

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
UNIDAD ADMINISTRATIVA ESPECIAL DE SERVICIOS PUBLICOS (UAESP)

Project on Master Plan Study for Integrated Solid Waste Management in Bogota, D.C.



FINAL REPORT

*Volume I
Summary*

November, 2013

KOKUSAI KOGYO CO., LTD.
EX RESEARCH INSTITUTE LTD.

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Preface

The Project on Master Plan Study for Integrated Solid Waste Management in Bogota D.C. is now officially completed and the Final Report is submitted herewith.

Principal contents of this Summary of Final Report are the evaluation of the current situation of solid waste management in Bogota D.C. and the Master Plan.

Colombia has a well-established system in which relevant organizations from the central government level to the local government level cooperate effectively to provide appropriate solid waste services to the citizens. In addition, the private sector has acted as a service provider of waste management services in Bogota D.C. based on a scheme of Public-Private Partnership.

Efforts in waste minimization and recycling have just begun in Bogota D.C., although a high level of conventional solid waste service is provided. The Bogota D.C. government works on these issues in a serious manner. The Zero Waste Policy and the Recycler Inclusion Plan are the main pillars in this field. The Master Plan elaborated in this Project proposes various measures to materialize the policy and the plan targeting a 20% reduction of municipal solid waste by 2027. The minimization mainly consists of three measures, i.e., material recycling, composting, and construction and demolition waste recycling. No high cost waste treatment technology is included. A 20% reduction in waste is not an easy target compared with major cities in other countries. Achievement of the target requires each citizen to thoroughly understand and participate in the waste minimization effort.

As mentioned before, the current solid waste management is appropriately carried out in Bogota D.C. However, two vulnerabilities can be envisaged when looking to the future. First, this immense city, with more than 7 million inhabitants, has only one final disposal site, Doña Juana Landfill. If an accident occurs and the landfill closes, waste will be accumulated in the city and it will have adverse effects on the citizens' health. Second, there is no transfer station in the city which stretches lengthwise far to the north and south. Introduction of a transport system with transfer stations would increase efficiency of collection work and reduce costs. The Master Plan also proposes such new infrastructure to overcome these vulnerabilities.

The Master Plan, together with plans targeting other wastes such as hazardous waste, is to be reflected in updating of the Decree 312 in 2006. We hope that the output of the Project presented here will contribute to the improvement of solid waste management and citizens' welfare in Bogota D.C.

November 2013
Ikuo MORI
Project Leader

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Volume II Main Report (1) (English, Spanish)

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This is the Volume I, Summary (English)

In this report, the project cost is estimated by using the June 2013 price and an exchange rate of US\$1.00 = COP1,900 = JP¥100.00

The Master Plan

1 Objectives and Goals

The following three general objectives were selected for the Master Plan:

1. Guarantee the quality and continuity of the garbage collection service to the users.
2. Minimize the amount of solid waste.
3. Guarantee the proper final disposal for unused/unexploited solid waste.

The following specific objectives were defined pursuant to these general objectives:

Objectives and Goals of the Master Plan

No.	General/Specific Objectives	Present	Short Term 2013-2015	Medium Term 2016-2018	Long Term 2019-2027
1	Guarantee the quality and continuity of the garbage collection service to the users.				
1.1	Maintain coverage of the urban area	100%	100%	100%	100%
1.2	Increase coverage of the rural area	30%	100%	100%	100%
2	Minimize the amount of solid waste				
	(total minimization rate)	(5.4%)	(10.8%)	(12.7%)	(20.3%)
2.1	Promote recycling of materials (material recycling minimization rate)	Informal Alqueria (5.4%)	85 tons/day to the system (6.2%)	427 tons/day to the system (6.2%)	1,074 tons/day to the system (9.7%)
2.2	Develop and extend the composting system (composting minimization rate)	- (0.0%)	25 tons/day to the system (1.1%)	58 tons/day to the system (2.0%)	249 tons/day to the system (2.8%)
2.3	Develop and extend the combined construction and demolition waste recycling system (cdw minimization)	- (0.0%)	redirect 100% from Doña Juana 850 tons/day to the system (3.5%)	901 tons/day to the system (4.5%)	1,055 tons/day to the system (7.7%)
2.4	Raise awareness and train users to succeed in achieving the reduction, reuse, separation at source and differentiated disposal of solid waste				
3	Guarantee the proper final disposal of unused/unexploited solid waste				
3.1	To ensure the operation of the Doña Juana landfill	Optimization Phase I	Phase II (17 million tons)		Master Plan (38 million tons)
3.2	To reduce the vulnerability of the current final disposal system	-	-	-	2 new landfills

2 Key indicators

The following table shows the key indicators of the Master Plan.

Key Indicators in the Master Plan

Component	Unit	Present 2012	Short 2015	Medium 2018	Long 2027
1 Population					
Population	thousand	7,565	7,875	8,184	9,114
2 Flow of solid waste					
Production	tons/day	6,704	7,135	7,566	8,859
Collection	tons/day	6,340	6,659	6,973	7,784
Recycled material, total	tons/day	366	473	592	1,074
Present	tons/day	366	0	0	0
Transition	tons/day	0	389	165	0
Plant	tons/day	0	85	427	1,074
Composting	tons/day	0	103	180	276
CDW recycled	tons/day	0	850	901	1,055
Final disposal	tons/day	6,304	6,368	6,604	7,065
Minimized quantity	tons/day	364	767	962	1,794
3 RBL service coverage					
Urban area	%	100	100	100	100
Rural area	%	30	100	100	100
4 Minimization rate					
Material recycled	%	5.4	6.2	6.2	9.7
Composting	%	0.0	1.1	2.0	2.8
CDW recycled	%	0.0	3.5	4.5	7.7
Total	%	5.4	10.8	12.7	20.3
5 Infrastructure and equipment					
51 RBL Collection, sweeping and cleaning					
511 Collection truck					
Compacter 25 yd3	nos.	*217	237	251	-
Compacter 16 yd3	nos.		35	36	246
Ampliroll 10 M3	nos.	**219	35	36	46
Van 4,5 Ton	nos.		14	16	11
Dump trucks 12 m3	nos.		36	39	-
512 Transfer Station					
Western station	tons/day	-	-	-	4,500
Northern station	tons/day	-	-	-	2,000
513 Transport					
Tractor-truck	nos.	-	-	-	66
Trailer	nos.	-	-	-	70
52 Recycling					
521 Recycled material					
6 ton Truck	nos.	8	29	143	359
Gathering center (30tons/day)	nos.	1	3	15	36
522 Composting					
Plant (100tons/day)	nos.	-	1	2	3
523 CDW recycling					
Drop-off point (60tons/day)	nos.	-	2	5	12
Recycling plant (200tons/day)	nos.	-	2	3	3
524 Recycling park					
Recycling plant	The need for these infrastructures will be analyzed below with the participation of the private sector				
CATARS					

Component	Unit	Present 2012	Short 2015	Medium 2018	Long 2027	
53	Final disposal					
	Doña Juana	tons/day	6,340	6,368	6,604	2,119
	Western landfill	tons/day	-	-	-	3,532
	Northern landfill	tons/day	-	-	-	1,413
6	Cost (Colombian pesos)					
61	Cost per year					
	FR, commercial	million \$	50,454	52,521	54,588	60,789
	BL, sweeping and clean-up	million \$	65,035	69,217	73,399	85,945
	RT, recollection	million \$	197,188	220,853	227,982	216,210
	Recycling	million \$	0	73,852	90,950	116,236
	DT, final disposal	million \$	44,668	65,341	67,769	76,031
	PMIRS	million \$	3,703	3,940	4,177	4,888
	Total	million \$	361,048	485,724	518,865	560,099
62	Unit cost					
	Per generation	\$/ton	147,548	186,508	187,885	173,216
	Per population	\$/pers.	47,728	61,683	63,398	61,458
63	Cost increase rate (2012 = 100%)					
	Total cost	%	-	35%	44%	55%
	Per generation	%	-	26%	27%	17%
	Per population	%	-	29%	33%	29%

* Number of compactors for RBL service

** Number of other vehicles for the RBL service

3 Principal Facilities

This section shows principal facilities of the Master Plan.

a. Transfer Stations

The plan is to establish two transfer stations; the Western Transfer Station and the Northern Transfer Station. The following is a summary of the facilities:

a.1 Western Transfer Station

Scale: Quantity of waste handled: 4,500 tons/day
 Function: Transfer of waste from collection trucks to large trucks.
 Location: This is in the western sector of Bogota D.C. Details of the location have not been defined.
 Others: It will go into operation as of the year 2021.

a.2 Northern Transfer Station

Scale: Quantity of waste handled: 2,000 tons day
 Function: Transfer of waste from collection trucks to large trucks
 Location: This is in the northern sector of Bogota D.C. Details of the location have not been defined.
 Others: It will go into operation as of the year 2021.

b. Gathering/Collection Center

Scale: Quantity of waste handled: 30 tons/day
Function: Recovery, weighing and collecting recyclable materials from separately collected waste
Location: 36 sites in Bogota D.C. Details of the location have not been defined.
Others: New centers do not necessarily have to be built as the existing warehouses can be used after they have been improved.

c. Composting plant

Scale: Quantity of waste handled: 100 tons/day
Function: Composting of organic waste from market places, cut grass and tree pruning
Location: 3 sites inside or outside Bogota D.C. Details of the location have not been defined.
Others: New composting plants do not necessarily have to be built; private plants can be used or new plants built.

d. CDW Recycling Plant

Quantity: Quantity of waste handled: 200 tons/day
Function: Mixed cdw recycling plant
Location: 3 sites inside or outside Bogota D.C., which are to be established within the disposal site for cdw or zones adjacent to these. Details of the location have not been defined.
Others: These do not necessarily have to be built by the public sector as existing private plants can be used or new plants could be built by the private sector.

e. New Landfills

The plan is to establish two landfills: the Western Landfill and the Northern Landfill. The following is a summary of the facilities:

e.1 Western Landfill

Scale: Quantity of waste handled: 4,700 ton/day in 2027
Total capacity: approximately 55 million tons
Function: Final disposal of ordinary solid waste.
Location: The plan is for the zone to be outside Bogota D.C. to the west. Details of the location have not been defined.
Others: The landfill will go into operation as of the year 2021.

e.2 Northern Landfill

Scale:	Quantity of waste handled: 2,800 tons/day in 2027 Total capacity: approximately 38 million tons.
Function:	Final disposal of ordinary solid waste.
Location:	The plan is for the zone to be outside Bogota D.C. to the north. Details of the location have not been defined.
Others:	It will go into operation as of the year 2026.

At this stage of the study, none of the locations for installation has been defined. However, the following figure shows a general image of the location of the landfills and the transfer stations, which are large scale facilities.



4 Feasibility of the Master Plan

The minimum per capita cost calculated for this Master Plan will be 51,308 pesos while the maximum per capital cost will be 64,133 pesos. When compared against the current situation, these values mean 2.5% and 28.2% increases, respectively. On the other hand, it was calculated that the per capita ability to pay of the citizens ranges from 51,600 to 134,600 pesos (0.5 to 1.3% of the income). The costs of the Master Plan can be covered with the rate. In the event that the Master Plan costs increase 20%, the per capita cost will be 76,960 pesos and it will be within the range of the ability to pay. Therefore, it is possible to say that the Master Plan is financially feasible.

If we calculate the economic indicators with an 8, 10, and 12% discount rate, we obtain the 1.06 proportion between benefits and costs with an 8% discount. However, other indicators did not evidence any economic pertinence. The balance between costs and benefits is negative during the first 10 years; however, it becomes positive after 20 years. As a consequence, this Master Plan is not so attractive as to encourage direct investment from the private sector, which demands the short-term recovery of the capital. Nevertheless, the economic pertinence of this Master Plan could be increased as it generates benefits in the long term by means of risk reduction, well-timed investment and efficient operation through the public-private alliance.

5 Recommendations

a. Establishment of a Solid Infrastructure

The Master Plan will solidly support the solid waste management system for 30 years. It is expected to fuel an honest discussion between the district government, the departmental government, and other related parties in order to build the infrastructure for solid waste management supporting the metropolitan city of Bogotá, with over 7 million inhabitants.

b. Use of New Minimization Technology

The minimization technologies evolve on a daily basis. There will be a feasible technology for Bogotá within the framework of those technologies. It is important to promote the participation of the private sector towards minimization and recycling that can introduce and assume, much faster, this type of technological innovation.

c. Building Trust

The fulfillment of the Inclusion Plan is not a technical challenge for Bogotá D.C. It is rather a social challenge concerning all the citizens. Citizens separate waste at source properly; recyclers collect separate recyclable materials. This is quite hard to achieve this coordination. It is important to promote the mutual trust between the generators and the collectors.

d. Updating of the PMIRS

The goal of the JICA Project was to set a Master Plan to meet the challenges faced or to be faced by Bogotá D.C., now and in the future, to facilitate the updating of the PMIRS by the UAESP. It is expected that this Master Plan turns out the PMIRS and contributes for Bogota D.C. to have a firm solid waste management system for the future.

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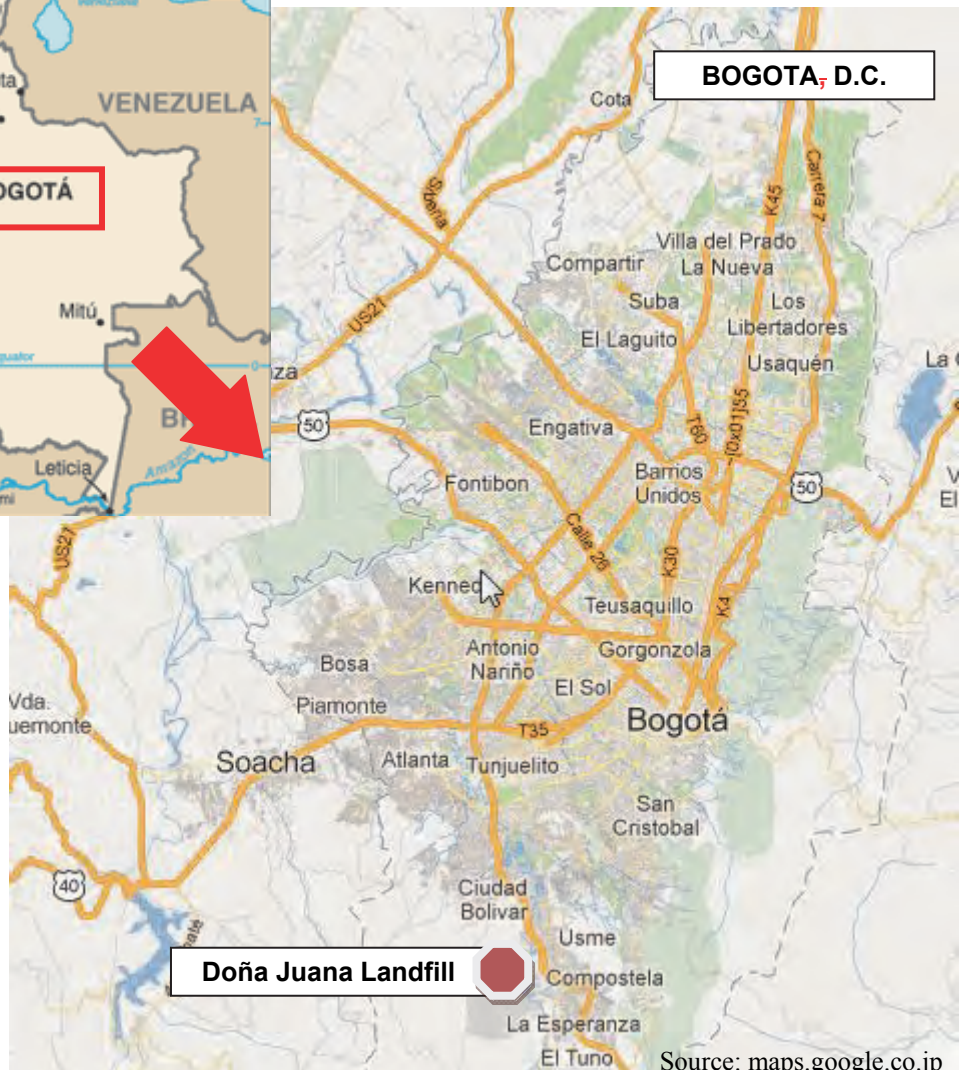
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Republic of Colombia



Source: maps.google.co.jp

Project on Master Plan Study for Integrated Solid Waste Management in Bogota, D.C.

Project Area

1 Study Area



Overlooking of the City of Bogota D.C. from the top of the mountain Monserrate



Old Town, Bolivar Square



Old Town, Candelaria District



High-class residential area (Estrato 6), Usaquen District



The station of public transportation, Trans Milenio planned by JICA



Street recyclers collecting recyclable materials with carriages

2 Waste Management of the City



Containers for waste separation installed in public spaces



Public service of street sweeping



General collection of waste



Bogota City's attempt for organizing 13,757 recyclers (Inclusion Plan).



