16 ton/day
  - Amount to be dumped illegally is 6,64 ton/day

### Concept of technical system

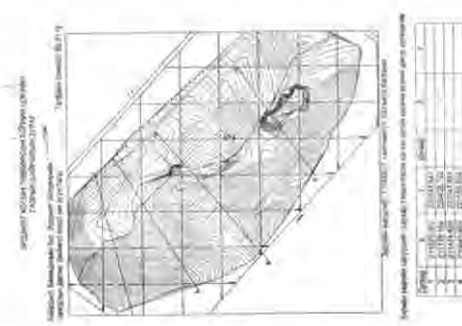
- Compactor trucks will be used in apartment area collection (loading capacities should be 2.5 to 3 tons)
- Dump trucks will be used in ger area collection (loading capacities should be 4 to 5 ton; total number of trucks-3)



**b.4 Orkhon Aimag**

<p style="text-align: center;"><b>General Information about the City                  (The biggest soum in Mongolia)</b></p> <ul style="list-style-type: none"> <li>- Number of bags (administration unit): 19; Households: 21793; Population: 85121; Total livestock: 147,561 heads.</li> <li>- 7 bags out of the 19 are apartment area while the rest are ger area. Animal husbandry is common in ger areas.</li> <li>- The final disposal site of Erdenet is located at a distance of 26 km from the city center and has been utilized since 1977. Total area is 80.3 ha.</li> </ul>	<p style="text-align: center;"><b>Problems in SWM of Erdenet City (2)                  (institutional system-related)</b></p> <ul style="list-style-type: none"> <li>▶ Fee collection in ger area is not systemized; and thus, fee collection rate is considerably low.</li> <li>▶ Insufficiency in professionalized personnel.</li> <li>▶ Collection trucks are too old=&gt;fuel utilization rate is high.</li> </ul>
<p style="text-align: center;"><b>The SWM Master Plan for Erdenet City (draft)</b></p> <p style="text-align: center;"><b>2011</b></p>	<p style="text-align: center;"><b>Problems in SWM of Erdenet City (1)                  (technical system-related)</b></p> <ul style="list-style-type: none"> <li>◆ The population of Erdenet has increased 2 times for the last decade reaching to 90,000 people.</li> <li>◆ As 60% of the population live in ger areas (usually remote areas), collecting waste fees from these households is rather difficult. Illegal dumping in valleys, ditches and pastures is common.</li> <li>◆ Outside discharge points is used in apartment areas. However, many open-dumped illegal sites are generated frequently; and thus, waste pickers, stray dogs and other domestic animals (sheep, goat, cattle etc) scatter these waste in the surrounding environment.</li> <li>◆ The City maintenance company dispatches 10 dump trucks for waste collection daily. However, the number of trucks are not sufficient for the 19 bags.</li> <li>◆ As collection trucks are old, breakdowns occur frequently. Fleet renewal is necessary (purchase of new vehicles is necessary).</li> <li>◆ No buffer zone is set around the final disposal site, and thus, factory-zone (area where factories are located in) extended to the territory of the final disposal site.</li> <li>◆ No policies or plans are formulated for the final disposal system of the city.</li> <li>◆ Landfill operation is stopped due to the lack of landfill equipment.</li> <li>◆ As no weighbridge is installed at the disposal site, the data related to disposal amount is not reliable.</li> </ul>

### Framework for SWM M/P



- The final disposal site is located at Altanbulag mountain in the factory zone of Erdenet copper-mine in the territory of Govil bag.
- No historical and cultural heritages, small stream and drinking water sources exist within a radius of 1.5 km from the final disposal site. Distance from the site to the animal farm owned by Erdenet mine is 0.5 km.
- 16 households reside at or around the final disposal site.

### Forecasted population

Years	Total population	Apartment population	Ger population
2009	91518	31116	60402
2010	93192	31685	61507
2011	94896	32265	62631
2012	96631	32855	63777
2013	98398	33455	64943
2014	100198	34067	66131
2015	102030	34690	67340
2016	103896	35325	68571
2017	105796	35970	69825
2018	107730	36628	71102

### Forecasted annual waste generation amounts

Years	PXX	PXX-A	PXX-G	HWAAXX (kg/day)	HMGAXX (kg/day)	Other waste (kg/day)	MSWXX (ton/day)
2009	91518	31116	60402	8713	36543	7105	52.4
2010	93192	31685	61507	9182	37666	7355	54.2
2011	94896	32265	62631	9678	38833	7616	56.1
2012	96631	32855	63777	10199	40048	7889	58.1
2013	98398	33455	64943	10749	41312	8174	60.2
2014	100198	34067	66131	11329	42628	8471	62.4
2015	102030	34690	67340	11940	43998	8782	64.7
2016	103896	35325	68571	12584	45425	9107	67.1
2017	105796	35970	69825	13263	46912	9447	69.6
2018	107730	36628	71102	13978	48461	9803	72.2

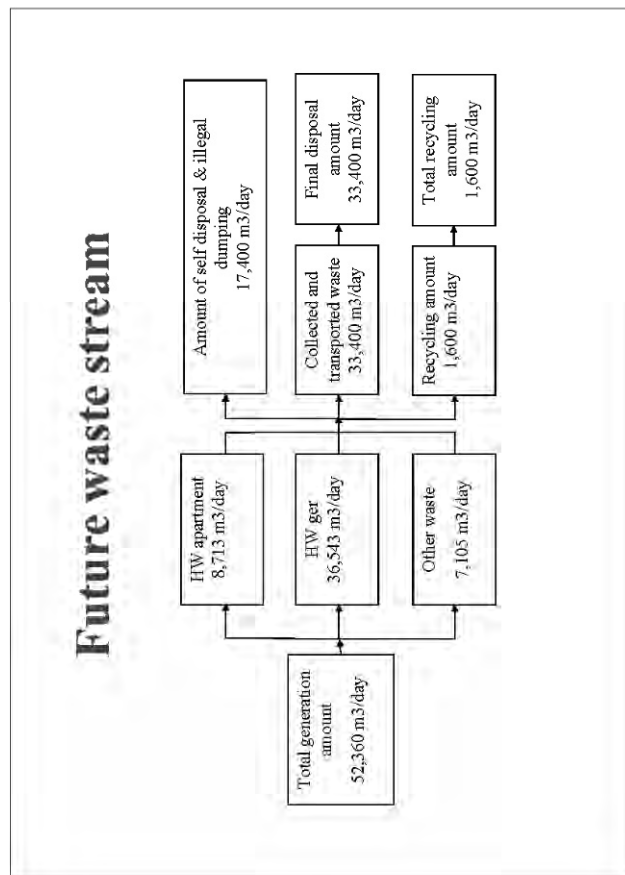
P-Population  
HWAAXX-Household waste of apartment area  
HMGAXX-Household waste of ger area  
MSWXX-Other waste amount

### Future waste stream (forecasted)

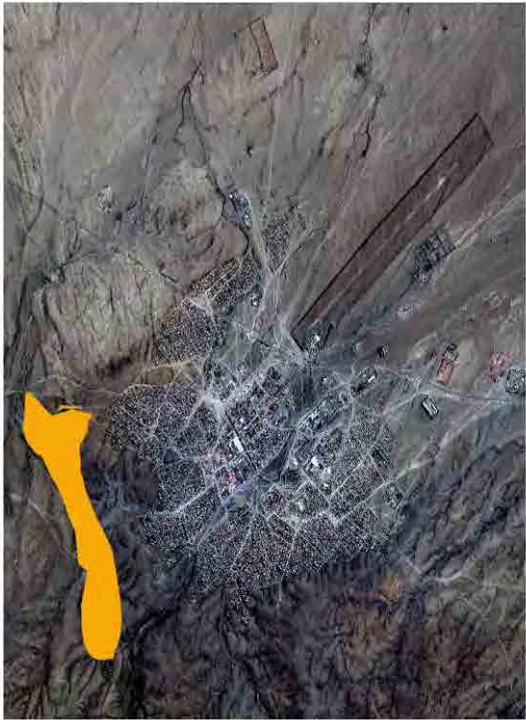

Year	PXX	PXX-A	PXX-G	HWAAXX (kg/day)	HMGAXX (kg/day)	OWAAXX (kg/day)	MSWXX (ton/day)	MSWXX (ton/day)	MSWXX (ton/day)	REAXX (ton/day)	C-DAAXX (ton/day)
2009	91518	31116	60402	8713	36543	7105	52.36	17.4	1.6	33.4	
2010	93192	31685	61507	9182	37666	7355	54.20	18.0	1.6	34.6	
2011	94896	32265	62631	9678	38833	7616	56.13	18.5	1.7	35.9	
2012	96631	32855	63777	10199	40048	7889	58.14	19.1	1.7	37.3	
2013	98398	33455	64943	10749	41312	8174	60.24	19.7	1.8	38.7	
2014	100198	34067	66131	11329	42628	8471	62.43	20.4	1.9	40.2	
2015	102030	34690	67340	11940	43998	8782	64.72	21.1	1.9	41.7	
2016	103896	35325	68571	12584	45425	9107	67.12	21.8	2.0	43.4	
2017	105796	35970	69825	13263	46912	9447	69.62	22.5	2.1	45.1	
2018	107730	36628	71102	13978	48461	9803	72.24	23.2	2.2	46.8	

P-Population  
HWAAXX-Household waste of apartment area  
HMGAXX-Household waste of ger area  
OWAAXX-Other waste amount  
MSWXX-Household solid waste  
MSWXX - original & illegally dumped waste  
REAXX-Recycling amount  
C-DAAXX-Collection & final disposal amount