Entrance gate of the final disposal site of the city, DoñaJuana



Sanitary landfilling of the DoñaJuana

3 Pilot Project



Separate containers for recyclables installed in the apartment area (Primavera Occidental)



Separate discharge of the recyclables by the residents (Primavera Occidental)



Unloading of recyclable materials in the Alqueria recycling Center



Separation of recyclable materials in the Alqueria



Separation of PET in the Alqueria



Compression of plastic materials in the Alqueria

4 Trainings



UAESP officers in the lecture (Training in Chile)



Site visit to the recycling facilities (Training in Chile)



UAESP officers in the lecture of the Tokyo Metropolitan City (Japan Training, Tokyo)



Lecture of the Setagaya incineration Plant (Japan Training, Tokyo)



Site visit to the Mie Recycling Center (Japan Training, Mie Prefecture)



Site visit to the community recycling of the Komono town (Japan Training, Yokkaichi City)

5 Seminars and Workshops



First JCC Meeting



Project Kick-off Seminar



Workshop on the training in Chile by UAESP officers



3R Seminar



Seminar on the experiences of Japan training and Revision of PMIRS



Final Seminar with more than 200 participants

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Abbreviations

ANDI	National Association of Industries
ASE	Exclusive Service Area
ASE	Exclusive Service Area
B/C	Benefit Cost Ratio
CAR	Regional Autonomous Corporation
CAR	Regional Autonomous Corporation of Cundinamarca
CC	Coordination Committee
CDM	Clean Development Mechanism
CDM	Clean Development Mechanism
CDW	Construction and Demolition Waste
CRA	Drinking Water & Basic Sanitation Regulatory Commission
DANE	National Statistics Bureau
DF/R	Draft Final Report
EAAB	Water and Sewage Company of Bogotá
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
F/R	Final Report
GDP	Gross Domestic Product
GOC	Government of Colombia
GOJ	Government of Japan
GRP	Gross Regional Product
I/R	Inception Report
IDU	Urban Development Institute
IEE	Initial Environmental Assessment
IT/R	Interim Report
JICA	Japan International Cooperation Agency
JMT	JICA Mission Team
MAVDT	Ministry of Environment, Housing and Regional Development
MRF	Material Recovery Facility
NCG	National Central Government
NPV	Net Present Value
PMIRS	Integrated Solid Waste Management Plan
POS	Public Opinion Survey
POT	Land Use Plan
PRM	Potentially Recyclable Materials
PTL	Leachate Treatment Plan
R/D	Record of Discussions
RBL	Collection, Sweeping and Cleaning
RPF	Refuse Paper & Plastic Fuel
RSDJ	Dona Juana Landfill
SC	Steering Committee
SDA	District Secretariat of Environment
SW	Solid Waste

SWM	Solid Waste Management
UAESP	Special Administrative Unit for Public Services
WACS	Waste Amount and Composition Survey
WEEE	Waste of Electric and Electronic Equipment

Current Situation

1 Profile of the Project

1.1 Background

Due to rapid urbanization, proper waste management is an important challenge in Bogota D.C. Bogota D.C. developed a master plan for integrated solid waste management (PMIRS) in 2006 and is working to achieve its goals. However, because of an increasing population (said to be 8 million) and changing lifestyles, a gap between PMIRS and the actual situation has arisen.

Under these circumstances, the Government of Colombia (GOC) requested the government of Japan (GOJ) to provide technical assistance for formulating a master plan of solid waste management, revising the actual PMIRS and defining the role of various stakeholders, in order to bridge the gap.

In response to the request, and due to important status of the environment under Japan's cooperation policy, JICA, the official agency responsible for the implementation of the technical cooperation program of the GOJ, has come to undertake the Project in cooperation with the authorities concerned of the GOC.

After a series of discussions, JICA and the Colombian side agreed on the scope and contents of the Project and exchanged a Record of Discussions (R/D) in November 2011. The Project was implemented based on this R/D.

1.2 Title of the Project

The title of the Project is **“Project on Master Plan Study for Integrated Solid Waste Management in Bogota, D.C.”**

1.3 Expected Goals

It is expected that the following will be attained after completion of the Project.

- (1) Bogota will implement the master plan (PMIRS) properly, so that the quality of life and welfare of inhabitants will be improved.
- (2) The solid waste management shall be carried out adequately by including various stakeholders and by clarifying their roles.

1.4 Outputs

- (1) A Master Plan for sustainable and proper solid waste management in Bogota is formulated.
- (2) Capacity of Unidad Administrativa Especial de Servicios Publicos (UAESP) is enhanced in policy planning and implementation of solid waste management by means of utilization, monitoring and evaluation of the Master Plan.

1.5 Project Site and Beneficiaries

- (1) Project Site

Bogota, D.C.

- (2) Beneficiaries

Direct beneficiaries: Counterpart personnel of UAESP

Indirect beneficiaries: Inhabitants of Bogota

1.6 Schedule

The Project began in March 2012 and will end in November 2013.

Year	2012												2013											
	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Fiscal Year	First F.Y.												Second F.Y.											
Work in Colombia	■												■											
Work in Japan	□																					□		
Reporting	△ IC/R											△ IT/R										△ DF/R	△ F/R	
SC Meeting	▲											▲										▲		
Seminar/Workshop		△						△				△					△	△				△		
Study Tour																								

IC/R : Inception Report
 IT/R : Interim Report
 DF/R : Draft Final Report
 F/R : Final Report
 SC : Steering Committee

Figure 1-1: Project Schedule

1.7 Organization

1.7.1 Implementation bodies

- (1) Project Execution Unit, UAESP

UAESP assigned personnel listed in the following table for the Project.

Table 1-1: Project Execution Unit

Actual Directors:

No	Name	Position/Responsibility
1	Nelly Mogollón Montañés	Director General
2	Ismael Martínez	Planning Office
3	Pedro Ramos Gutierrez	Final Disposal
4	Miguel Vigoya Abuchar	Collection, Sweeping and Cleaning – RBL
5	Lucia del Pilar Bohórquez	Recycling
6	Mauricio Valencia Silva	Administration and Finance
7	Omar Barón Avendaño	Legal Issues
8	Ilva Nubia Herrera Gálvez	Cemetery and Public Lighting
9	Patricia Elena Rozo Marulanda	Communication, Relation and Inter-institution

Technical Group:

No	Name	Position / Responsibility
1	Hilda Castro	Planning Office
2	Diana Castañeda	Legal Issues
3	Yira Bolaños	Internal Control Office
4	Carlos Rojas	Consultant to Director's Office
5	Angela Gayón Martínez	Recycling
6	Paola Ávila Forero	Recycling
7	Heimunth Duarte Cubillos	Recycling
8	Gabriel Córdoba	Recycling
9	Gilberto Corredor	Collection, Sweeping and Cleaning (RBL)
10	Diego Triana	Collection, Sweeping and Cleaning (RBL)
11	Ruth Quevedo	Collection, Sweeping and Cleaning (RBL)
12	Belquis Sepúlveda Mancipe	Final Disposal
13	Ivan Florian	Final Disposal
14	Elsa sichaca	Final Disposal

Other persons participated in the project:

No	Name	Position / Responsibility
1	Guillermo Asprilla	Ex - Director General
2	Carlos Arboleda	Ex - Director General
3	Henry Romero	Ex – Vice Director General and Ex Head of Planning Office
4	Germán Cabuya	Ex – Head of ICT Office
5	María Fernanda Aguilar	Ex – Director of RBL
6	Leonardo Rodríguez	Ex – Director of Recycling
7	Argemiro Plaza	Ex – Director of Recycling
8	Libia Esperanza Cuervo	Ex – Director of Final Disposal
9	Nhora Usme	Ex – Consultant to Director's Office

1 Profile of the Project

10	Guillermo Gálvez	Ex – Head of Education Office
11	Carolina Abusaid	Ex – Head of Planning Office
12	Henry Nieto	Ex – Director of Public Lighting and Cemetery
13	Carlos Jaimes	Ex – Public Lighting

(2) JICA Mission Team (JMT)

JICA Mission Team is composed of staff of Japanese consulting firms which have a contract with JICA. The Team is to work jointly with the aforementioned Unit for implementation of the Project. The following table shows its members.

Table 1-2: JICA Mission Team

No.	Name	Responsibilities
1	Ikuo MORI	Team Leader/Solid Waste and Hazardous Waste Management Expert
2	Mario VALLE	Waste Analysis 1/Collection and Transport
3	Eduardo HADDAD	Hazardous Waste Treatment
4	Koji KUSUNOKI	Waste Analysis 2/Recycling
5	Tamotsu SUZUKI	Intermediate Treatment
6	Ximena ALEGRIA	Final Disposal & Facilities
7	Mie NAGAYASU	Public Awareness /Environmental and Social Considerations
8	Masaru OBARA	Economy & Finance
9	Keiko YAGUCHI	Interpreter & Translator

1.7.2 Steering Committee

Steering Committee (hereinafter referred to as “SC”) was supposed to be established in order to facilitate inter-organizational coordination. However, the PMIRS Committee had been established already according to the Decree 312 of 2006, and this committee functioned as the SC.

(1) Functions

The major functions of SC were:

- To review the overall progress and achievements of the project,
- To examine major issues arising from or in connection with the Project, and
- To propose the modification of the activities depending on the necessity

(2) Members

SC was composed of the following members. Several meetings of the PMIRS Committee was held, and consults with a few of the additional members has occurred individually.

i) Legal PMIRS Follow-up Committee Members:

- Representative from Secretaria Distrital de Habitat
- Representative from Secretaria Distrital de Planeacion
- Representative from Secretaria Distrital de Ambiente
- Representative from Secretaria Distrital de Salud
- Representative from Secretaria Distrital de Gobierno
- Representative from cooperative of recyclers organized by UAESP
- Representative from Mayors
- Representative from Comites de Desarrollo y Control Social de Servicio Publico de Aseo
- Representative from UAESP

ii) Additional Members

- Ministerio de Ambiente Vivienda y Desarrollo Territorial (MAVDT)
- JICA Expert Team
- Representative(s) of JICA Colombia Office
- Government of Cundinamarca
- Corporacion Autonoma Regional-CAR

iii) Observers

- Official(s) from Embassy of Japan

1.8 Reporting

1.8.1 Reports

Reports were prepared jointly by the Project Execution Unit and the JICA Mission Team. The copies of the reports that were needed were printed by JICA and submitted to the Colombian side as follows.

Table 1-3: Reports

No.	Title	No. of copies		Date
		English	Spanish	
1	Draft Inception Report	10	10	April 2012
2	Inception Report	10	10	April 2012
3	Draft Interim Report	10	10	December 2012
4	Interim Report	10	10	January 2013
5	Draft Final Report	Digital	Digital	August 2013
6	Final Report	-	-	November 2013
	- Summary	20	20	
	- Main Report	20	20	

(1) Draft Inception Report

The Draft Inception Report presented the scope of the Project set up by the R/D and detailed activities planned by the Japanese side based on the R/D. The contents were discussed by both the Colombian side and the Japanese side.

(2) Inception Report

The Draft Inception Report was finalized as the Inception Report (this Report) based on the agreement made by the aforementioned discussion. Then, the Project is to be implemented based on this Inception Report.

(3) Draft Interim Report

Draft Interim Report contained the results of activities conducted in the first fiscal year, between April and December 2012.

(4) Interim Report

The Draft Interim Report was finalized as the Interim Report, after its revision by both the Colombian and the Japanese parts.

(5) Draft Final Report

Draft Final Report is to contain all results of activities conducted in the Project. Then, this is to be reviewed by both the Colombian side and the Japanese side. Comments on the report should be conveyed to the JICA Mission Team within one month after the receipt of the report.

(6) Final Report

The Draft Final Report is to be finalized as the Final Report based on the aforementioned comments.

2 Profile of the Study Area

2.1 Economic and Social Conditions

2.1.1 Colombia

2.1.1.1 Economic Indicators

The World Bank categorizes Colombia as an “upper middle income” country, with Gross Domestic Product (GDP) of US\$288,200 Million, total population of 46.3 million people, and per capita GDP of US\$5,510 in the year 2010. The following Table shows the details of GDP, Total and per capita, at Current Prices and at Constant Prices of 2005.

Table 2-1: Gross Domestic Product (GDP) Total and Per Capita

Gross Domestic Product (GDP) of Colombia: Total & Per Capita, Current Prices & Constant Prices of 2005										
Year	GDP Total				Population		GDP per Capita			
	Current Prices		Constant Prices		(Persons)	Annual Growth (%)	Current Prices		Constant Prices	
	(Thousand Million Pesos)	Annual Growth (%)	(Thousand Million Pesos)	Annual Growth (%)			(Pesos)	Annual Growth (%)	(Pesos)	Annual Growth (%)
2000	208,531		284,761		40,295,563		5,175,036		7,066,808	
2001	225,851	8.3	289,539	1.7	40,813,541	1.3	5,533,727	6.9	7,094,190	0.4
2002	245,323	8.6	296,789	2.5	41,328,824	1.3	5,935,881	7.3	7,181,162	1.2
2003	272,345	11.0	308,418	3.9	41,848,959	1.3	6,507,808	9.6	7,369,789	2.6
2004	307,762	13.0	324,866	5.3	42,368,489	1.2	7,263,936	11.6	7,667,632	4.0
2005	340,156	10.5	340,156	4.7	42,888,592	1.2	7,931,153	9.2	7,931,153	3.4
2006	383,898	12.9	362,938	6.7	43,405,956	1.2	8,844,362	11.5	8,361,479	5.4
2007	431,072	12.3	387,983	6.9	43,926,929	1.2	9,813,388	11.0	8,832,464	5.6
2008	480,087	11.4	401,744	3.5	44,451,147	1.2	10,800,329	10.1	9,037,877	2.3
2009	504,647	5.1	408,379	1.7	44,978,832	1.2	11,219,656	3.9	9,079,360	0.5
2010	543,747	7.7	424,719	4.0	45,509,584	1.2	11,947,967	6.5	9,332,518	2.8
2011	615,772	13.2	449,900	5.9	46,044,601	1.2	13,373,381	11.9	9,770,961	4.7
2000-11		10.3%		4.2%		1.2%		9.0%		3.0%

Source: DANE - Dirección de Síntesis y Cuentas Nacionales, Own calculation

The Bank of the Republic (Banco de la República), on 4 June 2012 presented the last decade figures for the Consumer Price Index (IPC), the Representative Market Exchange Rate between the Colombian Peso and the US Dollar (TRM), the Interest Rate on Fixed Term Deposits (DTF), the Interest Rate for Consumption, the Commercial Interest Rate, and the Mortgage Rate, as indicated in the following Table.

Table 2-2: Recent Economic Indicators: IPC, TRM, DTF, Interest Rates

Recent Economic Indicators (4 June 2012)						
IPC - TRM - DTF - Other Interest Rates						
Year	Consumer Price Index (IPC)	Market Representative Rate (TRM)	Interest Rate on Fixed Time Deposits (DTF)	Interest Rate on Consumption	Commercial Interest Rate	Mortgage Rate
	(%)	(Pesos/US\$)	(%)	(%)	(%)	(%)
2000	8.75	2,229.18	12.15	28.77	16.73	22.24
2001	7.65	2,291.18	12.44	33.57	17.70	20.46
2002	6.99	2,864.79	8.94	28.45	13.39	19.74
2003	6.49	2,778.21	7.80	27.05	12.90	20.61
2004	5.50	2,389.75	7.80	26.00	12.70	19.11
2005	4.85	2,284.22	7.01	24.16	11.97	17.89
2006	4.48	2,238.79	6.27	20.55	10.98	14.89
2007	5.69	2,014.76	8.01	22.29	13.48	15.13
2008	7.67	2,243.59	9.74	25.74	15.33	16.78
2009	2.00	2,044.23	6.15	23.22	11.53	15.36
2010	3.17	1,913.98	3.66	18.15	7.72	13.14
2011	3.73	1,942.70	4.21	18.12	8.39	13.00

Source: Banco de la República

The following Table was indicated by the Bank of the Republic (Banco de la República), and showed the exchange rates as the annual averages that prevailed during the last decade.

Table 2-3: Exchange Rate between Colombian Peso and US Dollar

Exchange Rate between Colombian Peso and US Dollar	
Year	Annual Average (Pesos/USDollar)
2000	2,087.42
2001	2,299.77
2002	2,597.96
2003	2,877.50
2004	2,626.22
2005	2,320.77
2006	2,357.98
2007	2,078.35
2008	1,966.26
2009	2,156.29
2010	1,897.89
2011	1,848.17
2000-2011 rate of change	-1.10%
2003-2011 rate of change	-5.38%

Source: Banco de la República

2.1.1.2 Social Indicators of Colombia

a. Poverty, Life Expectancy, Literacy

The World Bank data indicated that poverty, as per percentage of the population in poverty situation went down continuously, from 47.2% in 2004, down to 45.0% in 2005, to 42.0% in 2008, to 40.2% in 2009 and 37.2% in 2010, a total reduction of 10% in the 6 years between 2004 and 2010. Life expectancy has been stable at 73 years since 2005 up to 2009. Likewise, the literacy rate has been stable at 93% since 2005 up to 2009 in the population aged 15 years and older.

b. Access to Water

The World Bank data also indicated that the percentage of rural population with access to improved water sources was estimated at 73% in 2008. The access to improved water sources was defined as the availability of a minimum of 20 liters of water per person per day within 1km from the house. Improved water sources included house connection, public faucets, boreholes, shallow protected well, and stored water rain.

c. Primary Education

Following with the World Bank data, gross registration for primary education was 120% in the year 2007, 2008 and 2009, but went down to 115% in the year 2010. Gross registration was defined as the ratio between the total number of students registered in primary education, regardless of age, and the population officially in the age group corresponding to the primary education.

d. Infantil Mortality

The World Bank data also defined the mortality rate up to 5 years of age as the probability per thousand of a newborn to live up to 5 years of age. The World Bank data indicated that this mortality rate up to 5 years of age was 21 per 1,000 in the years 2007 and 2008, 20 in the year 2009 and 19 in the year 2010.

2.1.2 Bogota, Capital District

2.1.2.1 Economy of Bogota, Capital District

Bogota, Capital District, the capital city of Colombia, has contributed with around 26% of the Gross Domestic Product of Colombia between the years 2000 and 2010. The values of production in Bogota, C.D., have varied from 54,413 Thousand Million Pesos in the year 2000 to 126,212 Thousand Million Pesos in the year 2010, which were equivalent to 26.3%

and 25.5%, respectively, of the Colombian GDP in those years. Details are shown in the following Table.

Table 2-4: Production of Bogota in reference to Colombian GDP

Colombia - Bogota		
Year	Colombia GDP	Bogota GRP
	(% of Colombia GDP)	(% of Colombia GDP)
2000	100.0	26.3
2001	100.0	26.5
2002	100.0	26.8
2003	100.0	26.5
2004	100.0	26.3
2005	100.0	26.1
2006	100.0	26.1
2007	100.0	26.0
2008	100.0	25.5
2009	100.0	26.0
2010	100.0	25.4

Source: DANE

On the other hand, the sector structure of the economy differs between Colombia as a whole and Bogota, Capital District, as indicated in the following Table.

Table 2-5: Comparison between Sector Structures

Colombia - Bogota		
Economic Sector	Colombia	Bogota
	(%)	(%)
Primary	14.0	0.0
Secondary	23.0	19.0
Tertiary	54.0	72.0
Taxes	9.0	9.0
Total	100.0	100.0

Sources: DANE, World Bank

2.1.2.2 Relevant Social Characteristics of Bogota, Capital District

The following Table shows the population of Bogota between 1985 and 2005, in periods of 5 years. The total population of Bogota was 6,840,116 persons in 2005, composed of 3,554,408 women and 3,285,708 men. The population growth rate in Bogota between 1985 and 2005 was 2.44% cumulative annual rate, which is double the national population growth rate.