**b.5 Uvurkhangai Aimag**

<p style="text-align: center;"><b>Uvurkhangai province (Arvaikheer city)</b></p> <p><i>General information of Arvaikheer city:</i>                  Population: 27,560                  Households: 7,788                  Number business entities and organizations: 412                  Annual waste generation amount: 30,030 ton (ger-8,100 ton;                  apartment-1,530 ton; factories-11,400 ton; others-9,000 ton)</p>	<p style="text-align: center;"><b>SWM problems</b></p> <ul style="list-style-type: none"> <li>• Illegal dumping is common.</li> <li>• Newly selected landfill site is not proper in terms of location (ger area has extended to the territory of landfill site).</li> <li>• Collection &amp; transportation requires much time.</li> <li>• Disposal system for construction waste is not appropriate.</li> <li>• Waste at the former disposal site has not been buried completely.</li> <li>• Vehicles and equipment are going to be insufficient by 2013.</li> <li>• Waste separation system does not exist.</li> </ul>
	 <p><b>Final Disposal Site</b></p> <p>Waste transported to the final disposal site is landfilled using WZ bulldozer. The thickness of soil covered over waste is 20 to 30 cm.</p>

<p style="text-align: center;"><b>Future technical system</b></p> <ul style="list-style-type: none"> <li>• <b>Introduction:</b> Since 2003, Batgun zam partnership has been responsible for waste collection.</li> <li>• The partnership employs 18 workers (leader-1, drivers-6, collection workers-5, operators-4 and sweeping staffs-2).</li> <li>• 3 dump trucks (Russian-made), 2 small-scale trucks (Forland) are dispatched for waste collection in all areas of the city.</li> <li>• A bulldozer WZ-25 operates on landfill operation.</li> </ul>	<p>In 2010, the 5 trucks conducted 4,174 trips and transported 25,044 m<sup>3</sup> waste to the final disposal site.</p> 
<ul style="list-style-type: none"> <li>• A ticket to be distributed to households. It is handed to drivers when waste is collected. The purpose is to confirm the performance by the collection service.</li> </ul> 	<p style="text-align: center;"><b>Roles of the ticket</b></p> <ul style="list-style-type: none"> <li>• Illegal dumping into ditches decreased;</li> <li>• Responsibilities of residents, drivers and collection workers improved;</li> <li>• Amount of wages to drivers and collection workers became appropriate as it is calculated based on the collected tickets; and</li> <li>• Fee collection rate increased.</li> </ul>

## Framework for SWM M/P

- Waste disposed at the former site need to be buried completely. (Although burying operation was conducted before, it did not complete due to the insufficient budget).
- The newly selected disposal site named Nam Tolgoi Disposal Site is located at a distance of 5 km in the south-east from the soum center. As ger area has extended to the territory of the disposal site, location of the final disposal site should be reselected.
- Waste separation activity being conducted at apartments No.1, 2 and 3 should be improved /waste is being separated into two categories/
- Opportunities of recycling will be sought (currently, a local factory is producing pillars from pet bottles and plastic bags and toilet paper from low quality paper).
- Public awareness and education will be conducted through PR tools.

- The population growth rate is 0.1%.
- Technical capacity should be increased in 2013 by procuring new vehicles and equipment.

## Forecasted population

Years	Total population	Apartment population	Ger population
2011	29676	8903	20773
2012	31955	9587	22369
2013	34409	10323	24086
2014	37051	11115	25936
2015	39897	11969	27928
2016	42960	12888	30072
2017	46259	13878	32381
2018	49812	14943	34868
2019	53637	16091	37546
2020	57755	17327	40429

## Annual waste generation amounts, forecast

Year's	Pxx	Pxx_A	Pxx_G	HWAxxx (kg/day)	HVCAxx (kg/day)	Other waste (kg/day)	MSWxx (ton/day)
2011	29676	8903	20773	2493	12568	2365	17.4
2012	31955	9587	22369	2778	13698	2587	19.1
2013	34409	10323	24086	3096	14934	2831	20.9
2014	37051	11115	25936	3451	16286	3099	22.8
2015	39897	11969	27928	3846	17766	3393	25.0
2016	42960	12888	30072	4286	19385	3716	27.4
2017	46259	13878	32381	4777	21157	4072	30.0
2018	49812	14943	34868	5323	23098	4462	32.9
2019	53637	16091	37546	5933	25223	4852	36.0
2020	57755	17327	40429	6612	27555	5364	39.5

P=Population  
HWA=Household waste of apartment area  
HVCA=Household waste of ger area  
OWA=Other waste amount

## Forecasted landfill volume (required)

Years	CFDAXx (ton/day)	YFDxx (ton/year)	YRLV (m <sup>3</sup> /year)	ARLV (t <sub>3</sub> )
2011	5.3	1943.1	2331.7	2331.7
2012	5.7	2083.2	2489.9	4831.5
2013	6.1	2234.0	2680.8	7512.3
2014	6.6	2396.2	2875.5	10387.8
2015	7.0	2570.9	3085.0	13472.8
2016	7.6	2758.8	3310.6	16783.4
2017	8.1	2961.2	3553.4	20336.8
2018	8.7	3179.0	3814.8	24151.6
2019	9.4	3413.6	4096.3	28248.0
2020	10.0	3686.3	4399.5	32647.5

CFDA=Collection & final disposal amount  
YFD=Yearly final disposal amount  
YRLV=Yearly required landfill volume  
ARLV=Accumulated required landfill volume

## Forecasted amount of waste to be disposed at the disposal site

Year	Pop	Pop_A	Pop_G	H/W/Abcc (kg/day)	C/W/Abcc (kg/day)	MS/Abcc (ton/day)	SDID_Acc (ton/day)	RE/Abcc (ton/day)	CFD/Abcc (ton/day)	
2011	28976	8903	20773	2493	12588	2366	17.4	7.4	0.5	9.5
2012	31955	9587	22368	2778	13698	2587	19.1	8.1	0.6	10.4
2013	34409	10323	24086	3096	14934	2831	20.8	8.8	0.6	11.4
2014	37051	11115	25936	3451	16286	3099	22.8	9.6	0.7	12.5
2015	39887	11969	27928	3846	17766	3393	25.0	10.5	0.8	13.8
2016	42960	12888	30072	4286	19385	3716	27.4	11.5	0.8	15.1
2017	46258	13878	32381	4777	21167	4072	30.0	12.5	0.9	16.6
2018	49812	14943	34869	5323	23098	4462	32.9	13.7	1.0	18.2
2019	53637	16091	37546	5833	25225	4892	36.0	14.9	1.1	20.0
2020	57755	17327	40428	6612	27556	5364	39.6	16.3	1.2	22.0

P=Population  
BWA=Household waste of apartment area  
BWS=Household waste of ger area  
CWA=Other waste amount  
MS=Manufactured solid waste  
SDID\_A=Amount of self disposal & illegally dumped waste  
RE=Recycling amount  
CFD=Collection & final disposal amount

### 9. Vehicles to be procured

Type	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m <sup>3</sup>	Nos	1	1	1	1	1	1	1	1	2	2
Compactor	8m <sup>3</sup>	Nos	0	0	0	0	0	0	0	0	0	0
C a v o C a b n	10m <sup>3</sup>	Nos	3	11	12	13	14	14	14	15	16	17
Total		Nos	4	12	13	14	15	15	15	16	18	21

### 10. Amount of investment by year

Types	Capacity	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m <sup>3</sup>	1000 Tg	123500	123500	123500	123500	123500	123500	123500	123500	247000	247000
Compactor	8m <sup>3</sup>	1000 Tg	0	0	0	0	0	0	0	0	0	0
C a v o C a b n	10m <sup>3</sup>	1000 Tg	253500	929500	1014000	1058500	1099500	1183000	1183000	1267500	1352000	1435900
Total		1000 Tg	377000	1053000	1137500	1222000	1222000	1306500	1306500	1391000	1599000	1683500

- All apartment waste will be separated at generation source and collected according to the current schedule.
- Number of vehicles to be dispatched to 9 ger areas will be increased and the collection schedule will be adjusted.
- Trucks being used currently will work for ger collection. As apartment area collection needs compactor trucks, new trucks will be procured.
- Financial sources will be planned for procurement of equipment.
- New location will be selected for final disposal site.
- PR activities will be increased.

## Plan of M/P formulation

- A working group for M/P formulation will be organized. The members will be selected from City maintenance company, DoNET, and Department of land relation. Support by the JICA Expert Team is necessary.
- The DoNET will take main responsibility in formulation and implementation of the M/P.
- The M/P will be formulated for 15 years from now.
- Financial sources for implementation of the M/P will be sought from the Central Government, MONET, international projects/organizations and the Local Budget.

**b.6 Khuvs gul Aimag**

<p style="text-align: center;"><b>Draft of SWM M/P of Khuvs gul Aimag</b></p> <p style="text-align: center;">Khuvs gul aimag                  Ch. Erdenechimeg                  B. Khandarmaa</p>	<p style="text-align: center;"><b>Current issues of SWM of Khuvs gul aimag</b></p> <ul style="list-style-type: none"> <li>• Murun sum (Khuvs gul aimag center) has more than 40,000 population, 11,400 HHs, 13 bags and more than 330 business entities.</li> <li>• There is a TUK responsible for waste issues. It has 40 workers. It employs 10-15 drivers and 18-20 loading workers every month on contract basis ensuring temporary job place offering.</li> <li>• Currently TUK has 1 dump ruck and 1 wheel loader.</li> </ul>
<ul style="list-style-type: none"> <li>• TUK collects solid waste from 15 to 30 of every month and disposes waste at a final disposal site, Elistiin Ard.</li> <li>• Waste generated from factories and business entities is collected on call basis.</li> <li>• A final disposal site is located 8 km from the city center and it has a buffer zone within 81 ha of area, and waste is disposed in fenced 39 ha of area.</li> </ul>	<p style="text-align: center;"><b>Positive aspects</b></p> <ul style="list-style-type: none"> <li>• Fixed waste collection schedule every month.</li> <li>• Waste fee collected together electricity bills based on a contract made with "Erchim Khuch" LLC in 2009. every month 6-8 million MNT is invoiced and received from the company.</li> <li>• Business entities with established contracts have already get used to provide waste for regular collection services.</li> <li>• Waste is disposed in designated place at the landfil site.</li> </ul>

### Current issues

- **Technical system issues:**

- Since waste is collected from every HHs, some HHs discharge waste in the streets which is scattered by WPs, dogs and wind polluting surrounding environment
- Residents discharge waste in the street when before and after collection schedule
- Bag Governor and Environment Protection Inspector are not taking appropriate measures against those residents
- Officers of organizations responsible for waste collection are not eligible to penalize and take actions against environment pollution and waste scattering and dumping cases.