Table 2-6: Bogota: Demographic Indicators 1985-2005

Bogota: Demographic Indicators 1985 - 2005					
Year	Population			Masculinity Index (per 100 women)	Average Age (year)
	Total	Male	Female		
1985	4,225,649	1,999,538	2,226,111	89.82%	21.91
1990	4,947,890	2,351,993	2,595,897	90.60%	23.18
1995	5,699,655	2,717,697	2,981,958	91.14%	24.23
2000	6,302,881	3,016,761	3,286,120	91.80%	25.62
2005	6,840,116	3,285,708	3,554,408	92.44%	27.55
1985-2005 rate of change	2.44%	2.51%	2.37%	-	-

Source: DANE

Life expectancy at birth showed a continuously increasing trend, and for the period 2000-2005 it was 78.3 years for women, and 72.6 years for men, with an average of 75.4 years. On the contrary, infant mortality showed a continuously declining trend, and for the period 2000-2005 it was 20.5 per thousand live births.

As can be seen in the following table, households in Bogota in 2011 were provided with public services such as water supply, electricity, sewer service, and solid waste collection in very high proportions exceeding 99%. Further, the proportion of households having bathrooms and toilet facilities also exceeded 99%. However, households with the exclusive use of toilet facilities accounted for 93%, and households with shared toilet facilities accounted for 7%. Compared with the very high proportions of households with the public services already mentioned, households with the supply of natural gas accounted for around 88%, and households with fixed line telephones amounted to 70%. Slightly over 1% of the households with the electricity and natural gas services did not pay for the said services.

Public Services Available to Households in Bogota					
Service	Total	Hholds with Service		Hholds w/o Service	
	Households	Number	%	Number	%
Solid waste collection	2,185,874	2,183,985	0.9991	1,889	0.0009
Fixed line telephone	2,185,874	1,537,124	0.7032	648,749	0.2968
One line		1,437,061	0.6574		
Two lines		96,641	0.0442		
Three lines or more		3,423	0.0016		
Natural gas	2,185,874	1,915,083	0.8761	270,791	0.1239
Pay for directly		1,801,500	0.8242		
Pay for with the rent		86,682	0.0397		
Do not pay		26,901	0.0123		
Electric energy	2,185,874	2,169,598	0.9926	16,276	0.0074
Pay for directly		2,012,019	0.9205		
Pay for with the rent		133,322	0.0610		
Do not pay		24,258	0.0111		
Bathroom	2,185,874	2,171,283	0.9933	14,591	0.0067
With shower		2,149,032	0.9831		
Without shower		22,251	0.0102		
Toilet	2,185,874	2,183,254	0.9988	2,619	0.0012
Connected to sewer		2,178,018	0.9964		
Connected to septic tank		5,236	0.0024		
Inside the house		2,155,069	0.9859		
Outside the house		28,186	0.0129		
Exclusive of the house		2,025,299	0.9265		
Shared		157,956	0.0723		
Sewer	2,185,874	2,182,517	0.9985	3,357	0.0015
Water supply	2,185,874	2,182,051	0.9983	3,823	0.0017
Public		2,171,130	0.9933		
Communal		8,310	0.0038		
Public fawcet		1,251	0.0006		
Bottled water		2,572	0.0012		
Tank lorry, well, rain, river		2,610	0.0012		
Inside the house		2,106,381	0.9636		

Source: Encuesta Multipropósito para Bogotá EMB 2011, DANE

2.2 Natural Condition

2.2.1 Geography

Bogotá is located on the east of the Savannah of Bogotá, 2640 metres above sea level. Although it is located in savannah, the geographical site is actually a high plateau in the Andes Mountains. The extended region is also known as "Altiplano Cundiboyacense (high plateau of Cundinamarca and Boyacá)".

The Bogotá River crosses the savannah, forming Tequendama Falls (Salto de Tequendama) to the south. Tributary rivers form valleys with flourishing villages, whose economy is based on agriculture, livestock raising and artisanal production.

The savannah is bordered to the east by the Eastern Cordillera of the Andes mountain range. Surrounding hills, which limit city growth, run from south to north, parallel to the Guadalupe and Monserrate mountains. The western city limit is the Bogotá River. The Sumapaz Paramo (moorland) borders the south and to the north Bogotá extends over the plateau up to the towns of Chía and Sopó.

2.2.2 Climate

Bogotá has a subtropical highland climate. The average temperature is 14.5 °C, and it varies from 4 to 19 °C in fair skies days, to 10 to 18 °C in heavy rain days. Dry and rainy seasons alternate throughout the year.

Table 2-7: Climate data for Observatorio Meteorológico Nacional, Bogotá D.C. (1971–2000)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high (°C)	20.2	20.3	20.4	20.1	20	19.2	18.6	18.8	19.2	19.5	19.6	19.9	19.6
Daily mean (°C)	14.3	14.5	14.9	14.9	15	14.5	14.6	14.1	14.3	14.3	14.4	14.6	14.53
Average low (°C)	7.6	8.4	9.5	9.7	9.7	9.5	9.2	8.9	8.7	9	9.2	8	8.95
Precipitation (mm)	50	68	91	135	120	54	35	45	70	137	127	81	1,013

Source: Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM)

3 New Policies and Integrated Solid Waste Management Master Plan

New policies in solid waste management have been defined by the new Bogota D.C. government. One of these policies is “Zero Waste”; additionally, there is another important policy such as “Plan to Include Recycling Workers in Public Waste Management.”

On the other hand, Bogotá D.C. has a Master Plan for Integrated Solid Waste Management (PMIRS in Spanish) since 2006 which is a District decree; consequently, it is a legal base for UAESP activities and other related institutions. However, some parts of the current PMIRS are not compatible with the new policies; as a result, there is a need to adjust the PMIRS.

This chapter shows the new policies and the PMIRS.

3.1 New Policies

3.1.1 Zero Waste

Zero Waste is a policy presented in the Development Plan, Article 30. The Development Plan is commitment on which the District government will be working between 2012 and 2015 during four years. Zero Waste includes the following 6 issues:

1. Strategy for sustainable production
2. Waste minimization culture and separation at the source
3. Recycling model for Bogota
4. Final reuse and waste disposal minimization in the sanitary landfill
5. Zero Debris.
6. Special and hazardous integrated waste management.

When implementing the previous issues, it expected to reach the following goals:

- To instruct and increase conscious awareness up to 100% of clients for cleansing service to attain separation at the source and differentiated waste disposal.
- To expand to 100% of the city coverage for recycling routes.
- To begin to operate 6 recycling parks and 60 warehouses that will be specialized in recycling.
- To structure a District system for Recyclers and Recovery Material personnel.

- To establish a promotion program and develop markets for recyclable products.
- To construct and operate 60 recycling companies.
- To make use of that 20% of solid waste received in the sanitary landfill.
- To manage 100% of debris generated in the city by using modern techniques, treatment, and final disposal.
- To promote the construction of 6 debris disposal sites.
- To improve planning for making use, treat, and dispose of debris in Bogota.
- To define location of areas for waste management, treatment, use, and disposal in Bogota.
- To develop an efficient and sustainable model for debris management in the city.
- To develop a strategy for management, recover, and making use of e-waste that would be based in the responsibility by different actors in the cycle of the product.
- To control, make use, and treat 100% of waste tons generated in the District.

3.1.2 Inclusion Plan

a. Background

The Plan to Include Recycling Workers in Public Waste Management (Inclusion Plan) is a plan presented to the Constitutional Court to comply with Court Order 275 issued on the 19th of December, 2011. Furthermore, the Court issued another order (No. 84, April 19th, 2012) which order immediate implementation of the Inclusion Plan.

Bogota has spent the last 10 year in these inclusion efforts for recycling workers. In the following paragraph the Decree 312, 2006 describes some background:

In Sentence T724 of 2003, issued by the Constitutional Court warned, in terms of article 24 of Decree 2591, 1991, to the Executive Unit for Public Services in the Capital District of Bogota or the District entity that replaces it to include affirmative actions in the future to favor Bogota's recyclers whenever cleansing public services are contracted, taking into account that the activity recyclers conduct is closely linked to the cleansing service, in order to attain real equality conditions and comply with social responsibilities by the State; additionally, by no means the entity should have the omissions such as the ones which took place in Tender Bidding No. 01, 2002 regarding recyclers in Bogota and decided to "GRANT protection on fundamental rights related to due process, to equality, to work of actors" (Quote Decree 312, 2006).

b. Expected Results

The following outputs are expected through Implementation Plan:

- 100% city coverage by selective routes.
- Recovery of 2,200 tons/day of recyclable waste which will not reach the sanitary landfill.
- Potential to include 8,916 recyclers in selective collection routes, storage centers, and recycling parks; it is not included the expansion of pre-transformation processes.
- Income improvement by all recyclers, organized or independents, due to payment from transport and collection tariff.

(Source; page 25 of the Plan)

3.2 Integrated Solid Waste Management Master Plan

Integrated Solid Waste Management Plan (PMIRS) is a valid district decree (Decree 312, 2006) and complemented with District Decree 620, 2007.

3.2.1 Structure

PMIRS is structured as it is shown in the following figure.

“Structural Objectives” reflect the direction Bogota D.C. intends to follow regarding solid waste management. Additionally, there is a series of “Principles” that can be considered the philosophy followed when implementing the PMIRS.

The Plan is composed of three “Axis: Territorial-Environmental, Social-Productive, and Economical-Financial.” Each axis has it “Objectives, Policies, Strategies, and Programs/Projects.”

In order to monitor and evaluate the progress on PMIRS, it has been prepared “Evaluation, Control, and Follow-up tools for the Master Plan” which consists of “Goals” and indicators.

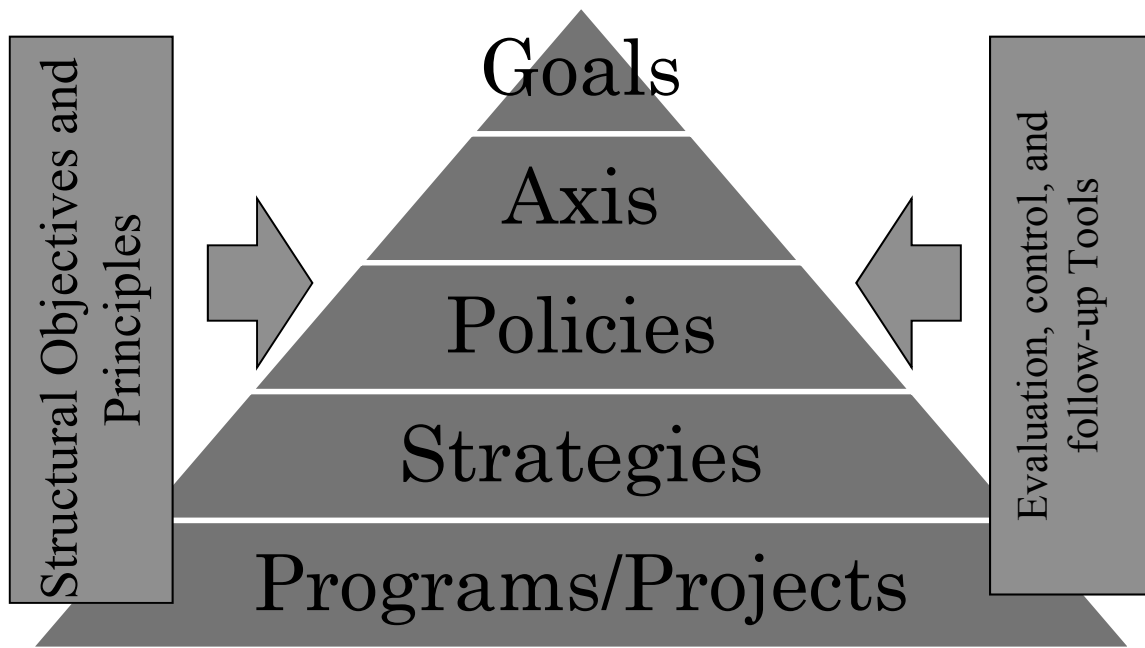


Figure 3-1: PMIRS Structure

3.2.2 Structural Objectives

According to Article 4 in the Decree, the Plan is directed to attain the following structural objectives:

- *To promote, among citizens of the Capital District and other municipalities in the Region that agree with the Plan, a culture of waste minimization and separation at the source, its productive use based on the understanding of the positive impacts of these practices for the natural environment, health, and public space constructed.*
- *To attain the highest economies of scale, the highest efficiency index, competitiveness, and productivity, and the lowest environmental and social impact to provide a Cleansing Public Service to reduce costs to clients.*
- *To coordinate regionally the infrastructure for waste final disposal, treatment, and transportation macro routes to make use of the comparative and competitive advantage for different municipal territories and the corresponding capacities for private, public, and community agents that are related to solid waste management.*
- *To always coordinate the financial efficiency and sufficiency in solid waste management towards attaining social objectives in order to advance affirmative actions for low income clients and recycling workers under poverty and vulnerability conditions for their social inclusion and acknowledgement of their role in Solid Waste General System.*

- *To timely prevent and respond to risks, disasters, and emergencies which could take place to guarantee permanent provision of Public Service Cleansing.*

3.2.3 Goals and Indicators

The following goals and indicators are obtained from “Title XI: Evaluation, Control, and Follow-up Tools for the Master Plan, in the PMIRS.”

a. To short, medium, and long term:

1.1 For Common Waste Household Public Service, UAESP will guarantee 100% coverage of household collection, final disposal, and treatment of these wastes. This indicator will be measured as it is defined by the Water Supply and Basic Sanitation Regulatory Commission.

1.2 For the Non-household Public Cleansing Service Component.

1.2.1 Street Sweeping and Cleansing. UAESP will guarantee 100% coverage in all road network in the Capital District by using mechanical means in the road network. This indicator will be measured as it is defined by the Basic Sanitation Regulatory Commission.

1.2.2 Public Areas Sweeping and Cleansing. UAESP will guarantee 100% coverage for cleansing of the following areas:

- *Areas of free passage which are accessible to any resident.
- *Front gardens, not enclosed,
- *Road separators,
- *Roundabout,
- *Loops not constructed yet,
- *Sidewalks,
- *Squares, small squares,
- *Parks of different size,
- *Environmental Control Buffer Zone,
- *Areas for Environmental Preservation and Management

This indicator will be measured based on the square meters (m²) of public area reported by DAPD to the UAESP.

1.2.3 Grass Cutting: UAESP will guarantee 100% coverage of grass cutting in public areas with a minimum frequency of 10 times per year. This indicator will be adjusted according to tariff costs accepted by Water Supply and Basic Sanitation Regulatory Commission for this Public Cleansing Service component.

1.2.4 Pruning Waste: To service 100% of requests by the public entity and Public Cleansing Service clients; there has to be a review and consultanship of the request by District Botanic Garden beforehand, taking into account available resources for that purpose.

1.2.5 Final Disposal and treatment. UAESP will guarantee 100% coverage for final disposal and treatment of waste discharged in the sanitary landfill whenever Capital District participates.

1.2.6 Leachate treatment. UAESP guarantees 100% coverage for leachate treatment that is considered in the environmental permit and environmental management for the sanitary landfill; the permit is issued by an authorized environmental authority.

1.3 For Public Cleansing Service Quality: The District Administration will guarantee compliance of quality and indicators quality which are established by the Water Supply and Basic Sanitation Regulatory Commission for the definition of tariff costs and those proposed by the District Administration to the regulatory entity to attain the Concept "Clean Area" as long as the costs are covered by Public Cleansing Service fee approved.

1.3.1 The number of weekly frequency for street sweeping and cleansing of public roads and areas: no less than twice a week and more than twice a week for areas with high citizen participation according to frequent analysis conducted by UAESP.

1.3.2 Number of weekly frequency for ordinary household cleansing service collection: 3 times a week for residential clients and small generators.

1.4 Hazardous waste collection: provision of hazardous waste cleansing service beginning in 2007.

1.5 For waste final disposal: expand service life of Doña Juana sanitary landfill for 7 more years beginning in 2008.

1.6 For emergency prevention and response: to account for contingency plans and respond to risks for 100% cleansing service beginning in 2008.

1.7 For use of waste generated: 2 debris facilities operating since 2007.

1.8 For use of waste generated: To contract thermal reduction and/or biogas generation in Doña Juana Sanitary Landfill beginning in 2008.

1.9 For use of waste generated: 2 recycling parks operating since 2007.

1.10 For use of waste generated: Operation of special collection routes for recyclable materials that will collect 100% of waste separated at the source beginning in 2007.

b. For Medium Term:

1.11 Health care collection and treatment: UAESP guarantees 100% coverage for healthcare waste collection, pathological, and similar waste generated by hospitals, clinics, labs, and,

generally, every establishment in the urban area of Capital District which generates this type of waste between 2006 and 2010.

1.12 Hazardous waste collection: to attain a 100% coverage between 2006 and 2010.

1.13 Debris collection: to attain a 100% coverage between 2006 and 2010.

1.14 For information: Contracting concession companies for cleansing service provision with costs and efficiency indicators in 2010.

1.15 For waste final disposal: reduction up to 20% of waste which is discharged in Doña Juana Landfill in a 10 years period.

1.16 For Fees: 100% of clients know fee options by 2009.

1.17 For Service: 12 Local Municipalities with client information system of SPA beginning in 2011.

c. Long Term

1.18 For Recycling: Recycling and make use of waste from the Public Cleansing Service: 25% from 2006 to 2016.

1.19 For rural populated centers: Implementation of an integrated solid waste management in 10 rural populated centers by 2012.

1.20 For recycling: 10 storage centers for recycled material by 2012.

1.21 For PMIR: Committee for PMIRS follow-up working since 2007.

1.22 For Final Disposal: To have a regional landfill beginning in 2016 or when Doña Juana landfill site service life is finished. De

4 Current Solid Waste Management Situation

4.1 History of Solid Waste Management in Bogota D.C.

a. To December 2012

In 1994, Law 142, “Law of Public Utilities” was issued, whereby the State was allowed to delegate unto private companies, in the form of concession, the provision of public services, but under the State’s control and supervision.

In observance of the orders of the Council of Bogota and considering the provisions of Law 142 of 1994, the city’s administration granted a concession for garbage collection, sweeping and cleaning public areas and the final disposal of solid waste, resulting from the corresponding bidding process. The Office of the Mayor created the UESP – Executive Unit for Public Services – through Decree 782 in 1994 to supervise, control and plan these issues.

Thanks to these policies, the city now has an organized service that allows for garbage to be collected throughout the city three times a week in previously established timeframes. This service is provided through concession contracts with the consortia Ciudad Limpia, Lime, Aseo Capital and Atesa.

Each consortium is responsible for garbage collection in certain areas, in addition to sweeping main roads, tree pruning and lawn mowing.

This also entails collecting solid waste generated by small, medium and large-size waste generators, which are basically the city’s industrial and commercial establishments.

The Doña Juana landfill is located in the city’s southern area and is currently operated by the CGR consortium. The landfill has leachate and landfill gas treatment facilities, along with the cells.

Likewise, there is also a hospital route managed by Ecocapital Internacional, who is accountable for collecting medical waste and similar.

(Reference: portel.bogota.gov.co/portel/libreria/php/x_frame_detalle.php?id=40680)

b. As of December 2012

Two significant changes have been observed in the garbage collection system. One of them is the participation of a public entity, Aguas de Bogota, in the Garbage Collection, Sweeping and Cleaning (RBL, in Spanish) service. The city is divided into six (6) areas. Aguas de Bogota is responsible for three (3) areas and the other three (3) are covered by Ciudad Limpia, Lime and Aseo Capital, individually.

4 Current Solid Waste Management Situation

The other change was the division in the collection of ordinary waste, entailing the separation of the RBL service and the Potentially Recyclable Material (MPR, in Spanish) collection, by virtue of Decree 564 issued in December 2012. The former is handled by the RBL Concessionaires, and the latter by the recyclers.

These changes represent significant challenges for the local administration and the city, especially since establishing the MPR collection system requires organizing the recyclers, enhancing their capacity to render the service and raising awareness among the citizens on the importance of minimizing and recycling solid waste.

4.2 Current Waste Flow

The following tables and figures show current waste flow in Bogota D.C. Collection and Final Disposal figures are real and have been recorded in Doña Juana Sanitary Landfill weighbridge. Other figures are estimated based on surveys reviewed in this study. The city has 100% coverage regarding the collection service; as a result, it is assumed that wastes are not scattered in the streets and other spaces.

Table 4-1: Current Solid Waste Flow in Bogota D.C. in 2011

Unit: Tons/day

Service	Generation	For Recycling	Recycled	Rejected	Collect.	Other 3R*	Final Disp.
Household Collection	4,786	353	312	41	4,433	0	4,433
Household	2,515	126	111	15	2,390	0	2,390
Small businesses	2,270	227	201	26	2,043	0	2,043
Big Generators	510	51	45	6	459	0	459
Street Sweeping	345		0	47	392	0	392
Grass Cutting	108		0		108	0	108
Market	65		0		65	0	65
Debris	823		0		823	0	823
Pruning Waste	28		0		28	0	28
Total	6,665	404	357	-	6,308	0	6,308

* In September 2012, a part of Grass Cutting and Pruning Waste was being treated experimentally.

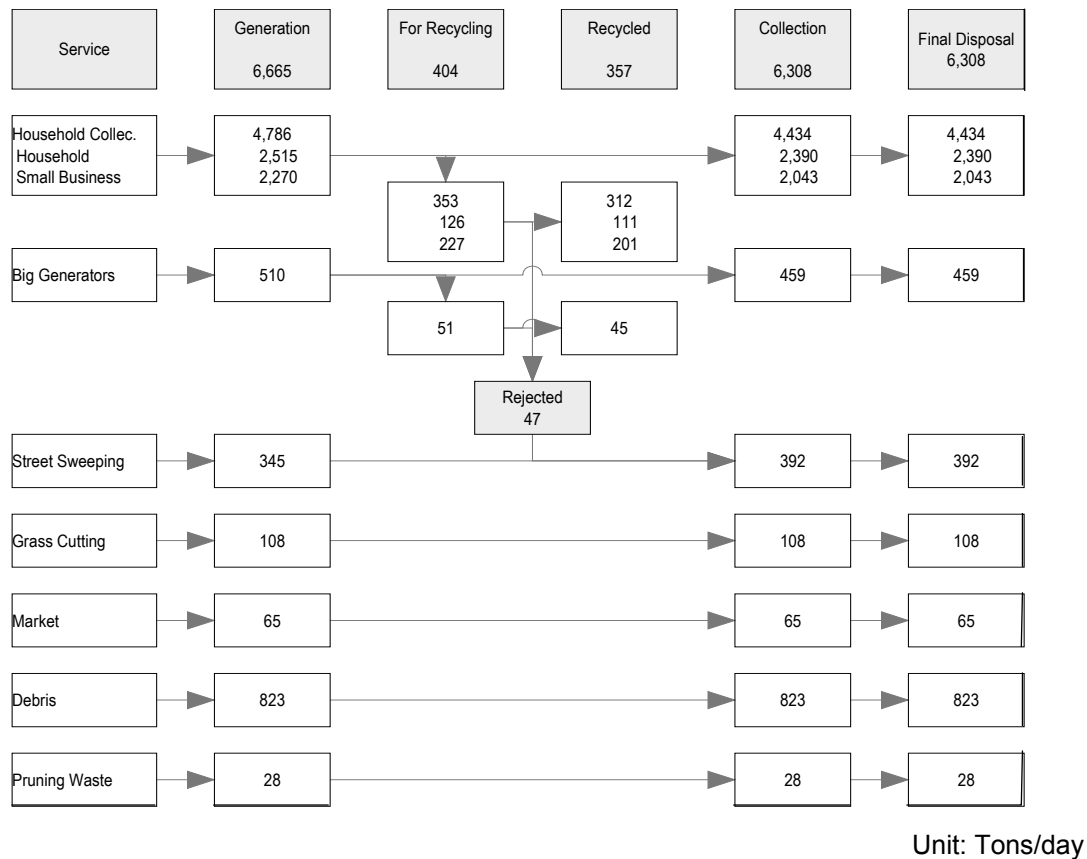


Figure 4-1: Current Solid Waste Flow in Bogota D.C. in 2011

4.3 Collection, Sweeping and Cleaning (CSC)

4.3.1 CSC History

4.3.1.1 Relevant National Legislation

The environmental principles related to garbage collection services are set forth in Colombia's 1991 Constitution. For example, Article 49 states that "the state is responsible for health care and sanitation services. All persons are guaranteed access to services for the promotion, protection, and recovery of health." Other important provisions in the same 1991 Constitution are Articles 78, 79, and 80 on collective and environmental rights, and Article 366 which refers to the state's social ends and public services.

In addition, the Congress passed Law 142 of 11 July 1994 that establishes the Residential Public Services Regime and other provisions, along with Law 632 of 29 December 2000 that partially amends it. In addition, the Ministry of the Environment/Ministry of Economic Development issued Decree 1713 of 6 August 2002 that provides the regulations for Law 142, with some partial amendments; Decree 1140 of 7 May 2003 amends Decree 1713, mainly in relation to collective storage systems; Decree 1505 of 4 June 2003 partially amends Decree 1713 of 2002, regarding plans for integrated waste management and other provisions.

4 Current Solid Waste Management Situation

In addition, on 19 December 2008, Congress passed Law 1259 that establishes environmental fines in the country for violators of the standards of garbage collection, cleanliness, construction and demolition waste collection, and other provisions.

Moreover, Resolution No. 1096 of 2000 adapts the Technical Regulations for Drinking Water and Basic Sanitation (RAS 2000), which, in turn, is modified by Resolution 1459 of 2005.

4.3.1.2 Relevant Local Legislation

Accord 417 of 2009 regulates the above-mentioned Law 1259, concerning the implementation of environmental fines in Bogota.

Finally, Resolutions No. 151 and 152 of 2012, signed by the Director General of the UAESP, adopt, respectively, the Technical and Operating Regulations, and the Commercial and Financial Regulations, along with the concession contracts, detailing components concerning garbage collection, transport, sweeping and cleaning of streets and public areas, grass cutting, tree pruning in public areas, and transport of waste to the disposal site.

4.3.2 Collection and Transport

4.3.2.1 Regular collection prior to December 18, 2012

a. General observations

Collection service was supplied by four (4) operators in six (6) special service areas (ASE) in 19 districts, as seen in Figure 5-2. Concession contracts 013-2012, 014-2012, 015-2012 and 016-2012 were granted to the companies LIME, Aseo Capital, Ciudad Limpia and ATESA, respectively.

The concessionaire's responsibility included: collecting and transporting to the final disposal or treatment site for waste generated by residential and small producer sources, ordinary waste generated by large generators, sweeping, cleaning public areas, lawn mowing, cleaning public green areas and trimming wherever the UAESP instructed. This, in addition to the commercial and financial task relating to the collection service in the areas where the service is rendered and collecting recoverable material by way of a selective collection route.



Figure 4-2: Six special service areas covered by 4 operators

Table 4-2: Collection by ASE and Service Provider (tons/day)

ASE		2009	2010	2011	2012	Ave.	%
1	Lime	1.131	1.207	1.236	1.262	1.209	20%
2	Atesa	886	967	970	948	943	15%
3	Aseo Capital	863	837	849	817	842	14%
4	Aseo Capital	926	1.001	1.022	1.002	988	16%
5	Lime	781	828	879	847	834	14%
6	Ciudad Limpia	1.195	1.272	1.352	1.374	1.298	21%
	Subtotal	5.782	6.112	6.309	6.249	6.113	100%

b. Supervision/Surveyorship

The UAESP hired a supervision/surveyorship service (034-2012) to supervise the contract with the concessionaires.

This supervision encompasses: Technical and Operating Supervision; Economic, Commercial and Financial Supervision; Legal Supervision; Environmental and Sanitary Supervision; and Systems Supervision.

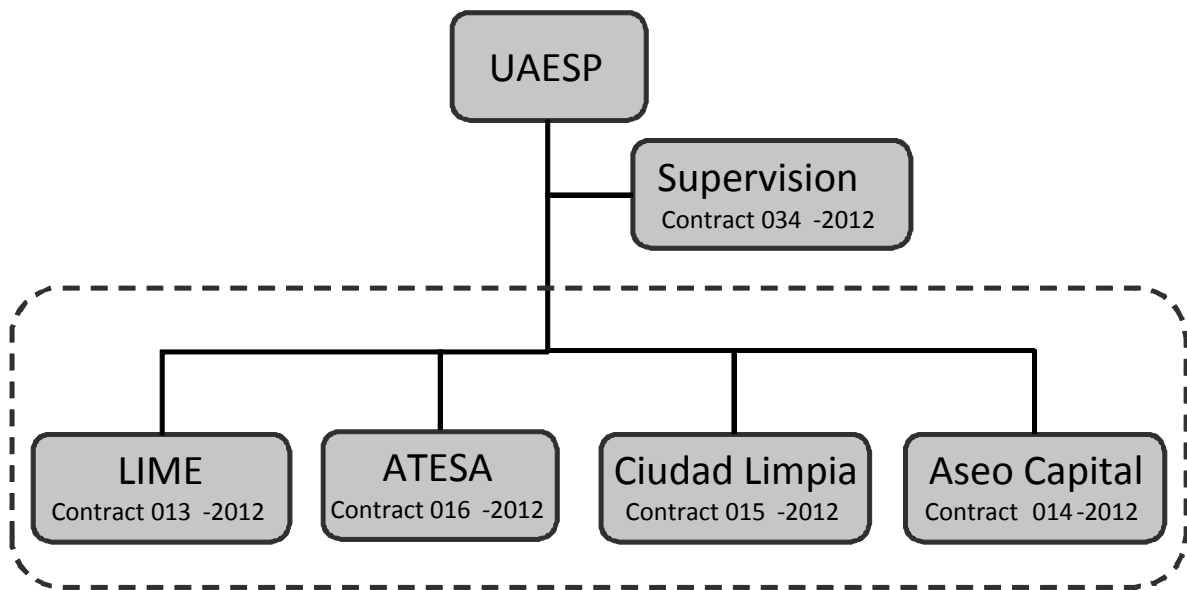


Figure 4-3: Contract Scheme before December 18

4.3.2.2 Collection Service after December 18, 2012 (Short Term)

a. General Observations

The UAESP decided to enter into inter-administrative contract 017 of 2012 with the Empresa de Acueducto y Alcantarillado de Bogota E.S.P. [*Water Utilities of Bogota*] grounded on Law 142/1994 or Public Utilities Regime, which authorizes the subscription, among others, of the following special contracts: “39.3 Contracts of public entities to (...) delegate unto third parties any of the activities they have carried out to provide the public services services (...)”.

The UAESP needed to enter into this contract as a consequence of the legal duties stated in Writ No. 275/2011 issued by the Honorable Constitutional Court, and of its obligation to ensure the efficient rendering of the garbage collection service in the city of Bogota. Moreover, the city's current administration adopted the Development Plan for Bogota D.C., through District Agreement 489 of 2012, which ordered on the "Third Axis, a Bogota that Defends and Reinforces that which is Public."

The obligations acquired by the Empresa de Acueducto with the UAESP are divided into two large groups:

- a) Those relating to the collection, sweeping and cleaning of non-exploitable ordinary waste, similar to those of the contractors part of the previous concession.
- b) Those relating to compliance with Writ 275/2011 issued by the Constitutional Court, which are practically additional to the contractual obligations of the previous concessions, eg. support Authorized Recycler Organizations (Organizations de Recicladores Autorizadas – ORA) in compliance with the tasks relating to the Collection and Transportation of Exploitable Waste.

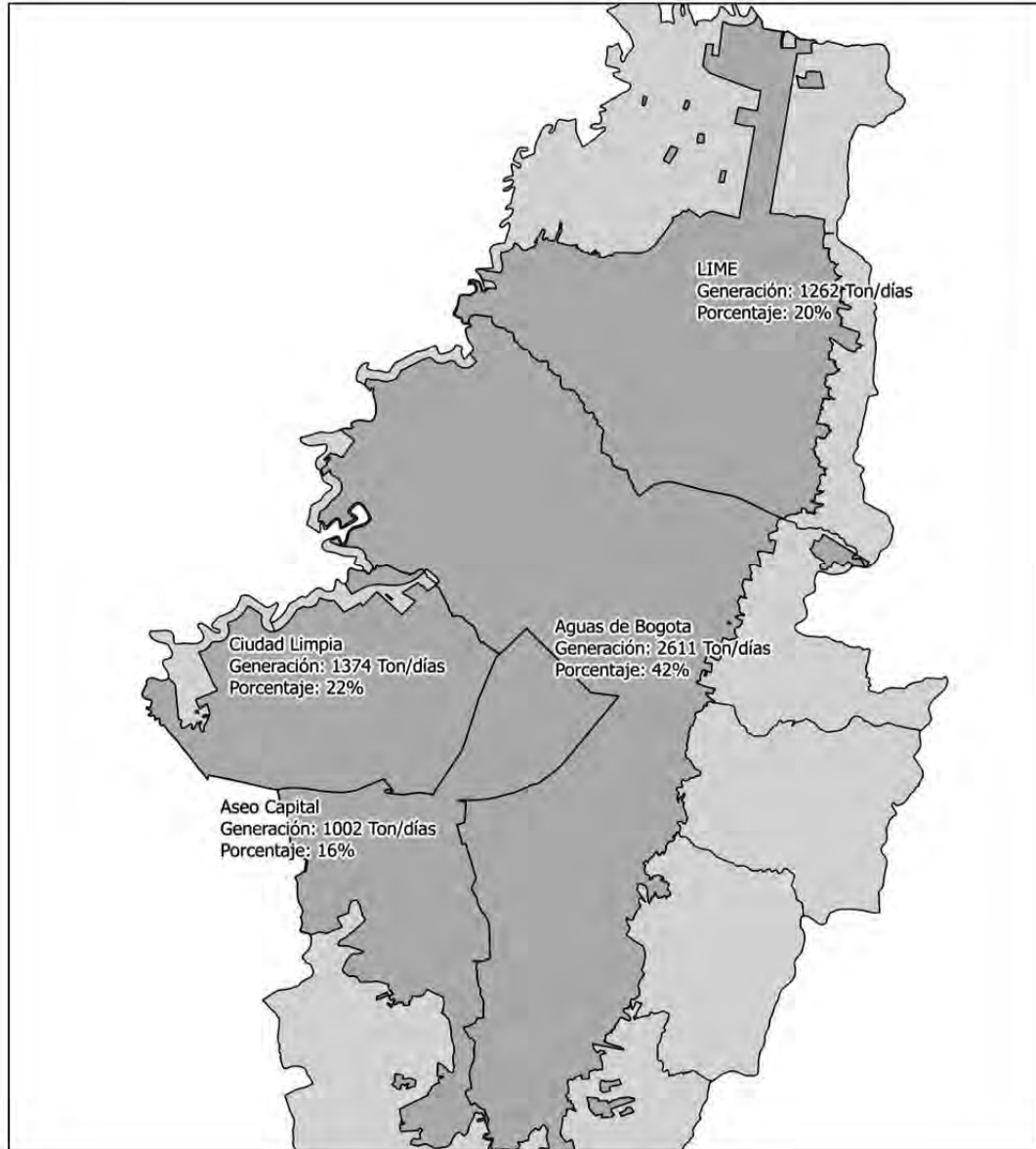
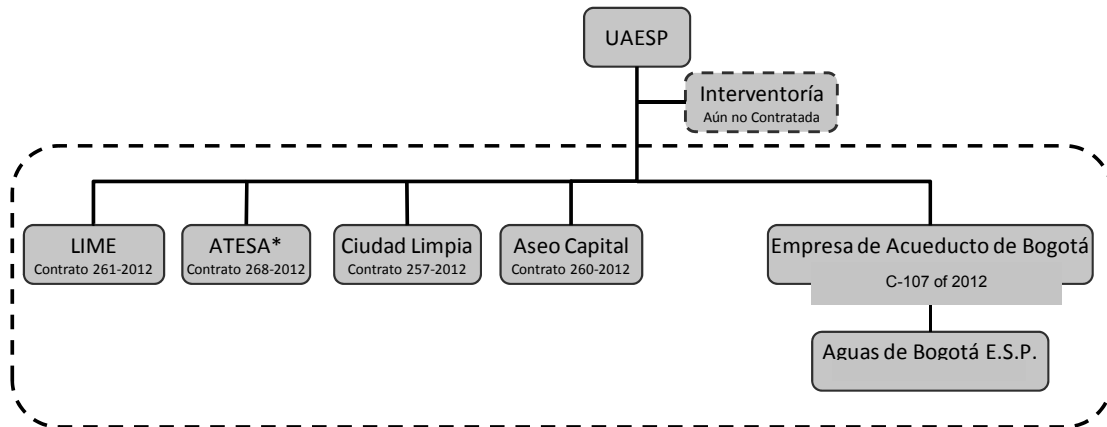


Figure 4-4: Distribution of Operators as of May 2013

Table 4-3: Collection by ASE and Service Provider (Tons/day) in May 2013

ASE	Operator	Ave.	%
1	Lime	1.262	20%
2,3,5	Aguas de Bogota	2.611	42%
4	Aseo Capital	1.002	16%
6	Ciudad Limpia	1.374	22%
	Total	6.249	100%



* ATESA's contract expired on April 22, 2013

Figure 4-5: Contract Scheme after December 18 (Short Term)

b. Interventoría

Up to May 2013, a Supervision task had not been hired to supervise the garbage collection works. The same RBL directorate had taken over the work previously handled by the Interventoria, such as field supervisión, taking in consideration to reinforce human resources in the short term and to contact out to the private sector in the middle and long term.