- **Institutional system issues:**

- Since the city covers about 10,000 ha of area, work force for collection and transportation is not enough to cover such a big area.
- No own equipment. Every month waste collection is provided based on renting 8-10 dump trucks with trailer.
- Above conditions cause economic difficulties. /fuel, spare parts etc./
- There are no compactor trucks, thus causing waste scattering around the city during the collection of waste from central apartment area.
- Landfill area is increasing month by month due to non-provision of pushing equipment.

### Framework of SWM M/P

- We would like to propose to continue utilizing the current Elstiin Ar final disposal site with introduction of improved landfill method. In 2008, MONET financed to purchase a weighbridge and a tractor, then a disposal site was fenced. Landfill area was divided by type of waste such as waste from meat processing plant, inner parts, ash generated from heating plant, construction and hazardous waste.
- A current disposal site is located south-east 8-10 km from the city center, downstream of prevailing wind direction, and it is in a mountain ditch with no drinking water sources. However, if landfill area widens it has a threat to pollute Delgermurun river, thus it is very important to introduce landfill method and rehabilitate by planting grass the unused area.

Location of disposal site of Murun city





ХОГ ХАЯГДЛЫН ХЭТИЙН  
ХЭМЖЭЭ

Year	Pxx	Pxx-A	Pxx-G	HWAxx (kg/day)	HWGAxx (kg/day)	OWAxx (kg/day)	MSWAxx (ton/day)
2011	36195	10859	25337	3040	15329	2884	21.3
2012	36249	10875	25374	3152	15539	2934	21.6
2013	36303	10891	25412	3267	15756	2987	22.0
2014	36358	10907	25450	3386	15981	3041	22.4
2015	36412	10924	25488	3510	16214	3097	22.8
2016	36466	10940	25527	3638	16454	3155	23.2
2017	36521	10956	25565	3771	16703	3214	23.7
2018	36576	10973	25603	3909	16961	3277	24.1
2019	36630	10989	25641	4052	17227	3341	24.6
2020	36685	11006	25680	4200	17502	3407	25.1

Population forecast

Year	Pxx	Pxx-A	Pxx-G
2011	36195	10859	25337
2012	36249	10875	25374
2013	36303	10891	25412
2014	36358	10907	25450
2015	36412	10924	25488
2016	36466	10940	25527
2017	36521	10956	25565
2018	36576	10973	25603
2019	36630	10989	25641
2020	36685	11006	25680

Population growth of Huvsgul aimag is 0.001% annually. apartment and ger area population ratio is calculated as 0.30 and 0.70 percent respectively.

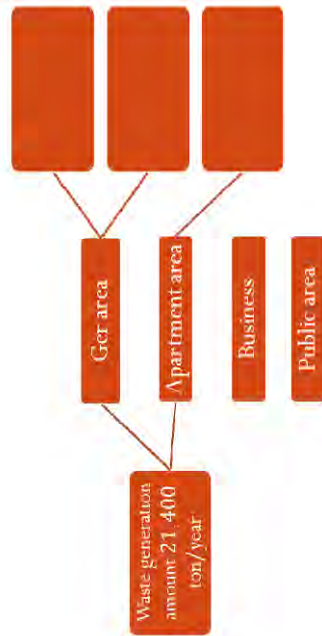
Calculation Sheet for Population Forecast and Future Waste Generation  
Calculation of landfill amount in Eistuin Ar disposal site:

Year	Pxx	Pxx-A	Pxx-G	HWAxx (kg/day)	HWGAxx (kg/day)	OWAxx (kg/day)	MSWAxx (ton/day)	SDIDAxx (ton/day)	REAXx (ton/day)	CFDAxx (ton/day)
2011	36195	10859	25337	3040	15329	2884	21.3	9.0	0.6	11.6
2012	36249	10875	25374	3152	15539	2934	21.6	9.2	0.6	11.8
2013	36303	10891	25412	3267	15756	2987	22.0	9.3	0.7	12.0
2014	36358	10907	25450	3386	15981	3041	22.4	9.4	0.7	12.3
2015	36412	10924	25488	3510	16214	3097	22.8	9.6	0.7	12.6
2016	36466	10940	25527	3638	16454	3155	23.2	9.7	0.7	12.8
2017	36521	10956	25565	3771	16703	3214	23.7	9.9	0.7	13.1
2018	36576	10973	25603	3909	16961	3277	24.1	10.0	0.7	13.4
2019	36630	10989	25641	4052	17227	3341	24.6	10.2	0.7	13.7
2020	36685	11006	25680	4200	17502	3407	25.1	10.4	0.8	14.0

Daily waste collection amount

Type of area	Waste source	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	t/day	Apartment	3.0	3.2	3.3	3.5	3.6	3.8	4.0	4.2	4.4	4.7
		Business	2.8	2.9	3.1	3.2	3.4	3.6	3.8	3.9	4.1	4.3
Ger	t/day	Ger	15.0	15.8	16.5	17.4	18.2	19.1	20.1	21.1	22.2	23.3
		Total	20.8	21.8	22.9	24.1	25.3	26.5	27.9	29.3	30.7	32.3

### Waste flow /in 2010/



- Concept of future technical system**
- Introduce bell collection system in apartment area. Collection to be scheduled as twice a week with closure of dust chutes.
  - Introduce collection of ger area waste directly from a khashaa in suks
  - Purchase collection equipment according to the formulated M/P
  - Present the formulated M/P to the local aimag Government authorities, and get a support from the budget as well as cooperation from projects and programs

### Calculation of required number of collection trucks up to 2020 :

Type of Truck	Capacity unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor 15m <sup>3</sup>	Nos	1	1	1	1	1	1	1	1	1	1
Compactor 8m <sup>3</sup>	Nos	1	1	1	1	1	1	1	1	1	1
Dump Truck 10m <sup>3</sup>	Nos	+	+	+	+	+	+	+	+	+	+
<b>Total</b>	<b>Nos</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>8</b>

### Waste Collection Amount by Type and Capacity of Trucks, 2020:

Type of Truck	Capacity unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor 15m <sup>3</sup>	Nos	5+	5.7	6.0	6.5	6.6	6.9	7.3	7.6	8.0	8.4
Compactor 8m <sup>3</sup>	Nos	1+	1+	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.1
Dump truck 10m <sup>3</sup>	Nos	17.5	18+	19+	20+	21.5	22.5	23.5	24.6	25.8	27.1

- Recycle system proposal**
- Organize public awareness raising activities on waste separation and negative impact of waste on human health and environment in cooperation of government and NGOs. Increase responsibilities of bag Governors and social workers
  - Support a proposal to establish a waste recycling facility within aimag
  - Organize residents who pick wastes
  - Step up measures to encourage waste separation at generation sources

Calculation Sheet for Required Landfill Volume

Year	CFDAxx (ton/day)	YFDxx (ton/year)	YRLVxx (m <sup>3</sup> /year)	ARLV (m <sup>3</sup> )
2011	11.6	4234.0	5080.8	5080.8
2012	11.8	4307.0	5168.4	10249.2
2013	12.0	4380.0	5256.0	15505.2
2014	12.3	4489.5	5387.4	20892.6
2015	12.6	4599.0	5518.8	26411.4
2016	12.8	4672.0	5606.4	32017.8
2017	13.1	4781.5	5737.8	37755.6
2018	13.4	4891.0	5869.2	43624.8
2019	13.7	5000.5	6000.6	49625.4
2020	14.0	5110.0	6132.0	55757.4

- Enhance responsibilities of relevant government officials
- Amend waste fee amount by submitting the proposal to the Citizens Representative Khural of aimag
- Approve required regulations
- Cooperate with aimag TV studios and other mass media tools to enhance public education activities

Annual Operation and Maintenance Costs in each year

Type of Truck	Capacity (m <sup>3</sup> )	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compressor	15m <sup>3</sup>	Tg	382,833	382,833	382,833	382,833	382,833	382,833	382,833	382,833	424,250	424,250
Compressor	8m <sup>3</sup>	Tg	102,561	102,561	102,561	102,561	102,561	102,561	102,561	102,561	102,561	102,561
Dump trucks	10m <sup>3</sup>	Tg	602,000	602,000	688,000	688,000	688,000	774,000	774,000	860,000	860,000	946,000
		Total	987,394	987,394	1,073,394	1,073,394	1,073,394	1,501,394	1,501,394	1,245,394	1,386,811	1,472,811

- Approve ordinance on establishment of a working group
- Set up methodology and planning
- Draft a real financial requirements

**b.7 Darkhan-Uul Aimag**

<p><b>Darkhan-Uul Province</b></p> <p><b>Frame WORK FOR SWM MASTER PLAN</b></p>	<p>Problems existing in SWM in Darkhan-Uul Province</p> <ul style="list-style-type: none"> <li>• There are many small-scale illegal dump sites in the provincial city.</li> <li>• Waste separation at generation sources has not been introduced.</li> <li>• Many problems exist in ger area fee collection.</li> </ul>																																												
<p><b>Framework for SWM Master Plan</b></p> <ul style="list-style-type: none"> <li>• The final disposal site of Darkhan soum (the provincial center of Darkhan-Uul province) named Baraat DS is located in a valley between two mountains.</li> <li>• Total area: 7 га</li> <li>• Distance to the city: 8 km</li> </ul>	<p><b>Forecasted population</b></p> <table border="1"> <thead> <tr> <th>Year</th> <th>Total population</th> <th>Apartment population</th> <th>Ger population</th> </tr> </thead> <tbody> <tr> <td>2011</td> <td>78651</td> <td>47190</td> <td>31460</td> </tr> <tr> <td>2012</td> <td>79770</td> <td>47862</td> <td>31908</td> </tr> <tr> <td>2013</td> <td>80906</td> <td>48543</td> <td>32362</td> </tr> <tr> <td>2014</td> <td>82057</td> <td>49234</td> <td>32823</td> </tr> <tr> <td>2015</td> <td>83225</td> <td>49935</td> <td>33290</td> </tr> <tr> <td>2016</td> <td>84410</td> <td>50646</td> <td>33764</td> </tr> <tr> <td>2017</td> <td>85611</td> <td>51367</td> <td>34244</td> </tr> <tr> <td>2018</td> <td>86829</td> <td>52098</td> <td>34732</td> </tr> <tr> <td>2019</td> <td>88065</td> <td>52839</td> <td>35226</td> </tr> <tr> <td>2020</td> <td>89319</td> <td>53591</td> <td>35727</td> </tr> </tbody> </table>	Year	Total population	Apartment population	Ger population	2011	78651	47190	31460	2012	79770	47862	31908	2013	80906	48543	32362	2014	82057	49234	32823	2015	83225	49935	33290	2016	84410	50646	33764	2017	85611	51367	34244	2018	86829	52098	34732	2019	88065	52839	35226	2020	89319	53591	35727
Year	Total population	Apartment population	Ger population																																										
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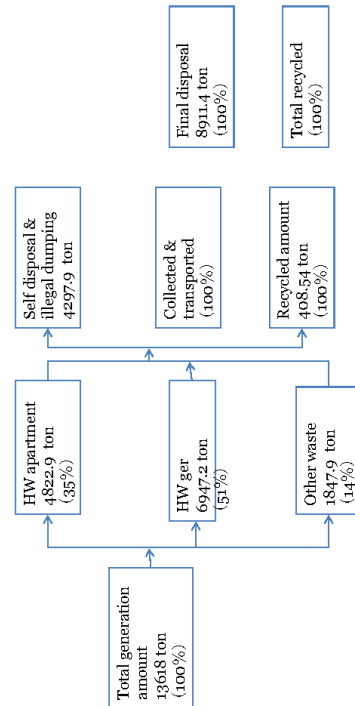
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дарж булах хогны хэмжээ  
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Daily generation amounts forecasted for Darkhan soum

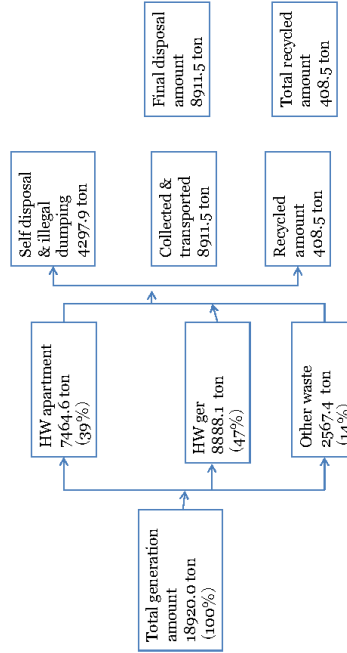
Year	Population	Apartment Population	Ger Population	HWAaxx (kg/day)	HWGaxx (kg/day)	Other waste (kg/day)	MSWxx (ton/day)
2011	78651	47190	31460	13213	19033	5063	37.3
2012	79770	47862	31908	13870	19540	5245	38.7
2013	80906	48543	32362	14560	20065	5436	40.1
2014	82057	49234	32823	15284	20611	5636	41.5
2015	83225	49935	33290	16044	21177	5844	43.1
2016	84410	50646	33764	16842	21764	6061	44.7
2017	85611	51367	34244	17680	22374	6289	46.3
2018	86829	52098	34732	18559	23008	6526	48.1
2019	88065	52839	35226	19482	23667	6774	49.9
2020	89319	53591	35727	20451	24351	7034	51.8

P-Population  
HWA-A-Household waste of apartment area  
HWGA-Household waste of ger area  
OWA-Other waste amount

Current waste stream in Darkhan soum (2011)



Future waste stream in Darkhan soum (2020)



Year	Pxx	Pxx_A	Pxx_G	HWAaxx (kg/day)	HWGAaxx (kg/day)	OWAaxx (kg/day)	MSWaxx (ton/day)	SDID_Axx (ton/day)	REAAxx (ton/day)	CFDAxx (ton/day)
2011	78651	47190	31460	13213	19033	5063	37.3	11.8	1.1	24.4
2012	79770	47862	31908	13870	19540	5245	38.7	12.1	1.2	25.4
2013	80906	48543	32362	14560	20065	5436	40.1	12.5	1.2	26.4
2014	82057	49234	32823	15284	20611	5636	41.5	12.8	1.2	27.5
2015	83225	49935	33290	16044	21177	5844	43.1	13.2	1.3	28.6
2016	84410	50646	33764	16842	21764	6061	44.7	13.6	1.3	29.8
2017	85611	51367	34244	17680	22374	6289	46.3	14.0	1.4	31.0
2018	86829	52098	34732	18559	23008	6526	48.1	14.4	1.4	32.3
2019	88065	52839	35226	19482	23667	6774	49.9	14.8	1.5	33.6
2020	89319	53591	35727	20451	24351	7034	51.8	15.3	1.6	35.0

P-Population  
HWA-A-Household waste of apartment area  
HWGA-Household waste of ger area  
OWA-Other waste amount  
MSW-Municipal solid waste  
SDID\_A-Amount of self disposal & illegally dumped waste  
REAA-Recycling amount  
CFD-Collection & final disposal amount

Техникийн Хэтийн  
Тогтолцооны Үзэл  
баримтлал

8. Number of vehicle counted

Types of vehicles	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	№	2	2	2	2	2	2	2	2	2	3
Truck	№	1	1	1	1	1	1	1	1	1	1
Tractor	№	5	5	5	5	5	5	5	5	5	7
Dump truck	№	3	3	3	3	3	3	3	3	3	7
Total	№	11	11	11	11	11	11	11	11	11	18

9. Number of vehicle to procure (by types of vehicles and by year)

Types of vehicles	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	№	2	0	0	0	0	0	0	0	0	1
Truck	№	2	0	0	0	0	0	0	0	0	0
Tractor	№	7	0	0	0	0	0	0	0	0	0
Dump truck	№	10	0	0	0	0	0	0	0	0	0

10. Amount of investment by year

Types of vehicles	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	1000 ₮	104,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Truck	1000 ₮	591,500.0	0.0	0.0	0.0	0.0	84,500.0	0.0	0.0	84,500.0	0.0
Tractor	1000 ₮	942,500.0	0.0	0.0	0.0	0.0	84,500.0	0.0	0.0	208,000.0	0.0
Dump truck	1000 ₮	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

11. By the O&M cost (by year)

Types of vehicles	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	1000 ₮	283	283	283	283	283	283	283	283	424	424
Truck	1000 ₮	103	103	103	103	103	103	103	103	103	103
Tractor	1000 ₮	602	602	688	688	774	774	861	861	860	946
Dump truck	1000 ₮	988	988	1024	1024	1074	1160	1160	1246	1387	1473

12. Annual O&M cost (by year)

Types of vehicles	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	1000 ₮	1,032,955	1,032,955	1,032,955	1,032,955	1,032,955	1,032,955	1,032,955	1,032,955	1,547,600	1,547,600
Truck	1000 ₮	372,955	372,955	372,955	372,955	372,955	372,955	372,955	372,955	372,955	372,955
Tractor	1000 ₮	2,321,400	2,321,400	2,642,400	2,642,400	2,963,400	3,284,400	3,605,400	3,926,400	4,247,400	4,568,400
Dump truck	1000 ₮	3,606,200	3,606,200	3,927,200	3,927,200	4,248,200	4,569,200	4,890,200	5,211,200	5,532,200	5,853,200

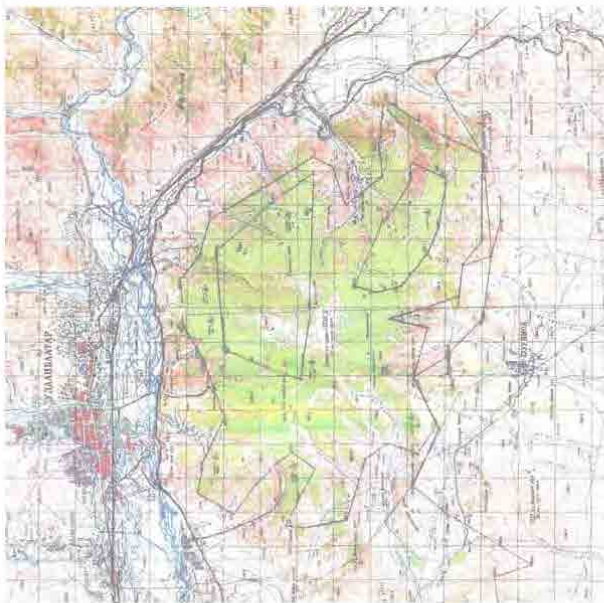
Waste separation and recycling

- Following PR activities will be conducted targeting residents and business entities:
  - ▲ Distributing booklets related to recycling
  - ▲ Organizing seminars
  - ▲ Advertising through mass media
  - ▲ Organizing communities (such as residents groups or partnership) that combats with waste issues.
- A small-scale recycling facility will be constructed.
- Small-scale waste processing factories will be classified by types of target wastes such as plastic processing and paper processing.