4.3.3 Transfer and Transport

Resolution No. 1096 of 17 November 2000 "By means of which the Technical Regulations for Drinking Water and Basic Sanitation - RAS, is adopted," states in Chapter F, point **F.3.4.3 Evaluation and Control**, that "the garbage collection service provider must manage and inventory detailed information about cost of the collection system, including capital costs, operation, and maintenance." It also states that "if, as a result of a periodic evaluation, the cost of collection is determined to be too high, the use of transfer stations (F.3.7) could be considered, provided that the costs and benefits of using the latter would be more economical."

The study by Jorge Perdomo and Juan Ramírez, entitled "Análisis económico sobre el tamaño óptimo del mercado y ubicación de estaciones de transferencia para el manejo de residuos

sólidos en Colombia” [Economic analysis of the optimum size of the market and location of transfer stations for solid waste management in Colombia] concluded that "when landfills are located more 35 kilometers (km), from the center of the area served, it is necessary to have at least one transfer station for the transshipment of solid waste to vehicles with larger capacity."

4.4 Recycling

According to the study “Caracterización de actividades de reciclaje en Bogotá” (*Characterization of recycling activities in Bogotá*, in English) conducted by the UAESP, along with Javeriana University, between August and December 2010, the real situation of recyclers was identified.

a. Number and distribution of recyclers

According to the results of the study, the total number of recyclers in Bogotá D.C. is 11,109 individuals: 31% of them are women and the other 69% are men.

The three localities where most of the recyclers are present are Kennedy, Suba and Ciudad Bolívar. 38% of the recyclers are in these three localities while 45% are in the warehouses. The distribution of the recyclers by locality corresponds to the distribution of the warehouses.

Table 4-4: Number of recyclers per locality

Locality	Number of recyclers	Proportion (%)
01_Usaquén	225	2.0
02_Chapinero	44	0.4
03_Santa Fe	677	6.1
04_San Cristóbal	508	4.6
05_Usme	316	2.8
06_Tunjuelito	222	2.0
07_Bosa	713	6.4
08_Kennedy	2078	18.7
09_Fontibón	495	4.5
10_Engativá	809	7.3
11_Suba	1,129	10.2
12_Barríos Unidos	307	2.8
13_Teusaquillo	16	0.1
14_Los Mártires	737	6.6
15_Antonio Nariño	106	1.0
16_Puente Aranda	433	3.9
17_La Candelaria	257	2.3
18_Rafael Uribe	575	5.2
19_Ciudad Bolívar	1026	9.2
96_La Alquería Collection Center	436	3.9
Total	11,109	

b. Type of activity

81% of the recyclers belong to one organization of recyclers while more than 18% do not belong to any organization but work on an individual basis.

Table 4-5: Types of activities of recyclers

Category	Number of people	Proportion (%)
Belongs to one organization	9,013	81.1
Does not belong to one organization	2,004	18.1
Unknown	92	0.8
Total	11,109	100

c. Collection Sites

87% of the collection places for recyclable waste of the recyclers are the streets followed by garbage rooms of condominiums (7%) and garbage rooms of malls (2%).

Table 4-6: Collection places for recyclable waste by recyclers

Collection places	Number	Proportion (%)
Garbage rooms of malls	224	2.0
Garbage rooms of condominiums	784	7.1
Streets	9,667	87.0
Other	339	3.1
Unknown	95	0.9
Total	11,109	100

d. Places for selling collected recyclable resources

Most of the recyclable resources collected by recyclers are sold to warehouses and a small proportion is sold to companies.

Table 4-7: Places for selling collected recyclable resources

Sales points	Number of people	Proportion
Trucks	177	1.6
Warehouses	10,656	95.9
Companies	186	1.7
Other recyclers	70	0.6
Unknown	20	0.2
Total	11,109	100.0

e. Type and amount of collected recyclable resources

On average, a recycler collects 800 kg of recyclable resources per month. The proportion of collected recyclable resources is shown in the table below.

Table 4-8: Type and amount of collected recyclable resources

Paper	Metals	Plastics	Glass	Other	Total
36,8%	28,1%	21,9%	11,7%	1,4%	100,0%

4.5 Dona Juana Landfill Diagnosis

4.5.1 Introduction

Doña Juana landfill started activities in 1988 and currently receives household and commercial solid waste generated in Bogotá and the municipalities of Cáqueza, Chipaque, Choachí, Fosca, Gutiérrez, Ubaque, Sumapaz, Une, and others (local municipalities, community units, etc.)

About 190,000 tons of waste is disposed of monthly, reaching a maximum daily waste of approximately 8,400 tons.

Waste is currently disposed of in the Optimization Zone Phase 1 in operation as of 2011.

The Unidad Especial de Servicios Públicos, UAESP (Special Public Services Unit) is in charge of managing Doña Juana Landfill, which maintains the following contracts or concessions for the correct execution of the landfill project:

- Concession Contract N°344 of 2010 entered into between Unidad Administrativa Especial de Servicios Públicos (hereinafter, UAESP) and the Sociedad Centro de Gerenciamiento de Residuos Doña Juana S.A. ESP (hereinafter, CGR Doña Juana S.A. ESP) for the “*Management, Operation and Integral Maintenance of Doña Juana Landfill of the City of Bogotá, D.C., Colombia, in its components for the final disposal of solid waste and leachate treatment, with alternatives to use waste entering the RSDJ from the regular garbage collection service*”. CGR Doña Juana S.A. ESP assumed the landfill operation on December 16, 2010.
- Concession Contract N° 137 entered into between Unidad Administrativa Especial de Servicios Públicos (UAESP) and Sociedad Biogás Doña Juana S.A. ESP, for “*Treatment and Use of Biogas from the Doña Juana Landfill of the Capital District, and application of the Clean Development Mechanism (CDM) of the Protocol of Kyoto*”. As of September 2009, began the emissions certification as set forth in the contract.
- Supervision Contract N°130 of 2011 entered into between Unidad Administrativa Especial de Servicios Públicos (UAESP) and Temporary Unit INTER DJ, with the objective of “*Performing the integral auditing of the concession contracts for the*

management, operation and maintenance of Doña Juana Landfill in its components of final disposal of regular and hospital solid waste, leachate treatment, treatment and use of biogas, use of solid waste from the regular garbage collection service and all those works executed within". The company Temporary Union INTER DJ started activities on June 20, 2011.

- Contract of Works N° 346 of 2010 entered into between Unidad Administrativa Especial de Servicios Públicos (UAESP) and the company Temporary Union Cerramiento MV with the objective of "Performing studies, designs and construction of the perimeter enclosure of Doña Juana Landfill". In October 2012 the documents relating to the termination and reception of completed works were formalized.

Below is shown a historical background of the Doña Juana Landfill.

4.5.2 Historical Background

Doña Juana Landfill (RSDJ) is located in the locality of Ciudad Bolívar, southeast of the city of Bogotá D.C. The property is bounded on the east with Avenida Boyacá and the Tunjuelo River, on the west with the rural road to Pasquilla and private properties, on the south with Quebrada Aguas Claras and on the north with private properties (see following images).

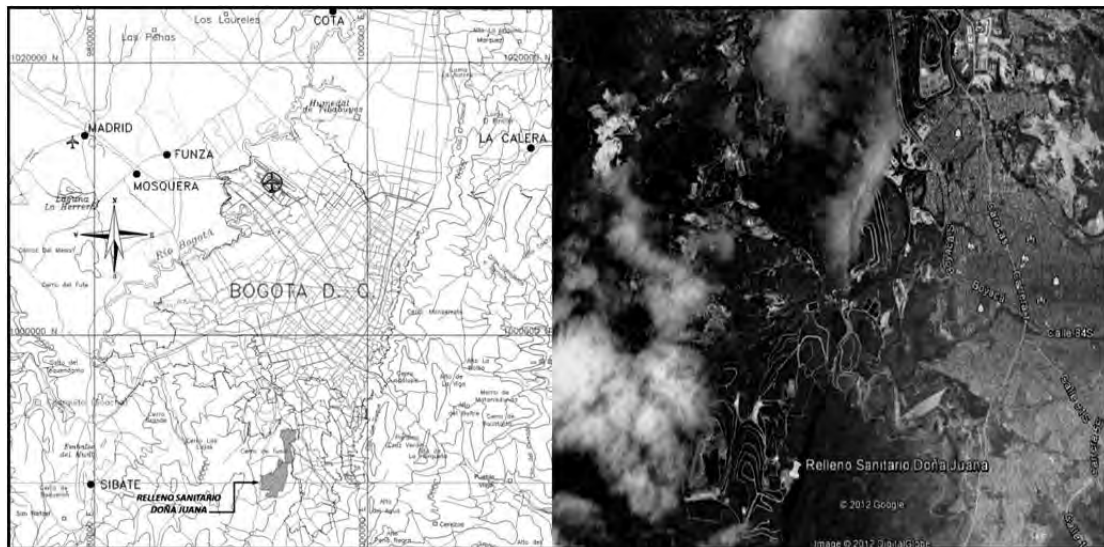


Figure 4-6: Location of Doña Juana Landfill

Geographic coordinates of the boundaries of the property where the landfill is located correspond to:

Table 4-9: Geographic Coordinate Vertices RSDJ

Vertex	Latitude	Longitude
1	4° 32' 03.23"	74° 07' 46.08"
2	4° 29' 17.68"	74° 08' 15.92"
3	4° 30' 41.19"	74° 07' 37.39"
4	4° 30' 21.84"	74° 08' 50.47 "

The total area without considering the surface of the new properties of the Optimization Zone or the new properties of the buffering zones is 483.13 hectares, of which only 189.69 hectares (37.15%) are used for the Landfill operation; this last area has been distributed in eight (8) zones, in which the stages for disposal of solid conventional waste and hospital waste have been developed or are under process of development. On the other hand, during 2007, 2008, 2009, 2010 and 2011, UAESP acquired or is in the process of acquiring 94.46 hectares for the Buffering Zone and 15.05 hectares for Optimization Zone VIII, and thus the total landfill area once acquisitions have been completed will have 594.92 hectares.

4.5.3 Current Operation of Doña Juana Landfill

Doña Juana Landfill currently has the following infrastructure:

- Access facilities, including a gate, and an entrance control booth.
- Two weighing scales, one to control weighing entry of trucks with waste and the other for their exit. (maintenance and improvement works are being carried out this year, and software changes for weighing control are also under consideration).
- Paved main access roads to the facilities of the biogas plant.
- Access roads to the operation area in granular compacted soils.
- Main camp with administrative area and shed for machinery and equipment.
- Meteorological station (Zone I) and Rainfall station (Zone IV).
- Pondages or storage deposits for leachates
- Biogas exploitation plant
- Plant for Treatment of Leachates
- Old landfill areas with final covering and pasture cover.
- CDW exploitation area
- Hospital waste cell
- Optimization Zone Phase I
- The following images show details of these facilities.

Below are the photographs of the current facilities of Doña Juana Landfill:



Access area to RSDJ



Entry weigh scale



Paved access roads¹



Access roads unloading front



Pondage – Reservoir



Treatment Plant for Percolated Liquids

¹ Source: GENIVAR 2011

4 Current Solid Waste Management Situation



Treatment Plant for Percolated Liquids



Treatment Plant for Percolated Liquids



Biogas Management Plant



Biogas Management Plant



Biogas Plant



Biogas Plant



CDW exploitation area



Old zones with final cover and pasture



Old zones with final cover and with and without vegetation



Hospital waste cell



Optimization Zone

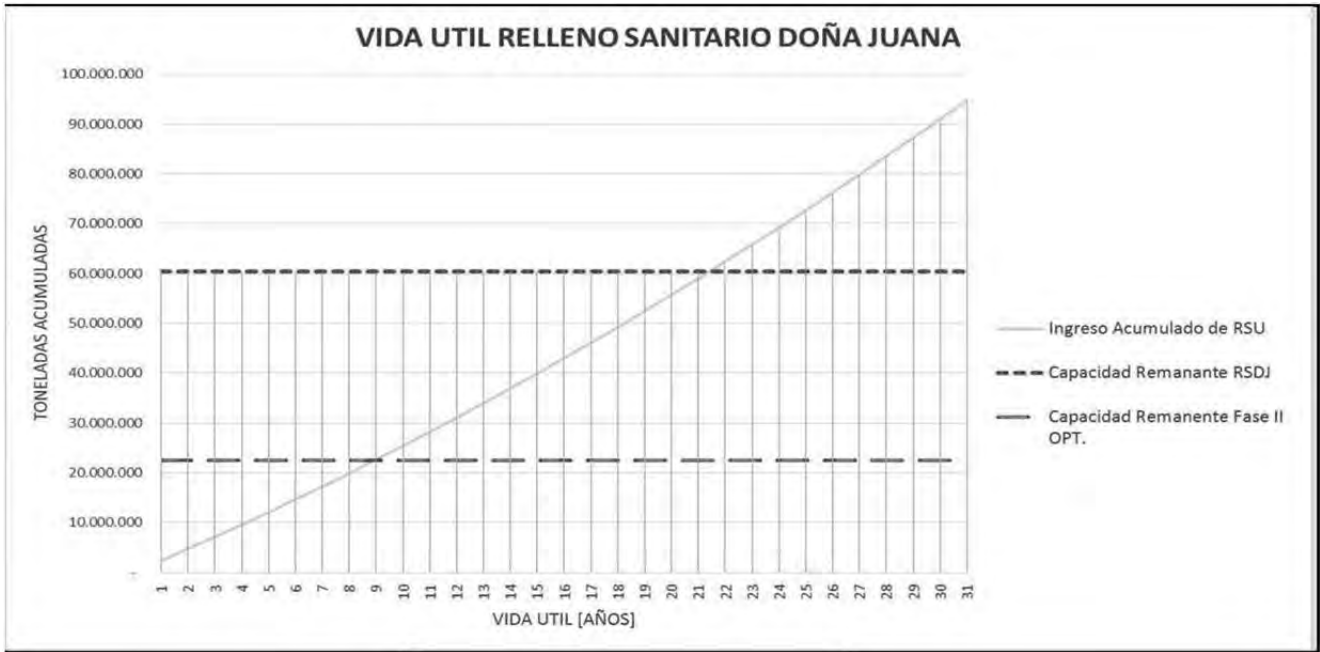


Optimization Zone

4.5.4 Productive Life of Doña Juana Landfill

Based on the remaining volume to January 2012 and the waste forecast without taking into account the minimization projects, the productive life of the landfill is 21,4 years, that is, until May 2033. If we only take into account the remaining volumen up to the completion of Optimization Phase II, the productive life would be reduced to 8,9 years, specifically, until November 2020.

The following figure shows the chart corresponding to the foregoing.



Source: Prepared by our own team 2013.

Figure 4-7: Productive Life Doña Juana Landfill

4.6 Hazardous Waste from Non-Industrial Sources

Colombia has relatively advanced regulations, aligned with world trends, mainly with respect to the generator’s responsibility for treatment or disposal of its hazardous waste (Law 430 of 1998), and the extended responsibility of producers and importers of articles containing hazardous substances (MAVDT Resolutions 693/2007, 371/2009, 372/2009, 1512/2010, 1511/2010, 1297/2010).

Although these resolutions set ambitious targets for post-consumer product collection, to date the initiatives of producers and importers are in the early stages of implementation, with unknown or as yet undisclosed results.

The success of these programs requires consumers to make the necessary effort to deliver the waste through the collection points or mechanisms established by producers. However, there

seems to be a lack of knowledge among the population regarding the existing programs, which so far have little dissemination.

According to the community survey carried out by the UAESP in the study called Characterization of Household Solid Waste Generated in the City of Bogota, 43% of the population is unable to distinguish hazardous waste, and 68% discards hazardous waste together with ordinary garbage, which indicates the need for investments in the environmental education of citizens.

According to the current resolutions, the programs planned by producers and importers and approved by the Ministry must have the support of municipal and district environmental authorities, whose responsibility it is to inform consumers of the obligation to separate hazardous from solid household waste, and take them to collection points or equivalent mechanisms.

The District Environmental Secretariat, by virtue of Agreement 322/2008 took over the responsibility for collecting WEEE through the ECOLECTA program. Despite its initial success, the program was interrupted in December 2011.

Bogota has had an Integrated Waste Management Plan since 2011. Its goals are ambitious, but relevant results are still to be achieved.

In the district of Bogota and in nearby towns in the department of Cundinamarca there are several service provider companies, duly licensed by the CAR or by the SDA, for storage, treatment and disposal or export of a wide range of hazardous waste products, including those generated in disperse and non-industrial sources – the subject matter of this diagnosis. Due to limited time and resources, it was not possible to verify their installed capacities to handle the market demand or the quality of the services they provide.

With respect to hospital and similar waste, to the extent verified, collection, transport and treatment services are performed with good scope and control.

4.7 Construction & Demolition Waste (CDW)

CDW encompasses all waste generated in construction, remodeling, demolition or excavation processes.

According to the data gathered by the UAESP and the SDA, Bogotá currently generates approximately 6,6 million m³ (2012) of cdw, and the forecast for 2020 is 10 million m³. The private sector is responsible for 70% of the cdw generated and the public sector for 30%.

4 Current Solid Waste Management Situation

However, the quantitative and qualitative data, in particular, regarding the cdw generated by the private sector is inconsistent, since it is not based on direct measurements. Likewise, the qualitative data of the public sector is based on IDU's cdw description study prepared over ten years ago, and this data has been extrapolated for the other entities of the sector.

The cdw landfills in and outside Bogota are the most current destination for most of the cdw generated.

Disposal at CDW landfills is a sound environmental practice, as long as inert waste is used to reconstitute degraded areas and disposal at landfills is avoided, thus extending its productive life.

On the other hand, the capacity of the cdw landfills located in Bogotá (Cantarrana and La Fiscala) is reaching their limit, and it is not enough to guarantee the city's autonomy regarding cdw management, in the presence of other cdw landfills located in neighboring cities. This points out the immediate need to assess and approve new sites while reducing the amount of cdw for disposal, by way of material re-exploitation and recycling.

To date, Bogotá only has one pilot plant for recycling cdw by crushing and filtering. It is operated by CEMEX next to La Fiscala cdw landfill, which does not have an operation license and has a very low capacity that doesn't allow it to take care of the demand. Other recycling plants are located in neighboring cities.

Although more accurate information is needed, it is estimated that over 80% of the total volumen of cdw generated is actually attributed to excavation soils, which may be partially reused, but may not be processed to obtain aggregates and other recycled material. Likewise, cdw including rock, asphalt, organic, hazardous and recyclable material account for less than 20% of the total.

The foregoing percentages are extremely significant, as they indicate the recycling potential towards setting up goals, and the physical infrastructure needed to comply with the objectives to be defined.

Technical standards or instructions that will define the procedures to classify and separate waste at the source, and other rules specifying the quality of the recycled material per their different applications, are still pending.

The disposal of combined waste, such as those generated in household renovations, as well as the cdw dumped at illegal sites remains a challenge, since the combination of materials complicates recycling them and prevents their acceptance at the cdw landfill.

The combined waste, whose collection is the responsibility of the UAESP, account for 3% of the total cdw generated in Bogotá, which is currently 208 thousand m³ per year (2012), and is disposed of at Doña Juana Landfill.

The customer care number, 110, mirrors the shortcomings of its operations. Furthermore, the time elapsed until household waste is collected and the apparently expensive rates charged encourage hiring unauthorized agents who dispose of the waste incorrectly, increasing environmental damages and increasing correction costs.

Supervisors and surveyors also display shortcomings, as they fail to inform of illegal depots and to timely respond to the special collection services.

The District of Bogotá has new and modern regulations that foster proper CDW management. However, Municipal Decree 312 of 2006 was not fulfilled in aspects such as the exchange of information among entities provided in Articles 69 and 107 and the goals set in Article 120. The new project “Zero CDW” (“Escombros Cero”) entails more realistic goals, but its success depends on the coordinated efforts of government authorities and private initiatives.

4.8 Institutional System

4.8.1 Policy for solid waste management

In 1998, the Ministry of the Environment, the predecessor of the Ministry of the Environment, Housing and Regional Development (the current Ministry of the Environment and Sustainable Development) established an integrated policy for solid waste management. Decree 1713 of 2002 assigned the responsibility for managing solid waste and the obligation to formulate and implement Integrated Solid Waste Management Plans [*Planes de Gestión Integral de Residuos Sólidos - PGIRS*] to the Municipalities and Departments.

Currently, and as a part of the priority policies, the closing, shut-down and restoration or technical transformation of open dumps into landfills is included. Resolution 1045 of 2003 and Resolution 1390 of 2005 issued by the Ministry of the Environment, Housing and Regional Development comprise the legal framework for said policy.

The following are part of the recent policies relating to the integrated management of solid waste:

- 1) Establish a PGIRS as the main planning tool for the cities.
- 2) Close open dumps and use landfills.
- 3) Apply a rate model that will cover the costs and use the service providers so that services relating to solid waste may become profitable.

- 4) Set up a policy to reduce and exploit the volume of solid waste

4.8.2 Laws and decrees relating to solid waste management:

Regarding the said policy, a series of laws and decrees have been enacted. Listed below are the main laws and decrees established nationwide relating to solid waste management.

- Political Constitution of Colombia 1991: established the obligation and responsibility of the entities regarding the environment and public utilities.
- Law 99 of 1993: Created the Ministry of the Environment (predecessor of the Ministry of the Environment, Housing and Regional Development).
- Law 141 of 1994: created the Fondo Nacional de Regalías for the exploitation of non-renewable natural resources and the Comisión Nacional de Regalías.
- Law 142 of 1994: Established the public utilities regime.
- Law 388 of 1997: Law of Regional development.
- Decree 1713 of 2002: Integrates social waste environmental management and public utilities and states the obligation of the municipalities and districts to formulate the Integrated Solid Waste Management Plan [*Plan para la Gestión Integral de Residuos Sólidos – PGIRS*].
- Law 732 of 2002: Law on the adoption and application of socio-economic stratification.
- Law 1151 of 2007: National Development Plan 2006-2010: addresses investments in water and hygiene, including the issues of solid waste and the allocation of financial incentives to the municipality in which the regional disposal site is located.
- CONPES 3530: Defines the strategies to reinforce the integrated management of solid waste.

4.8.3 Entities related to solid waste management

There are different national, regional and local entities involved in solid waste management. The following chart describes the main entities:

a. **Ministry of Housing, Cities and Regions**

The main purpose of the Ministry of Housing, Cities and Regional Development is to achieve, within the framework of its competencies, the formulation, adoption, direction, coordination and execution of public policies, plans and projects relating to the planned regional and urban development of the nation and the consolidation of city systems that implement efficient and sustainable land uses, taking into consideration the conditions for gaining access to and financing housing, as well as access to safe drinking water and basic sanitation utilities.

b. **Ministry of the Environment and Sustainable Development [*Ministerio de Ambiente y Desarrollo Sostenible – MADS*]**

The Ministry of the Environment and Sustainable Development is currently in charge of regulating environmental management and renewable natural resources issues, guiding and regulating environmental zoning issues and defining policies and regulations to which the recovery, conservation, protection, zoning, management, use and sustainable exploitation of the renewable natural resources and the country's environment will be subject in order to ensure sustainable development, without prejudice to the tasks assigned to other entities.

c. National Planning Department - Departamento Nacional de Planeación (DNP)

The National Planning Department (DNP) is an Administrative Department part of the Executive branch of public power and depends directly of the Presidency of the Republic. The administrative departments are entities of a technical character in charge of directing, coordinating services, and providing the Government with information to make decisions. They have the same category as the Ministries, but do not have legislative initiative².

The DNP coordinates the formulation of the National Development Plan and coordinates its execution, follow-up and evaluates its performance and results.

It is also the technical organization of the *Consejo Nacional de Política Económica y Social* – CONPES (National Council for Economic and Social Policies), and proposes policies and plans to this Council for its assessment. For instance, when the Ministry of the Environment and Sustainable Development wants to undertake an investment project related to solid waste management, it must prepare a plan in coordination with the DNP and the Ministry of the Finance and Public Credit, and the project is presented to CONPES through the DNP for its approval.

d. National Council for Economic and Social Policies - Consejo Nacional de Política Económica y Social (CONPES)

The National Council for Economic and Social Policies was created by Law 19 of 1958. It is in charge of analyzing and approving national policies, plans and projects related to the economic and social development of the country. The members of CONPES were defined by Decree 2148 of 2009 (permanent, non-permanent, guests and other attendees). CONPES and SOCIAL CONPES act under the direction of the President of the Republic and include permanent members with the right to participate and vote, the Vice-president of the Republic, all the Ministers, the Director of the Administrative Department of the Presidency of the Republic, the Director of the National Planning Department, and the Director of the

² Source: www.dnp.gov.co

Departamento Administrativo de Ciencia, Tecnología e Innovación – Colciencias (Department of Science, Technology and Innovation Management).

As mentioned in the DNP section, policies and national plans related to solid waste management must be approved by this Council.

e. Safe Drinking Water and Basic Sanitation Regulatory Commission - *Comisión de Regulación de Agua Potable y Saneamiento Básico (CRA)*

The Safe Drinking Water and Basic Sanitation Regulatory Commission (CRA) is a Special Administrative Unit, which has administrative, technical and financial autonomy, and is part of the Ministry of Housing, Cities and Regions. Its main purpose is to regulate monopolies, promote competition, and foster sustainability for the Safe Drinking Water and Basic Sanitation sector, preventing abuses of a dominant position, guaranteeing the provision of quality services at reasonable rates and extensive coverage.

This purpose is achieved through the regulatory development that involves the participation of users and Service providers and giving clear, complete and timely regulatory advice; with shared principles and values, highly qualified and empowered trained staff, working in efficient processes assuring a quality regulatory exercise, and supported by efficient and cutting-edge information technology systems.

This Commission is made up of the Ministry of Housing, Cities and Regions, the Ministry of Social Protection, the Director of the National Planning Department – DNP – expert commissioners and the *Superintendencia de Servicios Públicos Domiciliarios* (Superintendence of Public Utilities). Commissioned experts are elected by the President of the Republic for a term of 4 years. The Superintendence of Public Utilities may participate but has no voting rights³.

f. Superintendence of Household Public Services - *Superintendencia de Servicios Públicos Domiciliarios (SSPD)*

The Superintendence of Public Utilities (SSPD) is a governmental organization created by the Political Constitution of 1991 that is responsible for controlling, inspecting and supervising the entities providing public utility services, such as energy, gas, water, sewage and cleaning⁴.

³ Source: www.cra.gov.co

⁴ Source: www.superservicios.gov.co

g. Environmental Authorities (CAR, CDS, AAU)

Corporaciones Autónomas Regionales – CARs (Regional Autonomous Corporations) created by Law 99 of 1993, are public corporate entities, created by the Law, integrated by regional entities, which due to their characteristics constitute, geographically speaking, one same ecosystem or a geopolitical, bio-geographical or hydro-geographical unit, with administrative and financial autonomy, with its own capital and legal status, in charge by Law of administering the environment and renewable natural resources within its area of jurisdiction, and to encourage sustainable development according to the legal provisions and policies of the Ministry of the Environment.

Autoridades Ambientales Urbanas – AAU, (Urban Environmental Authorities) are organizations that may be established in cities with an urban population equal to or exceeding one million inhabitants and have the same functions as the CARs. However, their jurisdiction is limited to the urban area. AAUs are located in 6 regional entities (including municipalities and districts) in the country: Bogotá, Medellín, Cali, Barranquilla, Cartagena and Santa Marta.

The main functions of these mentioned entities relating to solid waste management include the granting of the environmental license for the landfill and its further supervision. In general, landfills are not located within the urban area; therefore they fall within jurisdiction of the CARs or the CDSs. On the other hand, the AAU assists in matters such as urban waste problems and illegal waste dumping, promoting recycling and hazardous waste management, in coordination with the corresponding territorial entity.

h. Regional Entities (Municipalities and Districts)

Decree-Law 2811 of 1974, the “National Code of Renewable Natural Resources and Environmental Protection” established that municipalities and districts are responsible of structuring a proper plan for the collection, transportation and final disposal of solid waste. Law 142 of 1994 also established that providing a proper garbage collection service is the responsibility of municipalities and districts.

Based on these laws, municipalities and districts can provide the cleaning service either directly, or by hiring companies to provide this service.

4.8.4 Legal & Institutional System at a District Level

4.8.4.1 Office of the Mayor of Bogotá D.C

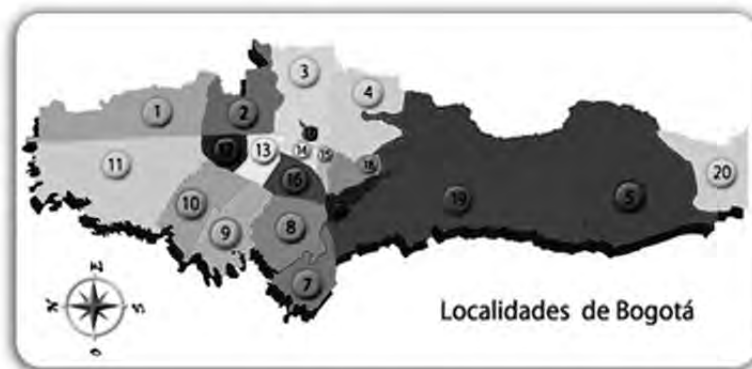
a. Government

The Constitution of 1991 organized Bogotá as a single, decentralized Capital District, with autonomy to undertake the management of regional entities and interests as set forth in Articles 322, 323 and 324 of the Constitution⁵.

The government and the administration of the Capital District are managed by: the Council of Bogotá, the Mayor, the Local Administrative Boards, the local authorities and mayors, and also any entities to be created and organized by the Council at the initiative of the Mayor.

The Capital District of Bogotá is subdivided in 20 localities and groups more than 1,200 neighborhoods in the urban area of Bogotá. Except for the locality of Sumapaz, which is located in the rural area, the other localities are considered part of the urban territory. Localities are subdivided also in Unidades de Planeamiento Zonal – UPZ, (Zonal Planning Units), and these congregate several neighborhoods in the rural area, called *veredas* or villages.

Each locality has a Junta Administradora Local – JAL, (Local Administrative Board), formed by minimum seven and maximum eleven members elected democratically for a four-year term that coincides with the term of the District Council.



- | | | | |
|-------------------------|----------------------|---------------------------|-------------------------------|
| 1. <u>Usaquén</u> | 6. <u>Tunjuelito</u> | 11. <u>Suba</u> | 16. <u>Puente Aranda</u> |
| 2. <u>Chapinero</u> | 7. <u>Bosa</u> | 12. <u>Barrios Unidos</u> | 17. <u>Candelaria</u> |
| 3. <u>Santa Fe</u> | 8. <u>Kennedy</u> | 13. <u>Teusaquillo</u> | 18. <u>Rafael Uribe Uribe</u> |
| 4. <u>San Cristobal</u> | 9. <u>Fontibón</u> | 14. <u>Los Mártires</u> | 19. <u>Ciudad Bolívar</u> |
| 5. <u>Usme</u> | 10. <u>Engativá</u> | 15. <u>Antonio Nariño</u> | 20. <u>Sumapaz</u> |

Figure 4-8: Localities of the Capital District ⁶

⁵ Source: www.bogota.gov.co

⁶ Source: www.bogota.gov.co

b. Administration

b.1 District Planning Secretariat

The mission of the Planning Sector is to support regional, economic, social and environmental planning and policies of the Capital District to build an equitable, sustainable and competitive city, guaranteeing an orderly growth of the Capital District, the improved use of the land in the city in rural and regional areas, and provide equal and equitable opportunities for the people of the Capital District, especially to the benefit of the elderly and ethnical populations, gender groups and the disabled.

Regarding solid waste management, this Office, is responsible for including the entire infrastructure necessary for proper solid waste management in the Zoning Plan [Plan de Ordenamiento Territorial] POT, in accordance with city policy.

b.2 District Environmental Secretariat

Its functions include the following:

- Control contaminant spills and emissions, disposal of solid waste and waste or hazardous waste and toxic waste, issue measures to correct or mitigate environmental damages and complement the action of the Water and Sewage Company of Bogotá – EAAB – towards the development of sanitation and decontamination projects, in coordination with the Special Administrative Unit of Public Services.

c. UAESP

The object of the Unidad Administrativa Especial de Servicios Públicos – UAESP is to guarantee the planning, provision, coordination, supervision and control of the solid waste collection, transportation, final disposal, recycling and exploitation services, cleaning of roads and public areas, funeral services within the infrastructure of the district and the street lighting service.

4.9 Financial System

The municipal government of Bogota, D.C. is responsible for the SWM service of the city, but the service is not provided directly by the city but by Concessionaires or private service providers, in addition to other services provided by the private sector. This implies that in the SWM service there are close interactions between the public sector on one side (UAESP: Unidad Administrativa Especial de Servicios Públicos = Special Administrative Unit of Public Services of the city government of Bogota, D.C., and other public sector offices like CRA: Comisión de Regulación de Agua Potable y Saneamiento Básico = Regulation

4 Current Solid Waste Management Situation

Commission for Water Supply and Basic Sanitation), and on the other side there are private sector firms undertaking activities related to the SWM service. Public sector offices are responsible for the supervision and control of the activities of the private sector firms. And this operation is reflected in the financial system.

The tariff regime for the SWM service is described in CRA Resolution 351 of December 2005, in which the currently applied methodology consists of the following steps: calculation of the costs of service using the price levels of June 2004, updating prices to August 2011, tariff calculation, and application of subsidies and contributions.

There is a cross-subsidy system based on the principle of solidarity and income redistribution. In this cross-subsidy system, the users of the SWM service who are considered to have sufficient financial ability to pay “contributions”, or amounts in excess of the values calculated with the application of the tariff, while other users who are considered to be without the adequate financial ability receive “subsidies”, or pay less than the amount calculated with the application of the tariff. Those who pay “contributions” are the SWM service users in the two top strata 5 and 6 of Residential users, as well as the Commercial, Industrial, and Large and Small Generators. On the other hand, those who receive “subsidies” are the three bottom strata 1, 2 and 3 of Residential users who are the most numerous. And the Residential users in Stratum 4 do not receive “subsidies” nor pay “contributions”, as they simply pay the amount that results from the application of the tariff.