Proposal for final disposal system:

- Landfill activity at the final disposal site will be improved.
- Environmental protection measures will be taken.
- Ecosystem equilibrium will be maintained.

**b.8 Tuv Aimag**

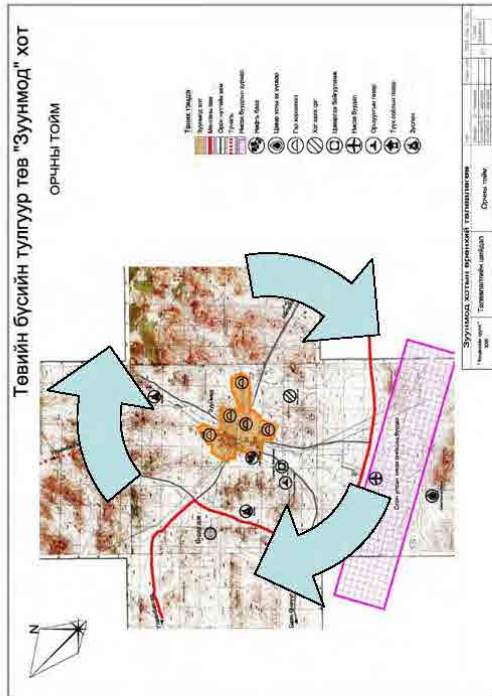
<p style="text-align: center;"><b>Tuv Aimag SWM M/P (draft)</b></p>	
<p style="text-align: center;"><b>Population</b></p> <ul style="list-style-type: none"> <li>• Total aimag population – 87,909 /2010/</li> <li>• Zuunmod city population – 15,295 /2010/</li> <li>• Household – 4,511</li> </ul> <p>Which:</p> <ul style="list-style-type: none"> <li>2,988 ger area households /66 %/</li> <li>1,523 apartment households /34 %/</li> </ul>	<p style="text-align: center;"><b>Future forecast</b></p> <ul style="list-style-type: none"> <li>• Zuunmod City Development 2020 Master Plan has been approved by the Government Decree in 2004. It is planned to be a regional center.</li> <li>• According to the Plan, it is estimated that the number of population will be 22,400 in 2020.</li> </ul>

## Activities of Aimag City Maintenance Department

- Final disposal site has been established by Zuumnod Mayor's Ordinance No.10 in 2010. 26 ha of area has been reduced into 18 ha and landfill method is applied in disposal site operations.



## Collection of apartment area waste





<p style="text-align: center;"><b>Equipment list</b></p> <p>8 m<sup>3</sup> -1 truck              3,5 m<sup>3</sup> -2 trucks              0,3 m<sup>3</sup> shovel excavator -1              800 kg crane -1              500 kg tractor with trailer -1</p>	<p style="text-align: center;"><b>Work force</b></p> <ul style="list-style-type: none"> <li>• 5 drivers</li> <li>• 7 loading workers</li> <li>• 9 cleaners</li> </ul>
<p style="text-align: center;"><b>Annual waste generation amount</b></p> <ul style="list-style-type: none"> <li>• Total 16,4 thousand/m<sup>3</sup></li> <li>• Of which: Solid waste - 11 thousand/m<sup>3</sup>                      ger area -7 thousand/m<sup>3</sup>                      apartment -4 thousand/m<sup>3</sup></li> </ul> <p style="text-align: center;">Others - 5,4 thousand/m<sup>3</sup></p>	<p style="text-align: center;"><b>Fee collection</b></p> <p>After making a contract with power distribution company, waste has been started to be collected together with electricity bills starting from June 2011.</p>

### Population Forecast and Future Waste Generation

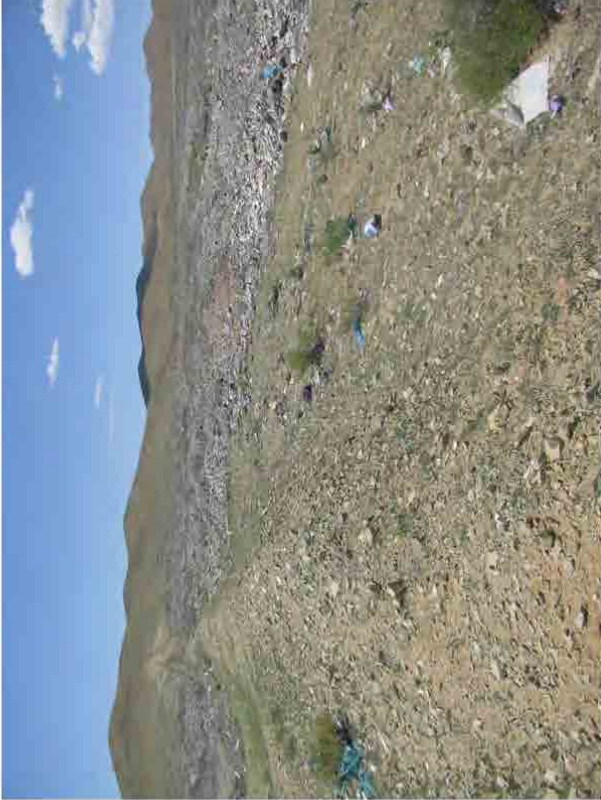

Year	P <sub>tot</sub>	P <sub>20,A</sub>	P <sub>20,Q</sub>
2011	15690	5244	10487
2012	16508	5448	10855
2013	17150	5659	11319
2014	17817	5890	11759
2015	18510	6108	12216
2016	19230	6346	12691
2017	19977	6593	13185
2018	20754	6849	13698
2019	21561	7115	14231
2020	22400	7392	14784

### Waste flow

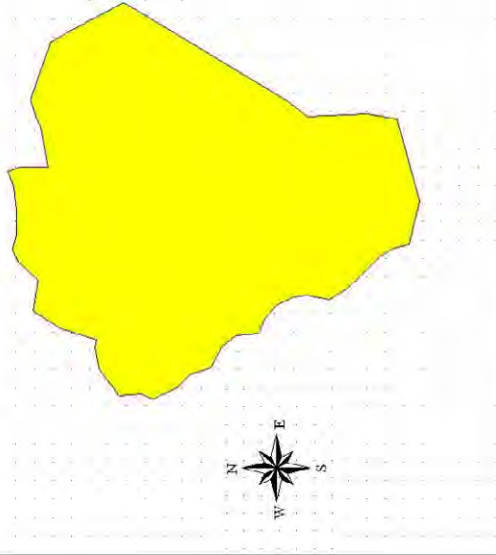
Year	P <sub>tot</sub>	P <sub>20,A</sub>	P <sub>20,Q</sub>	HW <sub>max</sub> (kg/day)	HW <sub>min</sub> (kg/day)	OW <sub>max</sub> (kg/day)	MSW <sub>max</sub> (ton/day)	SDI <sub>max</sub> (ton/day)	RE <sub>max</sub> (ton/day)	CFD <sub>max</sub> (ton/day)
2011	15690	5244	10487	1469	6345	1227	9.0	3.8	0.7	4.6
2012	16508	5448	10895	1579	672	1295	9.5	4.0	0.8	4.8
2013	17150	5659	11319	1698	7018	1368	10.1	4.2	0.8	5.1
2014	17817	5890	11759	1825	7364	1446	10.7	4.4	0.9	5.4
2015	18510	6108	12216	1963	7771	1528	11.3	4.6	0.9	5.8
2016	19230	6346	12691	2110	8181	1616	11.9	4.9	1.0	6.1
2017	19977	6593	13185	2260	8615	1709	12.6	5.1	1.0	6.5
2018	20754	6849	13698	2440	9074	1808	13.3	5.4	1.1	6.9
2019	21561	7115	14231	2623	9561	1913	14.1	5.7	1.1	7.3
2020	22400	7392	14784	2821	10076	2025	14.9	6.0	1.2	7.7

**Thank you for your  
 attention**

**b.9 Bayankhongor Aimag**

<p><b>SWM Master Plan of Bayankhongor sum</b></p> <p>30 June 2011</p>	<p><b>1. Current issues of SWM</b></p> <p>Technical system issues:</p> <ul style="list-style-type: none"><li>❖ Since the final disposal site is located next to Tuin Gol river banks, it becomes a main factor to pollute river</li><li>❖ There is wide spread waste scattering in the city center due to damages of facilities at waste discharge points.</li><li>❖ Waste discharge points located in the city center are burned by residents and business entities without permission causing extensive air pollution problems</li></ul>
	

FINAL DISPOSAL SITE, TOTAL 300 ha



### Institutional system

- ❖ Waste fee is not collected from all households located in ger area
- ❖ Equipment supply worsened and insufficient
- ❖ Poor cooperation and coordination between residents, bag and City Maintenance Department

### Framework of SWM M/P

Proposed final disposal site:

Site located in south-west from the city center in Bayan-Ovoo sum area. 6-10 km distance.

Background: To be located far from residential area, river banks and flood waterways, and not so far for waste transportation.