Table 4-10: Subsidies & Contributions in the SWM service

Type of Users of SWM	Subsidy (%)	Contribution (%)
Residential		
Socioeconomic Stratum 1 Low-Low	70	0
Socioeconomic Stratum 2 Low	40	0
Socioeconomic Stratum 3 Medium-Low	15	0
Socioeconomic Stratum 4 Medium	0	0
Socioeconomic Stratum 5 Medium-High	0	50
Socioeconomic Stratum 6 High	0	60
Commercial	0	50
Industrial	0	30
Large Generators	0	90
Small Generators	0	50

Source: Own preparation on the basis of collected information

4.10 Solid Waste Current Management Evaluation

4.10.1 Global Evaluation

a. Technical System

a.1 Non-hazardous Waste

Technical System	Evaluation
Storage and discharge	<ul style="list-style-type: none"> Residents generally know what days, they have collection service. In a part of the city center, there is night collection to prevent traffic jams. This situation leads to a long time period between discharge and collection which can cause that animals and persons dedicated to recycling open waste bags and scattered them; this manner, sanitary conditions in the city are worsened.
Collection	<ul style="list-style-type: none"> Conventional service, i.e., Collection, Street Sweeping, and Cleansing (RBL) operate satisfactorily. The city is divided into 6 areas for service provision and 4 companies operate. The service includes tree trimming and grass cutting.
Transport	<ul style="list-style-type: none"> There is no transfer and transport system in the city. The southern area of the city is closed to Doña Juana Sanitary Landfill; consequently, it is not necessary to have a transfer station. However, the between the sanitary landfill and the northern area is longer than 30 km and, additionally, waste has to be transported through roads with heavy traffic. As a result, it becomes economically feasible to introduce a transfer and transport system in the area.
Use of Waste Generated	<ul style="list-style-type: none"> As of November 2012, recycling is being conducted informally by the recycling population Society, in general, does not have respect for their activity, even though recyclers contribute to solid waste minimization. To improve their activity efficiently and their position in the society, UAESP and other entities in the District are working to regularize their situation according to the Inclusion Program which has been approved by the Constitutional Court. The direction is adequate, however, it is recommended to implement it step by step because to establish a new system and change the manner to think and the attitude by the recycling population and citizens will take a lot of time.
Final Disposal	<ul style="list-style-type: none"> Although the city has around 8 million citizens, there is only one sanitary landfill, Doña Juana. If there is an accident in the landfill or the access road to the landfill, the city will be full with waste until the problem is solved. Doña Juana operates, generally, satisfactorily by a private concessionaire, CGR. Inside the sanitary landfill, there is another company conducting a Clean Development Mechanism (CMD) project. The project is just burning gas in the sanitary landfill; however, there is a plan and equipment to convert it into gas to sold for house consumption. Doña Juana service life depends on obtaining the required permits and projected amount of waste to be minimized. In case Phase II in Optimization Area is developed, the area will reach full capacity by 2021 or 2022.

a.2 Debris and Hazardous Solid Waste

Waste	Evaluation
Health care	Ecocapital company offers collection, treatment, and transport to a special cell in Doña Juana sanitary landfill services. Health care wastes are managed adequately.
Other health care wastes	There is no system adequately functioning which attends solid wastes from small doctors' offices and clinics, although Ecocapital offers a service.
Hazardous from non-industrial sources	There is no hazardous waste system for waste generated in houses and small businesses, such as, batteries, light bulbs, paints, etc.
Debris	Mixed debris which is collected by the cleansing service is heterogeneous (contains metals, paper, plaster, etc.). They are not adequate for recycling and they are allowed for disposal in debris disposal sites; currently, the sanitary landfill is left as the only alternative.

b. Legal and Institutional System

Colombia, in general, has established a solid legal and institutional system. The Housing Ministry, City and Territory, and the Environmental and Sustainable Development Ministry have the responsibility about solid wastes. The first one dealing from the point of view of public service and the second from the point of view of environment. On the other hand, the Water Supply and Basic Sanitation Regulatory Commission (CRA) defines the fee and service quality, lastly, the Public Service Superintendency supervises the cleansing service operators.

On its part, Bogotá D.C. accounts with a good legal and institutional system as the capital city of the country. UAESP, Environmental Secretariat, Health Secretariat, Planning Secretariat, etc. are the entities in charge of integrated solid waste management.

c. Financial System

The tariff system is defined by CRA. Cleansing tariff is billed jointly with water supply and sewerage by Bogota's Water and Sewerage Company. Fee collection is very high, higher than 90%. The system works adequately so far.

4.10.2 Challenges to improve and strengthen Current Solid Waste

The new policy for the District Administration is focused "Zero Waste" and the implementation of "Inclusion Plan" for recyclers. Meanwhile, the current solid waste management shows great weaknesses such as there is no formal recycling system, alternative technologies for treatment or management have not been introduced, there is only one sanitary landfill (Doña Juana) and it has not been established a non-industrial hazardous waste management.

Taking a look at the new policies and existing weaknesses, challenges for future SWM are:

- To establish goals, for example, recycling rate and final disposal rate,
- To account with several final disposal sites and operate a facility to make use waste if feasible,
- To establish a transfer and transport system step by step, having a higher priority the northern part of the city,
- To construct and operate recycling parks jointly with a transfer station if feasible,
- To establish a separate collection system for recyclable materials according to the Inclusion Plan,
- To establish a hazardous waste (from non-industrial source) collection, treatment, and final disposal system, and
- To establish a clear concept about waste minimization, such as 3Rs, aiming to Zero Waste and begin disseminate it to citizens.

5 Alqueria Model Project

5.1 Objective

The Alqueria Model Project (hereinafter referred to as AMP) has the following objectives:

- The collection of recyclable waste introduced by the Office of the Mayor of Bogotá is a public service provided within the framework of a comprehensive solid waste management program and the AMP must therefore guarantee the quality of waste collection services.
- Establish the AMP target area and provide recyclable waste collection services to all generators within said area. The project includes a number of activities aimed at enhancing the understanding and participation of the community in the new delivery method.
- Review the feasibility of the recyclable waste collection activities carried out by a recycler organization in a given part of the target area.
- Identify problems and challenges associated with separate collection, through an assessment of the degree of community participation, the relevance of the collection system design, the cost of collection, etc., seeking to obtain base information that will enable planning of the expansion of the separate collection service to the entire Capital District.

5.2 Plan Contents

5.2.1 Target area definition

The treatment capacity of the La Alqueria collection center foreseen in the AMP was calculated as follows:

- La Alqueria treatment capacity: 30t/day

The target area surface and the population (number of homes) that can be covered at this scale of the facility were calculated as follows:

- Target area surface: 7.47km² (2.7km×2.7km)
- Total population and number of homes within the target area: 145.000 persons and 40.000 homes

5.3 Considerations regarding the Alqueria Model Project

5.3.1 AMP Background

Prior to beginning this study, the Alquería Pilot Project (which is different from the AMP) the selective collection was handled by a private operator. When the implementation of this Pilot Project was revised, the community living in the sector that was covered by selective collection routes trusted the scheme, which was deemed an established system. The Pilot Project included community awareness activities organized by the promoters of the private operators. Therefore, this Pilot Project may serve as a reference not only to structure the delivery and collection system for potentially recyclable material, but also to help the community further understand and cooperate in the expansion of the selective collection.

Therefore, the AMP's implementation was agreed on with the UAESP, bringing focus to a few of the issues identified by the Pilot Project, such as emphasizing community awareness, defining the collection scheme and improving the physical facilities and the operation and administration system of the Alquería collection center.

5.3.2 Progress Report

However, the AMP has not made the progress expected, mainly due to the following reasons:

- The other party of the selective collection contract for potentially recyclable material is no longer a private company but a public company (Aguas de Bogotá), and the said company may be changed from Aguas de Bogotá to an organized recycler's organization - ORA. Thus, it is currently unclear who will ultimately provide the selective collection service.
- The UAESP has planned for an ORA to take over the collection and classification of potentially recyclable material. Therefore, the structuring of the administration and operation system of the collection center has been delayed, as well as the technical training on material collection and separation that must be given to the recyclers so they may be able to provide this service as a public service.
- The Alquería facilities have not been improved due to insufficient budget.

5.3.3 Outlook

The UAESP believes the AMP implementation and evaluation is of great importance in order to disseminate the selective collection system in Bogotá D.C.. For this reason, it is in the process of entering into an agreement with a Spanish NGO (UNIMOS) so that the latter may implement the AMP, including improvement to the facilities based on the AMP Plan prepared by the JICA team. The UAESP wants to expand the coverage of the selective collection service based on the experience and know-how that will be gained with the AMP.

Master Plan



1 Preconditions for Planning

1.1 Scope of the Master Plan

1.1.1 Definition of Solid Waste and Competency

There are different types of solid waste, sources and parties involved. The limit of responsibility among different authorities regarding management of waste has not been clearly defined. Consequently, it is important to establish the definition of solid waste and the competency of authorities to clarify their responsibilities and maximize the use of resources in the management of solid waste, thereby avoiding duplication of efforts. The following table shows a proposal for the definition of solid waste and competency for its management.

Table 1-1: Proposal for the Definition of, and Competency for Solid Waste

Classification and Source		Competency*	POT Subsystem
Ordinary Waste • households, • small producers, • large-quantity generators, • market places, • roads and public spaces • hospitals and clinics	Non-hazardous waste • common organic and non-organic • combined cdw	UAESP DS Environment IPES DS Planning	garbage collection service
	Hazardous waste Hospital and other similar (infectious) waste	DS Health DS Environment UAESP (i) DS Planning	garbage collection service
	• WEEE (waste electrical and electronic equipment) • Post-consumer waste	DS Environment SD Health DS Planning UAESP	Integrated waste management
Industrial Waste • factories • construction and demolition works • waste water treatment	Non-hazardous waste • common organic and inorganic • Muds and biomuds	DS Environment DS Planning EAAB UAESP (ii)	Integrated waste management
	• CDW	DS Environment DS Planning	Integrated waste management
	Hazardous waste • heavy metals, chemicals, light fittings, tires, etc.	DS Environment DS Planning	Integrated waste management

Competency*: Senior authority has principal competency.

(i) UAESP continuously guarantees provision of collection, transport, treatment and final disposal service for these wastes.

(ii) UAESP within his competence in ensuring clean areas has to provide collection, transport and final disposal of no hazardous waste (organic and inorganic) generated from factories.

1.1.2 Scope of the Master Plan

This Master Plan basically focuses on solid waste for which the UAESP has competency, that is, **Ordinary Non-hazardous Waste**. In addition, the Plan provides a series of recommendations on managing other waste, such as hazardous solid waste from non-industrial sources and cdw.

1.2 Guidelines for Master Plan Formulation

Local governments in Colombia are required by certain laws to formulate Integrated Solid Waste Management Plans (“PGIRS”). In this study, DECREE 1713 of 2002 “Gestión Integral de Residuos Sólidos” (Integrated Solid Waste Management”, and RESOLUTION 1045 Of 2003 “Whereby a methodology for the preparation of the Integrated Solid Waste Management Plans – PGIRS – is adopted and other decisions are made”, were taken as guidelines for the formulation of the Master Plan, considering the Master Plan “PMIRS” as the PGIRS for the city of Bogota.

a. Target Years

The laws establish a planning time frame, i.e.: short-term: 3 years as short-term, 3 years as medium-term, 9 years as long-term, for a total time frame of 15 years. Therefore, target years are fixed for the formulation of the Master Plan, as follows:

- Short-term (3 years) 2013 - 2015
- Medium-term: (3 years) 2016 - 2018
- Long-term: (9 years) 2019 – 2027

b. Deadline for Considering Final Disposal

Laws also require a projection of solid waste for a 30-year horizon in order to secure the necessary storing capacity at the possible landfill sites. Hence, it is projected up to year 2042 in this study.

1.3 Generation of Solid Waste Projection

1.3.1 Generation Projection

This section shows the projection for the generation of solid waste in Bogotá D.C.

Table 1-2: Generation of Solid Waste Projections 2012 - 2042

Year	Population (1)		Waste (2)		Waste per inhabitant	
	nos.	increase	ton/year	increase	kg/day	increase
2012	7,564,740	-	2,446,990	-	0.886	-
2013	7,667,994	1.36%	2,499,426	2.14%	0.893	0.79%
2014	7,771,248	1.35%	2,551,862	2.10%	0.900	0.78%
2015	7,874,502	1.33%	2,604,300	2.05%	0.906	0.67%
2016	7,977,756	1.31%	2,656,735	2.01%	0.912	0.66%
2017	8,081,010	1.29%	2,709,172	1.97%	0.918	0.66%
2018	8,184,264	1.28%	2,761,607	1.94%	0.924	0.65%
2019	8,287,518	1.26%	2,814,044	1.90%	0.930	0.65%
2020	8,390,772	1.25%	2,866,479	1.86%	0.936	0.65%

Year	Population (1)		Waste (2)		Waste per inhabitant	
	nos.	increase	ton/year	increase	kg/day	increase
2021	8,494,026	1.23%	2,918,917	1.83%	0.941	0.53%
2022	8,597,280	1.22%	2,971,353	1.80%	0.947	0.64%
2023	8,700,534	1.20%	3,023,787	1.76%	0.952	0.53%
2024	8,803,788	1.19%	3,076,226	1.73%	0.957	0.53%
2025	8,907,042	1.17%	3,128,661	1.70%	0.962	0.52%
2026	9,010,296	1.16%	3,181,097	1.68%	0.967	0.52%
2027	9,113,550	1.15%	3,233,534	1.65%	0.972	0.52%
2028	9,216,804	1.13%	3,285,972	1.62%	0.977	0.51%
2029	9,320,058	1.12%	3,338,406	1.60%	0.981	0.41%
2030	9,423,312	1.11%	3,390,844	1.57%	0.986	0.51%
2031	9,526,566	1.10%	3,443,279	1.55%	0.990	0.41%
2032	9,629,820	1.08%	3,495,715	1.52%	0.995	0.51%
2033	9,733,074	1.07%	3,548,153	1.50%	0.999	0.40%
2034	9,836,328	1.06%	3,600,588	1.48%	1.003	0.40%
2035	9,939,582	1.05%	3,653,023	1.46%	1.007	0.40%
2036	10,042,836	1.04%	3,705,462	1.44%	1.011	0.40%
2037	10,146,090	1.03%	3,757,898	1.42%	1.015	0.40%
2038	10,249,344	1.02%	3,810,334	1.40%	1.019	0.39%
2039	10,352,598	1.01%	3,862,770	1.38%	1.022	0.29%
2040	10,455,852	1.00%	3,915,205	1.36%	1.026	0.39%
2041	10,559,106	0.99%	3,967,641	1.34%	1.029	0.29%
2042	10,662,360	0.98%	4,020,080	1.32%	1.033	0.39%

Source: Own preparation

Table 1-3: Generation Projection by Service, 2012 - 2042

Unit: ton/year

Year	Household	Commerce	Large Generation	Sweeping	Market Places	Lawn cutting	Tree pruning	Cdw	Total
2012	1,200,990	514,710	218,503	144,894	34,707	32,393	9,255	291,538	2,446,990
2013	1,226,726	525,739	223,185	148,000	35,451	33,087	9,453	297,785	2,499,426
2014	1,252,462	536,770	227,867	151,104	36,194	33,781	9,652	304,032	2,551,862
2015	1,278,198	547,799	232,550	154,209	36,938	34,476	9,850	310,280	2,604,300
2016	1,303,933	558,829	237,232	157,314	37,682	35,170	10,048	316,527	2,656,735
2017	1,329,669	569,858	241,915	160,419	38,426	35,864	10,247	322,774	2,709,172
2018	1,355,405	580,888	246,596	163,524	39,169	36,558	10,445	329,022	2,761,607
2019	1,381,141	591,918	251,279	166,629	39,913	37,252	10,643	335,269	2,814,044
2020	1,406,877	602,947	255,961	169,733	40,657	37,946	10,842	341,516	2,866,479
2021	1,432,613	613,977	260,644	172,839	41,400	38,640	11,040	347,764	2,918,917
2022	1,458,349	625,006	265,326	175,944	42,144	39,335	11,238	354,011	2,971,353
2023	1,484,084	636,036	270,007	179,048	42,888	40,029	11,437	360,258	3,023,787
2024	1,509,821	647,066	274,690	182,153	43,632	40,723	11,635	366,506	3,076,226
2025	1,535,556	658,096	279,372	185,259	44,375	41,417	11,833	372,753	3,128,661
2026	1,561,292	669,125	284,055	188,363	45,119	42,111	12,032	379,000	3,181,097
2027	1,587,028	680,155	288,737	191,468	45,863	42,805	12,230	385,248	3,233,534
2028	1,612,764	691,185	293,420	194,574	46,607	43,499	12,428	391,495	3,285,972

Year	Household	Commerce	Large Generation	Sweeping	Market Places	Lawn cutting	Tree pruning	Cdw	Total
2029	1,638,500	702,214	298,101	197,678	47,350	44,194	12,627	397,742	3,338,406
2030	1,664,236	713,244	302,784	200,783	48,094	44,888	12,825	403,990	3,390,844
2031	1,689,972	724,273	307,466	203,888	48,838	45,582	13,023	410,237	3,443,279
2032	1,715,707	735,303	312,149	206,993	49,581	46,276	13,222	416,484	3,495,715
2033	1,741,444	746,333	316,831	210,098	50,325	46,970	13,420	422,732	3,548,153
2034	1,767,179	757,363	321,513	213,203	51,069	47,664	13,618	428,979	3,600,588
2035	1,792,915	768,392	326,195	216,307	51,813	48,358	13,817	435,226	3,653,023
2036	1,818,651	779,422	330,878	219,413	52,556	49,053	14,015	441,474	3,705,462
2037	1,844,387	790,452	335,560	222,518	53,300	49,747	14,213	447,721	3,757,898
2038	1,870,123	801,481	340,243	225,622	54,044	50,441	14,412	453,968	3,810,334
2039	1,895,859	812,511	344,924	228,727	54,788	51,135	14,610	460,216	3,862,770
2040	1,921,595	823,540	349,606	231,833	55,531	51,829	14,808	466,463	3,915,205
2041	1,947,330	834,570	354,289	234,937	56,275	52,523	15,007	472,710	3,967,641
2042	1,973,067	845,600	358,971	238,042	57,019	53,218	15,205	478,958	4,020,080

Source: Own preparation

1.3.2 Projection of Solid Waste Composition

In 2011, UAESP carried out the residential and small-quantity generator solid waste characterization studies. For the formulation of the master plan, results are applied as shown in Table 9.7: Solid Waste Composition. The current composition is used in this master plan formulation.

Table 1-4: Solid Waste Composition

Component		Unit: %	
		Residential	Small and large generators
Foods	-	60.56	46.48
Gardening	-	0.87	3.23
Paper and Cardboard	MPR	7.10	11.91
Plastic	MPR	10.45	17.83
Rubber and Leather	-	0.42	0.91
Textiles	MPR	1.89	1.93
Wood	-	0.32	2.91
Metal	MPR	0.85	1.57
Glass	MPR	2.08	3.88
Ceramics, etc.	-	1.19	1.15
Hazardous	-	12.94	6.95
Others	-	1.32	1.27
Total		99.99	100.02
MPR		22.37	37.12
Non-recyclable		77.62	62.90
Total		99.99	100.02

Note: MPR: Potentially Recyclable Material

Source:

- UAESP, 2011, Caracterización de los residuos sólidos generados en la Ciudad de Bogotá D.C. (Caracterización Residencial)
- UAESP, 2011, Caracterización de los residuos sólidos de establecimientos comerciales, pequeños productores, generados en la Ciudad de Bogotá D.C. (Caracterización Comercial)
- UAESP, 2011, Caracterización de los residuos sólidos institucionales, pequeños productores, generados en la Ciudad de Bogotá D.C. (Caracterización Institucional)

1.4 Intermediate Treatment Facilities

The Bogota Capital District is currently reviewing the Integrated Solid Waste Management Plan (PMIRS, acronym in Spanish) defined in 2006, with the purpose of structuring a new solid waste disposal system focused on recycling materials and minimizing waste volume. In this framework the selection of an adequate and sustainable intermediate technology is also included, aimed at creating a new recycling society. In this sense, preliminary designs of the following intermediate treatment facilities were conducted, and their suitability to the Master Plan was analyzed in the optimum scenario selection.