### Population forecast

Year	Pxx	Pxx_A	Pxx_G
2011	27854	8368	19498
2012	28114	8434	19680
2013	28377	8513	19864
2014	28642	8593	20050
2015	28910	8673	20237
2016	29180	8754	20426
2017	29453	8836	20617
2018	29728	8918	20810
2019	30006	9002	21004
2020	30286	9086	21200

## Future waste flow

Year	P <sub>xx</sub>	P <sub>xx</sub> A	P <sub>xx</sub> G	HWA <sub>xx</sub> (kg/day)	OWA <sub>xx</sub> (kg/day)	MSWA <sub>xx</sub> (ton/day)	SID <sub>xx</sub> (ton/day)	REA <sub>xx</sub> (ton/day)	CFD <sub>xx</sub> (ton/day)
2011	27854	8356	19498	2340	11796	2219	16.4	7.0	8.9
2012	28114	8434	19680	2444	12052	2276	16.8	7.1	9.2
2013	28377	8513	19864	2553	12316	2335	17.2	7.3	9.4
2014	28642	8593	20050	2668	12590	2395	17.7	7.4	9.7
2015	28910	8673	20237	2787	12873	2459	18.1	7.6	10.0
2016	29180	8754	20426	2911	13167	2524	18.6	7.8	10.3
2017	29453	8836	20617	3041	13471	2592	19.1	8.0	10.6
2018	29728	8918	20810	3177	13785	2663	19.6	8.2	10.9
2019	30006	9002	21004	3319	14112	2737	20.2	8.4	11.2
2020	30286	9086	21200	3467	14450	2813	20.7	8.6	11.5

Economic Growth, Waste Amount Forecast  
GR\_GRxx = 0.55 \* GDPav (= 0.0623) = 0.034265 => Say 0.035

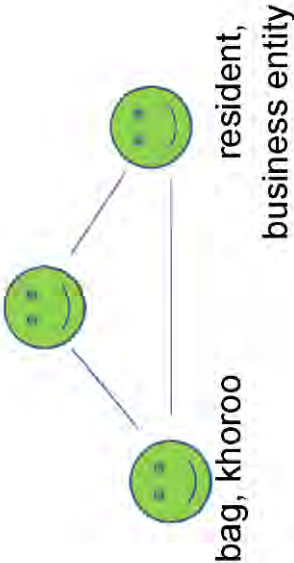
Year	P <sub>xx</sub>	P <sub>xx</sub> A	P <sub>xx</sub> G	HWA <sub>xx</sub> (kg/day)	OWA <sub>xx</sub> (kg/day)	MSWA <sub>xx</sub> (ton/day)
2011	27854	8356	19498	2340	11796	2219
2012	28114	8434	19680	2444	12052	2276
2013	28377	8513	19864	2553	12316	2335
2014	28642	8593	20050	2668	12590	2395
2015	28910	8673	20237	2787	12873	2459
2016	29180	8754	20426	2911	13167	2524
2017	29453	8836	20617	3041	13471	2592
2018	29728	8918	20810	3177	13785	2663
2019	30006	9002	21004	3319	14112	2737
2020	30286	9086	21200	3467	14450	2813

## Concept of future waste collection system

		Daily waste collection amount										
Type of area	Waste source	Unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Apartment	t/day	2.3	2.5	2.6	2.7	2.8	3.0	3.1	3.3	3.5	3.6
	Business	t/day	2.2	2.3	2.4	2.6	2.7	2.8	3.0	3.1	3.3	3.4
Other	Other	t/day	11.8	12.4	13.0	13.7	14.3	15.1	15.8	16.6	17.4	18.3
	<b>Total</b>	<b>t/day</b>	<b>16.4</b>	<b>17.2</b>	<b>18.0</b>	<b>18.9</b>	<b>19.9</b>	<b>20.9</b>	<b>21.9</b>	<b>23.0</b>	<b>24.2</b>	<b>25.4</b>

## Number of trucks to be procured in each year

Type of Truck	Capacity	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Compactor	15m <sup>3</sup>	unit	1	0	0	0	0	0	0	0	1	
Compactor	8m <sup>3</sup>	Nos	1	0	0	0	0	0	0	0	1	
Dump truck	10m <sup>3</sup>	Nos	3	0	0	1	0	0	0	0	3	
	<b>Total</b>	<b>Nos</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	
		Investment amount in each year										
Type of Truck	Capacity	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Compactor	15m <sup>3</sup>	1000t/g	123500	0	0	0	0	0	0	123500	0	
Compactor	8m <sup>3</sup>	1000t/g	104000	0	0	0	0	0	0	104000	0	
Dump truck	10m <sup>3</sup>	1000t/g	253500	0	0	84500	0	0	0	253500	0	
	<b>Total</b>	<b>1000t/g</b>	<b>481000</b>	<b>0</b>	<b>0</b>	<b>84500</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>481000</b>	<b>0</b>	

<p>- Recycle – Proposal for waste re-use and recycle                  Educate residents and provide them with advices:                  ❖ Importance of waste separation                  ❖ Use and consumption of waste recycled goods                  ❖ Organize residents into community system and establish model khoroo or streets                  ❖ Educate and cooperate with people who are living by picking waste</p>	<p>For waste service organizations:                  • Organize trainings on waste separation system                  • Organize trainings to strengthen human resources                  • Improve a monitoring system of services                  • Improve supply and quality of equipment</p>
<p>City maintenance</p>  <p>Improve cooperation</p>	<p>Concept of improvement for institutional system</p> <ul style="list-style-type: none"> <li>❖ Introduce a system of collection of waste fees together with electricity bills</li> <li>❖ Improve regular monthly waste collection system by introduction of fixed schedule that is to be informed to the residents</li> <li>❖ Organize public waste awareness raising activities, trainings and seminars, and establish a system of awards and promotions</li> </ul>

## A/P to formulate M/P

### ❖ RESPONSIBLE ORGANIZATION, OFFICER:

#### Aimag Government Office:

- Officer in charge of environment issues, Division of Development Policy
- Officer in charge of health issues, Division of Social Policy

#### DONET (Department of Nature, Environment and Tourism):

- Officer in charge of environment pollution and waste management

#### DOH (Department of Health):

- Officer in charge of environment pollution

#### City Government Office

- Manager, Mayor's Office

#### CMPJA (City Maintenance and Services Department):

- Manager in charge of waste transportation issues

#### All bag (duureg, khoroo) Governors

**b.10 Govisumber Aimag**

<h2 style="text-align: center;">SWM M/P framework of Govisumber aimag</h2>	<ul style="list-style-type: none"><li>• Govisumber aimag has 3 sums. Sumer sum has 376,819 ha of area where 1,058.37 ton of waste is accumulated in 1,010.2 ha.</li><li>• Out of above waste, “soft” waste covers 65 ha.</li><li>• Bayantal sum has 91,606 ha of area where 28,996 ton of waste is accumulated in 35.7 ha.</li><li>• Shiveegovi sum has 85,755 ha of area where 542,200.6 ton of waste is accumulated in 18.2 ha.</li></ul>
<h2 style="text-align: center;">SWM current issues</h2> <ol style="list-style-type: none"><li>1. Old, accumulated waste is scattered and covers huge area</li><li>2. Not enough waste collection services</li><li>3. Many open dumping places</li><li>4. Not enough waste fee collection rate</li></ol>	<ol style="list-style-type: none"><li>5. No final disposal site that meets required standard criteria</li><li>6. There are no collection and maintenance companies operating in Bayantal and Shiveegovi sums</li><li>7. Not enough financing</li></ol>



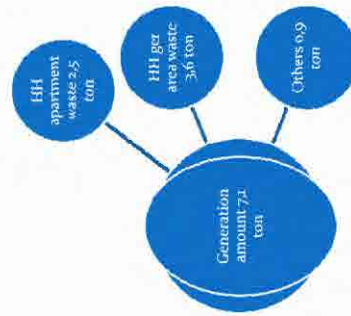
### Technical system issues

- Landfill equipment is essential for introduction of landfill method since final disposal amount is increasing. Current 4 loading workers and 1 watchmen and 1 tractor operator are not enough for waste collection operations.

### Location of final disposal site

- Located in old sand mining pit, about 7 km north west side of the city.
- Name: Orbity Tseg
- Area: 14.32 ha

### Future waste flow



### Population forecast

Year	Pop	Pop_A	Pop_G
2011	14888	8838	5956
2012	15298	9178	6118
2013	15709	9428	6284
2014	16131	9679	6453
2015	16585	9938	6626
2016	17010	10206	6804
2017	17467	10480	6987
2018	17936	10762	7175
2019	18418	11051	7367
2020	18813	11348	7565

## Future Waste Generation calculation sheet (2)

Year	Pxx	Pxx.A	Pxx.G	HWAxx (kg/day)	HWAxx (kg/day)	OWAxx (kg/day)	MSWxx (ton/day)
2011	14898	8838	5959	2503	3602	948	7.1
2012	15298	9178	6118	2682	3742	1068	7.4
2013	15769	9438	6294	2827	3895	1066	7.8
2014	16131	9678	6452	3002	4058	1108	8.2
2015	16595	9938	6626	3193	4219	1163	8.6
2016	17076	10208	6804	3394	4388	1221	9.0
2017	17467	10498	6997	3607	4565	1283	9.5
2018	17868	10782	7175	3834	4752	1346	9.8
2019	18418	11051	7367	4073	4950	1417	10.4
2020	18913	11348	7565	4331	5156	1488	11.0

3. Waste Collection Amount per day by type of trucks in case 1 day off in a week

Type of Truck	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	t/day	4.0	4.2	4.4	4.6	4.8	5.1	5.3	5.6	5.8	6.2
Dump truck	t/day	4.2	4.4	4.6	4.8	5.1	5.4	5.8	5.8	6.2	6.5
Total	t/day	8.2	8.6	9.0	9.5	9.9	10.4	10.9	11.5	12.1	12.7

4. Selection of Capacity of Compactor

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Compactor	8m3	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Dump truck	10m3	%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

1. Daily collection amount

Type of area	Waste source	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Apartment	t/day	2.5	2.6	2.8	2.8	3.0	3.2	3.4	3.5	3.7	3.8
	Business	t/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ger	Ger	t/day	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.1	5.2	5.8
	Total	t/day	7.0	7.4	7.7	8.1	8.5	8.8	8.4	8.6	10.6	10.8

2. Daily Waste Collection Amount by type of collection trucks

Type of Waste	Type of Truck	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Apartment	Compactor	t/day	2.5	2.6	2.8	2.8	3.0	3.2	3.4	3.5	3.7	3.8
	Compactor	t/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Business	CT Total	t/day	3.4	3.6	3.7	3.9	4.1	4.3	4.6	4.6	5.0	5.3
	Dump truck	t/day	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.1	5.2	5.8
Ger	DT Total	t/day	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.1	5.2	5.8
	DT Total	t/day	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.1	5.2	5.8

## Concept of Future Technical System

5. Waste Collection Amount by Type and Capacity of Trucks

Type of Truck	Capacity	unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Compactor	15m3	t/day	4.0	4.2	4.4	4.6	4.8	5.1	5.3	5.6	5.8	6.2
Compactor	8m3	t/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dump truck	10m3	t/day	4.2	4.4	4.6	4.8	5.1	5.4	5.6	5.8	6.2	6.5

6. Average Trip per day by type of trucks

Type of Truck	Capacity	unit	Average haulage amount per trip											
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
Compactor	15m3	t/day	4.0	4.2	4.4	4.6	4.8	5.1	5.3	5.6	5.8	6.2		
Compactor	8m3	t/day	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Dump truck	10m3	t/day	4.2	4.4	4.6	4.8	5.1	5.4	5.6	5.8	6.2	6.5		

## A.2.4 Evaluation of the Success of the Workshop

### a. Participant Evaluation

#### a.1 Questionnaire

### Questionnaires on the Workshop for Formulation and Implementation of SWM M/P at Central Provincial Cities based on the Experience in UBC

Please answer the following questions on the Workshop for Formulation and Implementation of SWM M/P at Central Provincial Cities based on the Experience in UBC. We would like to make use of your answers to improve our assistance for the improvement of SWM in provincial cities.

#### **Question 1: What organization do you belong to?**

1.1 Name of Aimag:

1.2 Name of Organization:

1.3 Position:

#### **Question 2: Do you think this Workshop is useful for you to prepare SWM M/P in your cities?**

2.1 Yes

2.2 No

#### **Question 3: If you answer YES for the Question 2, please inform of which programs (tick the column) and what part of them (please describe) do you think useful for you to prepare SWM M/P in your cities? (plural answer)**

Tick	Program	Part which is useful
	P.2 Objectives and contents of the workshop	
	P.3 Need and work flow of M/P formulation	
	P.4.1 Formulation of M/P for MUB (1): Site selection	

	P.4.2 Formulation of M/P for MUB (2): Planning of 3R system	
	P.5 Plan and operation of NEDS and NERC	
	P.6 Site visit of NEDS and NERC	
	P.7 M/P framework: Forecast of waste amount and composition, etc.	
	P.8 Plan and operation of collection system	
	P.9 Site visit of 3R promotion sites, workshop, etc.	
	P.10 Workshop (1): Preparation of framework for SWM M/P for each city	
	P.11 Workshop (2): Collection system planning for SWM M/P for each city	
	P.12 Workshop (3): Final disposal system planning for SWM M/P for each city	
	P.13 Workshop (4): Recycling system planning for SWM M/P for each city	
	P.14 Workshop (5): Formulation of concept of SWM M/P for each city and an action plan (A/P) for formulation of the M/P	
	P.15 Presentation of the concept of SWM M/P and the A/P for formulation of the M/P by 10 cities	

**Question 4: What kind of knowledge and experience did you gain in the workshop?  
 Please write the matters of which you think were useful and interesting.  
 In addition please mark the most useful one. (circle it ○)**

**Question 5-1: What did you want to learn through this workshop?**

**Question 5-2: Were you able to obtain such knowledge through this workshop?**

2.1 Yes

2.2 No

**Question 6: Do you have any opinions to improve this workshop? What kind of program do you need more about? Please describe below, if any?**

Opinion to improve the workshop:

Additional programs you need:

**Question 7: What kind of support do you need for the formulation of M/P for your city?**

(From central government)

(From JICA)

**Question 8: What kind of support do you need for improvement of SWM in your city?**

(From central government)

(From JICA)

*Thank you very much for your cooperation!*

**a.2 Answers**

17 of 18 Participants in total gave answers to the questionnaire. The one who did not left early due to some urgent works.

**Question 2: Do you think this Workshop is useful for you to prepare SWM M/P in your cities?**

**Answer 2:**

	Nos of Answer	Percentage
2.1 Yes	17	100%
2.2 No	0	0%

**Question 3: If you answer YES for the Question 2, please inform of which programs (tick the column) and what part of them (please describe) do you think useful for you to prepare SWM M/P in your cities? (plural answer)**

**Answer 3:**

Tick		Program	Part which is useful
Nos	%		
15	88	P.2 Objectives and contents of the workshop	The workshop objectives are appropriate. The workshop is effective and useful.
16	94	P.3 Need and work flow of M/P formulation	Work flow to formulate the M/P. Needs and method of formulation of the M/P. Whole program
15	88	P.4.1 Formulation of M/P for MUB (1): Site selection	Site selection method. Kinds of investigations needs for site selection. Entire program. Useful for assessment of our disposal site
16	94	P.4.2 Formulation of M/P for MUB (2): Planning of 3R system	3R system in UBC. Planning 3R system. Entire program. Method of attracting people
14	82	P.5 Plan and operation of NEDS and NERC	Entire program. Method of how to make a plan and implement it. Experience of MUB
16	94	P.6 Site visit of NEDS and NERC	To understand experience of MUB How to implement proper landfill operation Whole program
15	88	P.7 M/P framework: Forecast of waste amount and composition, etc.	Forecast method of population and waste generation amount. To understand necessity of basic data for M/P formulation.
16	94	P.8 Plan and operation of collection system	Whole program To get basic knowledge for collection system planning

17	100	P.9 Site visit of 3R promotion sites, workshop, etc.	To know public education. Communication with local officers engaged in the program Experiences (clean environment, etc.) in the khoroo
17	100	P.10 Workshop (1): Preparation of framework for SWM M/P for each city	To learn how to make framework (calculation of future population and waste generation amount) by myself using PC having instructions & advices. Practicing is very useful Entire program
17	100	P.11 Workshop (2): Collection system planning for SWM M/P for each city	To learn how to calculate number and types of collection vehicles To learn how to plan a collection system in Aimag Practicing is very useful
14	82	P.12 Workshop (3): Final disposal system planning for SWM M/P for each city	Practicing is very useful. To learn how to calculate required landfill area To learn how to plan a final disposal system
14	82	P.13 Workshop (4): Recycling system planning for SWM M/P for each city	To learn how to plan a recycling system Practicing is very useful
14*1	82	P.14 Workshop (5): Formulation of concept of SWM M/P for each city and an action plan (A/P) for formulation of the M/P P.15 Presentation of the concept of SWM M/P and the A/P for formulation of the M/P by 10 cities	To learn how to plan a recycling system Practicing is very useful Learned experiences of other aimags

(Note) There is miss-typing of questionnaire (Double item 14) in Mongolian version. Therefore, the answer made combined.

**Question 4: What kind of knowledge and experience did you gain in the workshop?  
 Please write the matters of which you think were useful and interesting.  
 In addition please mark the most useful one. (circle it ○)**



**Answer 4:**

Knowledge and Experience gained in the Workshop	Nos	%
1. Methodologies and experiences to formulate M/P.	12	71
2. I have become able to forecast population, waste amount and composition	10	59
3. I have become able to plan waste collection, transportation and recycle activities.	4	24
3. Disposal site operation and 3R activities based on experiences of NEDS and 3R pilot khoroo	4	24
4. Task to be completed on PC by participants themselves	3	18
4. Evaluation of candidate sites for Final Disposal	3	18
5. All necessary knowledge and experiences	2	12
5. Method to organize work on site (landfill planning)	2	12
6. Ideas from presentations conducted by provinces	1	6
6. Necessary information was obtained in proper timing	1	6
6. New ideas for SWM improvement	1	6
6. About RPF	1	6
6. Closure and rehabilitation of old disposal site	1	6
6. PR activities and way of enhancing resident's participation	1	6
6. Cooperation activities with WPs	1	6
6. method of field investigations	1	6
6. International experiences	1	6

**Question 5-1: What did you want to learn through this workshop?**

**Answer 5-1:**

Aspects to be expected to learn through the Workshop	Nos	%
1. Method to formulate M/P.	11	65
2. Method of implementing landfill	6	35
3. Method to conduct necessary surveys and calculations	5	29
3. Method to forecast population and waste generation amounts	5	29
4. Other SWM information/knowledge	1	6
4. Items contained in the programs	1	6
4. Preparation of collection schedule	1	6
4. Financial planning	1	6
4. Way of promoting 3Rs	1	6
4. All those transferred through the workshop	1	6

**Question 5-2: Were you able to obtain such knowledge through this workshop?**

**Answer 5-2:**

	Nos of Answer	Percentage
5.1 Yes	17	100%
5.2 No	0	0%

**Question 6: Do you have any opinions to improve this workshop? What kind of program do you need more about? Please describe below, if any?**

**Answer 6-1: Opinions to improve the workshop**

Opinions to improve this Workshop	Nos	%
1. I am satisfied with the effectiveness and results of this workshop.	7	41
2. To organize the workshop in one of the participants' provinces based on its condition	4	24
3. To extend time for workshops (to extend the total duration of the entire program)	2	12
4. To invite representatives from organizations implementing SWM as soon as possible	1	6
4. To conduct landfill at final disposal site completely	1	6
4. It would be more useful by implementing all process jointly in one selected region	1	6

**Answer 6-2: Program you need more**

Program to be provided in the another Workshop	Nos	%
1. Methods to improve public awareness, attitude and education	4	24
2. Hazardous and medical waste treatment technology (Classifications, collection and disposal methods and other necessary technological aspects).	2	12
2. Experiences in foreign countries, especially those related to waste collection and recycling. Good practice in other countries	2	12
3. Waste recycling methods and technologies that suits the conditions in Mongolia	1	6
3. Study tour to recycling factories located in UBC.	1	6
3. City development plan	1	6
3. Rehabilitation works at landfill site and old disposal site	1	6
3. Any supportive measures to establish small recycling factory	1	6
3. Management measures to facilitate activities of residents and business entities	1	6

**Question 7: What kind of support do you need for the formulation of M/P for your city?**

**Answer 7-1: From Central Government**

Opinions to improve this Workshop	Nos	%
1. To provide the provinces with consultation and guidance (manuals) in order for the provinces to formulate and implement their M/P (on-site and off-site)).	9	53
1. To provide the provinces with financial resources for purchase of new equipment and solution of SWM issues.	9	53

2. To support our province in building collaboration with ongoing projects and programs (Solve financing issues to formulate M/P within the framework of implementation of international programs and projects).	2	12
3. To provide provincial top officials with directions and guidance and to make them understand.	1	6
3. Amendments in Law on Household and Industrial Waste in order to improve legal environments; Law enforcement.	1	6
3. To monitor progress of M/P formulation and implementation activities	1	6
3. To enforce relevant articles of the Law on Household and Industrial Waste, National Waste Reduction Program and other regulations.	1	6
3. Organize trainings for relevant organizations and residents on formulation of M/P	1	6

**Answer 7-2: From JICA**

Program to be provided in the another Workshop	Nos	%
1. To conduct trainings and provide with guidance, information and methodological support	8	47
2. To send the JET to our province in order to provide us with necessary advice based on the local conditions/to organize training in provinces.	5	29
3. To cooperate with provinces on formulation of their M/P by means of providing financial consultative assistance.	4	24
3. To support provinces on conducting public education, preparation of PR tools and attracting residents participation	4	24
4. Provide with recommendations based on the investigations prepared by Aimags	2	12
4. Conduct survey at Aimag level	2	12
5. To evaluate the M/P formulated by provinces	1	6
5. To provide with necessary equipment (collection trucks)	1	6

**Question 8: What kind of support do you need for improvement of SWM in your city?**

**Answer 8-1: From Central Government**

Opinions to improve this Workshop	Nos	%
1. To provide with financial support for improvement of SWM, removal of illegal dump sites, purchase of fuel and equipment for landfill operation and preparation of PR tools for public education.	11	65
2. To provide with professional expertise required to improve SWM at aimag and soum level	2	12
3. To improve laws and legal environments	1	6
3. To conduct EIA	1	6
3. To set necessary amount in the provincial budget for landfill operation	1	6
3. To set higher waste fee for companies generating much waste (such as	1	6

construction company and heating plants).		
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**Answer 8-2: From JICA**

Program to be provided in the another Workshop	Nos	%
1. To send the JET to check conditions of provincial landfill sites and provide them with necessary consultancy on-site	4	24
1. To provide with professional support, guidance and organize on-site and off-site trainings	4	24
2. To provide with financial support	2	12
2. To Implement JICA projects and programs to improve local SWM	2	12
3. To provide with training materials	1	6
3. To cooperate on implementation of PR activities for residents	1	6
3. To support introduction of 3Rs in our province	1	6
3. To cooperate with provinces on improvement of the provincial SWM	1	6
3. To provide with necessary equipment (collection trucks)	1	6
3. To establish a small-scale recycling factory in our province	1	6
3. To ensure the implementation of close cooperation up to the level when all SWM related issues are solved according to its required standards	1	6

**b. JET Evaluation**

**b.1 Evaluation of the Answer made by the Participants**

At first, it is evaluated that this workshop is very useful for the officer in charge of SWM in Provincial City for formulating M/P in his/her Provincial City. Because all the respondents answered (yes) in question 2 「Do you think this workshop is useful doe you to prepare SWM M/P on your cities?」 . As for question3 「Which programs do you think useful for you to prepare SWM M/P in your cities?」 , more than 82% of the respondents replied it is useful for all the programs. As for question 4 「What kind of knowledge and experience did you gain in the workshop?」 , 71% replied 「Methodology and experiences for formulating M/P」 and 59% replied 「I have able to forecast population, waste amount and composition」 .

As for question 5-2 「Were you able to obtain such knowledge through this workshop?」 , 100% replied 「Yes」 .

As for question 6-1 「Opinion to improve the workshop」 , 24% replied 「to organize the workshop in one of the participants province based on its condition」 , and 12% replied 「To extend time for workshops」 . As for question 6-2 「Program you need more」 , 24% requested 「Methods to improve public awareness, attitude and education」 , 12% requested 「Hazardous and medical waste treatment technology」 , 12% requested 「Experience in foreign countries especially good practice in other country」 .

As for question 7-1 「What kind of support you need from Central Government」 , 53% replied 「To provide the provinces with consultation and guidance in order for the provinces to formulate and implement their MP」 , 「To provide the provinces with financial resources for purchase of new equipment and solution of SWM issues」 . As for question 7-2 「What kind of support you need from JICA」 , 47% replied 「To conduct trainings and provide with guidance,

information and methodological support」, 29% replied 「To send JET to their provinces in order to provide them with necessary advice based on the local conditions」.

As for question 8-1 「What kind of support do you need for improvement of SMW in your cities from Central Government」, 65% replied 「To provide financial support」, 12% replied 「To provide with professional expertise required to improve SWM in local city level」. As for question 8-2 「What kind of support do you need for improvement of SWM from JICA」, 24% replied 「To send JET to check conditions of provincial landfill sites and provide necessary consultancy onsite」, 24% replied 「To provide with professional support, guidance and organize on site and off site trainings」.

## **b.2 Evaluation of the Workshop by the JET**

### **b.2.1 Acquisition of required knowledge/information for the formulation of M/P**

The relevant personnel from Provincial Cities (PCs) that participated in the workshop obtained the basic knowledge and information required for the formulation of a MSWM M/P, which was the primary objective of the workshop. In order to determine the degree of understanding, the participating PCs were asked to prepare the Concepts of the M/Ps of their respective cities. In regard to this, the PCs had to have an understanding of what the MUB SWM M/P was, and use it as an example to prepare the Concepts of the M/Ps of their cities by themselves. At the end of the training, the Concepts of the M/Ps of ten cities were presented, which confirms their understanding. The participants from PCs would be able to formulate their M/Ps provided they had a certain amount of expert support.

### **b.2.2 Building of a network among persons relevant to SWM**

All the Provincial Cities (PCs) that participated in the workshop, including MUB, are faced with many problems concerning SWM. In this workshop, key personnel confronting these problems were able to consult with each other and exchange views on how to cope with such problems. Moreover, MONET played an active role in preparing for the workshop program by contacting the relevant personnel from PCs by letter and by phone to invite them to attend. In the workshop, there was interaction between personnel from the central government and SWM personnel from PCs; that is, the workshop was used as an opportunity to lay the groundwork for a network to facilitate information exchange on SWM between PCs and between the central and PCs. This will enable PCs to work hard together to improve their respective waste disposal services in the future. This network is also expected to be very effective in filtering in the central government's policies on SWM to the PCs.

### **b.2.3 Impact on the central government**

The participants from the central government, including the MONET, frequently receive support from abroad, and have obtained the latest knowledge and information on SWM in advanced nations through seminars, workshops, and overseas training. There is a great disparity between this latest knowledge and information and the existing MSWM situation of Provincial Cities (PCs) responsible for such work. In this workshop, the participants from the central government became well aware of this disparity through the work done jointly with PC personnel, such as the formulation of the Concepts of the SWM M/Ps. As a result, it is expected that the central government will set forth more realistic policies in the actual improvement of SWM.

### **b.2.4 Leadership of MPP/DPWT/PPWM**

Until now, MUB/EPWMD/CMPUA, the counterparts (C/P) in this technical cooperation project as well as the development study & grand aid project, have been passively learning about the formulation of M/P from the JET & JICA study team. In the workshop, however, MUB/EPWMD/CMPUA played an active role in conveying the information and knowledge they acquired to other PCs.

From this standpoint, in this training MUB/EPWMD/CMPUA made a positive effort to fulfill their roles as leaders of the other PCs in Mongolia. They actively carried out work such as computer operation, etc. for the participants from other PCs in the lectures and group works they were in charge of, and supported the overall work.

#### **A.2.5 Conclusion**

This workshop included 18 participants from 10 PCs in Mongolia and costs about 140,000 yen in total. (Transportation cost was born by participants. Lecture room expense and some accommodation cost for the participants). The cost per C/P was less than 10,000 yen, which is much much cheaper than past C/P training in Japan.

Even so, as mentioned above, the training was effective and the PCs were able to obtain the basic knowledge and information required for the formulation of their respective MSWM M/Ps in the future. The workshop also had considerable secondary effects, such as the fact that many people were able to gain an understanding of this JICA cooperation on SWM in MUB (the technical cooperation project, development study and grant aid project), interaction at the working level, etc.

The C/P training conducted in JICA studies in the past targeted the C/P personnel. As a result, it did not provide adequate opportunity to convey the technical cooperation project results to key personnel from other relevant organizations. This workshop was very significant in that it provided not only MUB personnel who are carrying out SWM improvement with assistance from Japan, but also many SWM personnel from other PCs throughout Mongolia with the chance to learn measures for improving SWM and acquire other relevant knowledge and information using the results of the JICA cooperation on SWM in MUB (the technical cooperation project, development study and grant aid project). The JET sincerely hopes that this kind of opportunity can be created through technical cooperation project in the future.