- Material recovery facility (30 ton/day)
- Material recovery facility (200 ton/day)
- Composting plant (100 ton/day)
- Incineration plant (300 ton/day)
- RPF (Refuse Paper & Plastic Fuel) Facility (40 ton/day)
- Temporary storage facility of construction waste (60 ton/day)
- Construction waste recycling facility (200 ton/day)

2 Selection of Optimum Scenario

Several scenarios for solid waste management are established in this chapter and the most appropriate scenarios for Bogota D.C. are selected by means of comparative analysis.

2.1 Scenarios

Taking into account the vulnerability of the present Doña Juana Landfill and new Bogota D.C. policies, such as Zero Garbage and the Inclusion Plan, several scenarios have been established from the following viewpoints:

- Final disposal
- Minimization

2.1.1 Final Disposal

The vulnerabilities of the present Doña Juana landfill can be summarized in the following two aspects:

- There is uncertainty as to the continued use of the RSDJ in the long term
- There is no other landfill that can be used as an alternative in the event of an unexpected event.

Considering the uncertainty of the use of the RSDJ in the future and the risk referred to above, the following three scenarios for the final disposal system have been established.

Scenario 0 (one landfill)

- Use the Doña Juana Landfill until the year 2030
- Build and operate a landfill as of the year 2031

Scenario I (two landfills)

- Use the Doña Juana Landfill
- Build and operate a landfill outside the city to the west as of the year 2021 together with a transfer station

Scenario II (three landfills)

- Use the Doña Juana Landfill
- Build and operate a landfill outside the city to the west as of the year 2021 together with a transfer station
- Build and operate a landfill outside the city to the north as of the year 2026 together with a transfer station

The following table shows the percentage distribution of the quantity of solid waste to the final disposal site according to the scenario and the figure shows the possible future locations of the landfills and transfer stations.

Table 2-1: Distribution of Solid Waste to the Final Disposal Sites

Scenario	Final Disposal	- 2020	2021 - 2025	2026 - 2030	2031 - 2042
Scenario 0	Doña Juana	100%	100%	100%	0%
	New (1)	0%	0%	0%	100%
Scenario I	Doña Juana	100%	50%	50%	50%
	Western	0%	50%	50%	50%
Scenario II	Doña Juana	100%	50%	30%	30%
	Western	0%	50%	50%	50%
	Northern	0%	0%	20%	20%

Note: (1) It is presumed that they will be located further away from Doña Juana.

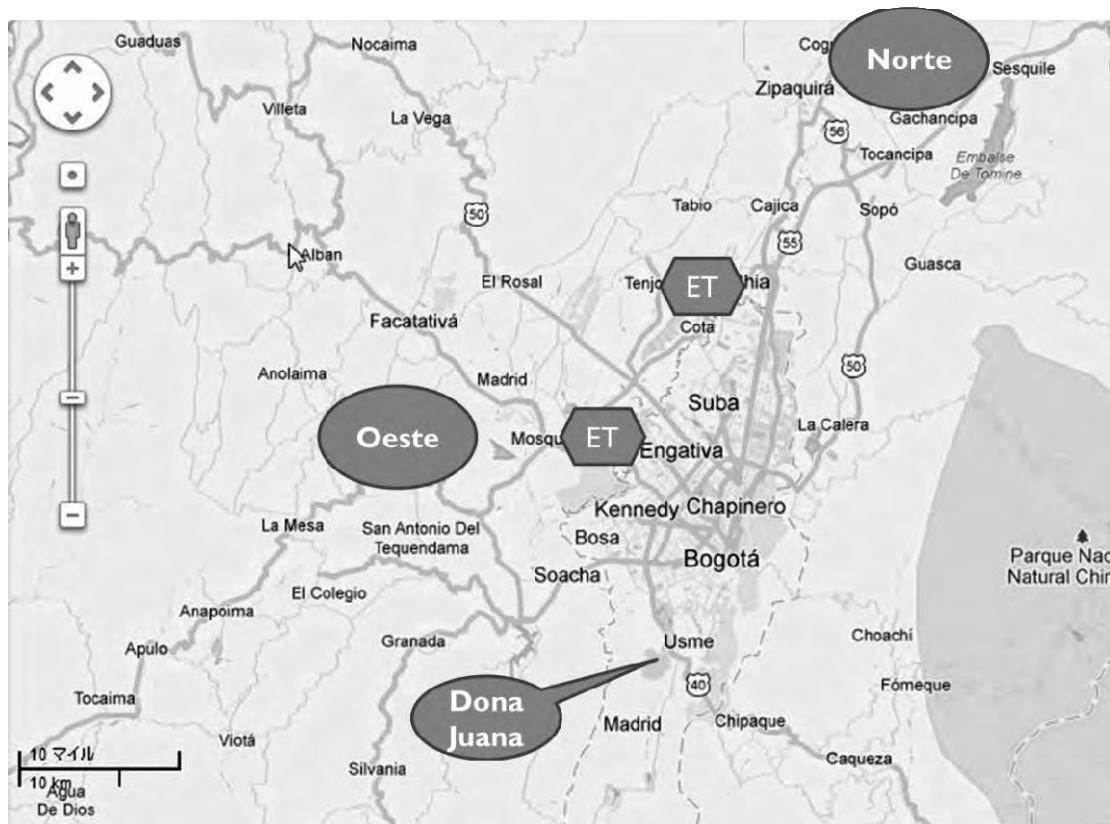


Figure 2-1: Image of Scenario II

2.1.2 Minimization

The present government of Bogota D.C. created the Zero Garbage policy and the Plan for Inclusion of the Recyclers in Public Waste Management. The former is an extensive minimization policy and the latter a plan focused on the recyclers of materials such as paper, plastic and metals, etc. Taking into account the policy and the plan, the following minimization scenarios are considered.

Scenario a (no official minimization)

- Continued as at present.

Scenario b (progressive minimization)

- Progressive introduction of minimization measures such as recycling materials, composting and recycling cdw

Scenario c (gradual minimization)

- Gradual introduction of minimization measures such as recycling materials, composting and recycling cdw

Scenario d (rapid minimization)

- Rapid introduction of minimization measures such as recycling materials with an ambitious goal, composting and recycling cdw

Scenario e (radical minimization)

- Rapid introduction of minimization measures such as recycling materials with a high goal, composting and recycling cdw with ambitious goals and also includes the application of incineration technologies and Refuse, Paper & Plastic Fuel, RPF

The goals of each minimization component are summarized in the following Table.

Table 2-2: Minimization Scenarios

Scenario	Source	2012 (present)	2015 (short)	2018 (medium)	2027 (long)
Scenario a	Recycled material	-	-	-	-
	Households	5.0 %	5.0 %	5.0 %	5.0 %
	Small/Large	10.0 %	10.0 %	10.0 %	10.0 %
	Composting	0.0 %	0.0 %	0.0 %	0.0 %
	Combined cdw	0.0 %	0.0 %	0.0 %	0.0 %
	Incineration	0.0 %	0.0 %	0.0 %	0.0 %
	RDF	0.0 %	0.0 %	0.0 %	0.0 %
Scenario b	Recycled material	-	-	-	-
	Households	5.0 %	5.6 %	6.5 %	11.0 %
	Small/Large	10.0 %	10.6 %	11.5 %	16.0 %
	Composting	0.0 %	10.0 %	20.0 %	100.0 %
	Combined cdw	0.0 %	10.0 %	20.0 %	100.0 %
	Incineration	0.0 %	0.0 %	0.0 %	0.0 %
	RDF	0.0 %	0.0 %	0.0 %	0.0 %
Scenario c	Material recycled	-	-	-	-
	Households	5.0 %	6.5 %	8.0 %	12.5 %
	Small/Large	10.0 %	11.5 %	13.0 %	20.0 %
	Composting	-	-	-	-
	Market place	0.0 %	30.0 %	60.0 %	100.0 %
	Grass and trees	0.0 %	60.0 %	90.0 %	100.0 %
	Combined cdw	0.0 %	100.0 %	100.0 %	100.0 %
	Incineration	0.0 %	0.0 %	0.0 %	0.0 %
	RDF	0.0 %	0.0 %	0.0 %	0.0 %

Scenario	Source	2012 (present)	2015 (short)	2018 (medium)	2027 (long)
Scenario d	Recycled material	-	-	-	-
	Households	5.0 %	8.0 %	11.0 %	15.0 %
	Small/Large	10.0 %	16.0 %	22.0 %	30.0 %
	Composting	-	-	-	-
	Market Place	0.0 %	30.0 %	60.0 %	100.0 %
	Grass and trees	0.0 %	60.0 %	90.0 %	100.0 %
	Combined cdw	0.0 %	100.0 %	100.0 %	100.0 %
	Incineration	0.0 %	0.0 %	0.0 %	0.0 %
	RDF	0.0 %	0.0 %	0.0 %	0.0 %
Scenario e	Recycled material	-	-	-	-
	Households	5.0 %	8.0 %	11.0 %	15.0 %
	Small/Large	10.0 %	16.0 %	22.0 %	30.0 %
	Composting	-	-	-	-
	Market place	0.0 %	30.0 %	60.0 %	100.0 %
	Grass and trees	0.0 %	60.0 %	90.0 %	100.0 %
	Combined cdw	0.0 %	100.0 %	100.0 %	100.0 %
	Incineration	0.0 %	0.0 %	0.0 %	100.0 %
	RDF	0.0 %	0.0 %	15.0 %	50.0 %

Note: These percentages are the ones that enter the recycling systems and are not those of minimization.

2.2 Analysis of Scenarios and Selection of an Optimum Scenario

2.2.1 Final Disposal Scenarios

a. Useful life of RSDJ

If the space of the landfill is used in accordance with the Director Plan, but if no type of minimization is practiced according to Scenario 0, the useful life of the Doña Juana Landfill will be until 2033; in Scenarios I and II, its useful life will not be exhausted within the coming 30 years, as shown in the figure below.

However, this useful life is not guaranteed and so it is vital to examine the viability of the Director Plan from all points of view and to obtain the required environmental license. In particular, there is uncertainty as to the use of space in the landfill after the Phase II optimization is full, that is, as of the year 2021, because this site is the only open terrain in the final disposal area and, once the Phase II site is full, new solid waste will be discharged onto the existing waste.

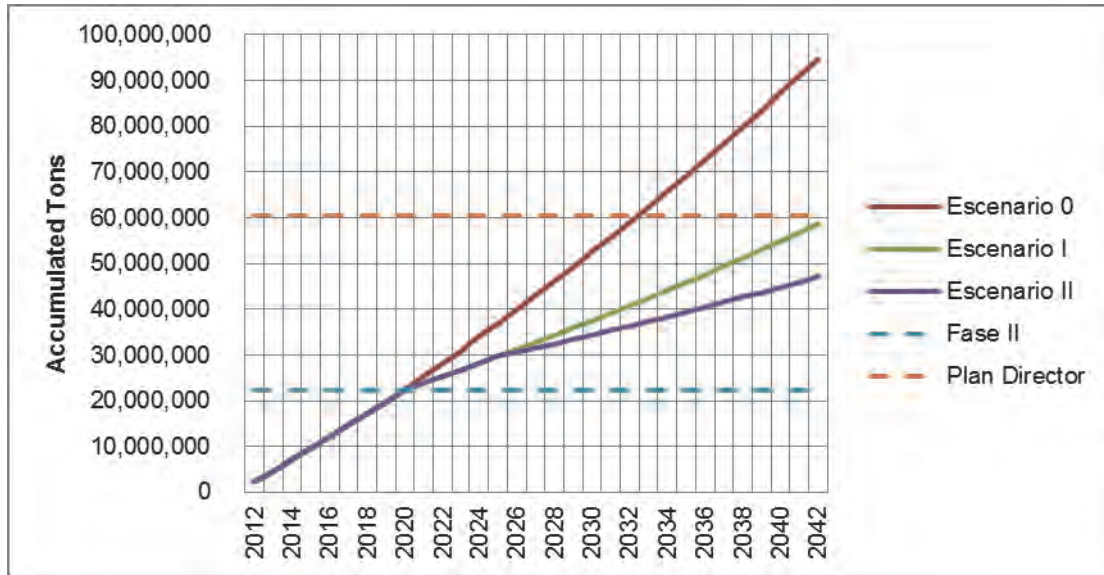


Figure 2-2: Useful Life of the Doña Juana Landfill according to Scenarios

b. Costs

As shown in the following table and the Figure, the costs of Scenarios 0, I and II are calculated by applying the estimated Master Plan unit costs. The amounts of the total costs of the term of 30 years for all the Scenarios are similar. There is also no considerable difference from the costs of the 15 year term.

In the year 2014, the costs of all the Scenarios would increase, because the execution of a new RBL [*collection, sweeping and cleaning*] service contract is programmed for that year and it requires the introduction of Euro IV. The costs of Scenarios I and II would begin to go down as of 2021 as a result of the introduction of the transfer and transport system. The cost of Scenario 0 would increase in the year 2031 because the new landfill instead of the RSDJ will be commissioned.

Table 2-3: Comparison of Total Final Disposal Costs of Scenarios

Scenario	2013 - 2027		2013 - 2042	
	Millions of pesos	Difference	Millions of pesos	Difference
Scenario 0	7,452,221	0.0%	17,338,672	0.0%
Scenario I	7,176,419	-3.7%	15,959,017	-8.0%
Scenario II	7,180,751	-3.6%	16,000,353	-7.7%

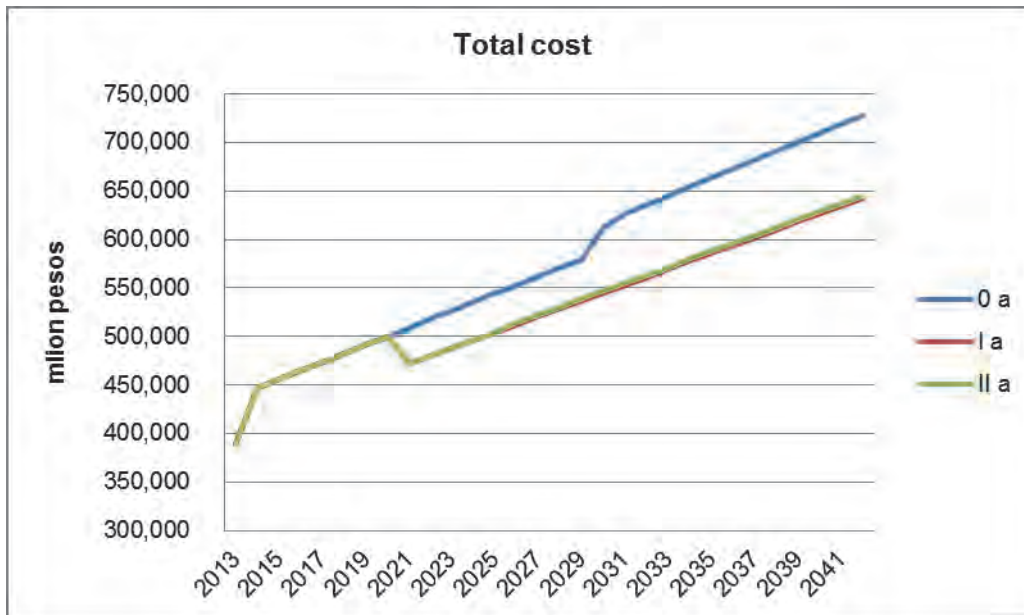


Figure 2-3: Comparison of Final Disposal Costs of Scenarios

c. Assessment of Scenarios and Selection of an Optimum Final Disposal Scenario

Based on the assessment shown in the following table, **selection of Scenario II is recommended.**

Table 2-4: Assessment of Scenarios with Regard to Final Disposal

Scenario	Strength / Timescale	Weakness / Threat
Scenario 0	The present infrastructure of the Doña Juana Landfill can be used until the year 2030.	Once the Optimization area is full the continued use of the RSDJ will be uncertain. It will be difficult to seek and operate a new landfill as of 2031. In 2031 the cost would rise considerably. It would be difficult to seek and operate a new landfill as of 2031. The cost will rise considerably in 2031.
Scenario I	As of 2021, two landfills will be operated. This will be at the risk of shutdown of the entire system of solid waste management due to an accident in the landfill. The total cost is more economic.	If it is impossible to use the RSDJ, the western landfill will be the only one. This system is as vulnerable as the present one. It will be difficult to seek and operate a new landfill as of 2021.
Scenario II	Two landfills will operate as of 2021 and three from 2026 onward. This reduces considerably the degree of risk of shutdown of the entire solid waste management system due to an accident in or on the way to the landfill.	It will be difficult to seek and operate new landfills to the west as of 2026 de 2021 and to the north from 2026 onward.

Scenario	Strength / Timescale	Weakness / Threat
	<p>The new landfills will be beneficial not only for the city of Bogota, but also for the municipalities of Cundinamarca, which do not have a landfill and have to carry their waste over a long distance to the Mondoñedo landfill.</p> <p>Competition will be accelerated and good rates and quality of service are expected.</p>	

2.2.2 Analysis of Scenarios with regard to Minimization

a. Minimization

Table 2-5 and Figure 2-4 show the rate of minimization of the five Scenarios. The rate of “Scenario a” would be maintained at 5.4%. That of “Scenario e” would be over 80% due to the impact of incineration. In “Scenarios b, c and d” the same minimization measures would be applied, but the speed of application would be different. Moreover, in Scenario d, the materials recycling goal is very ambitious.

Table 2-5: Rates of Minimization of Scenarios

Scenarios	2012	2015	2018	2027
Scenario a	5.4%	5.4%	5.4%	5.4%
Scenario b	5.4%	6.3%	7.5%	18.7%
Scenario c	5.4%	10.8%	12.7%	20.3%
Scenario d	5.4%	11.4%	15.1%	23.6%
Scenario e	5.4%	11.4%	15.5%	83.4%

Note: The minimization is obtained by dividing the quantity minimized by the quantity generated.

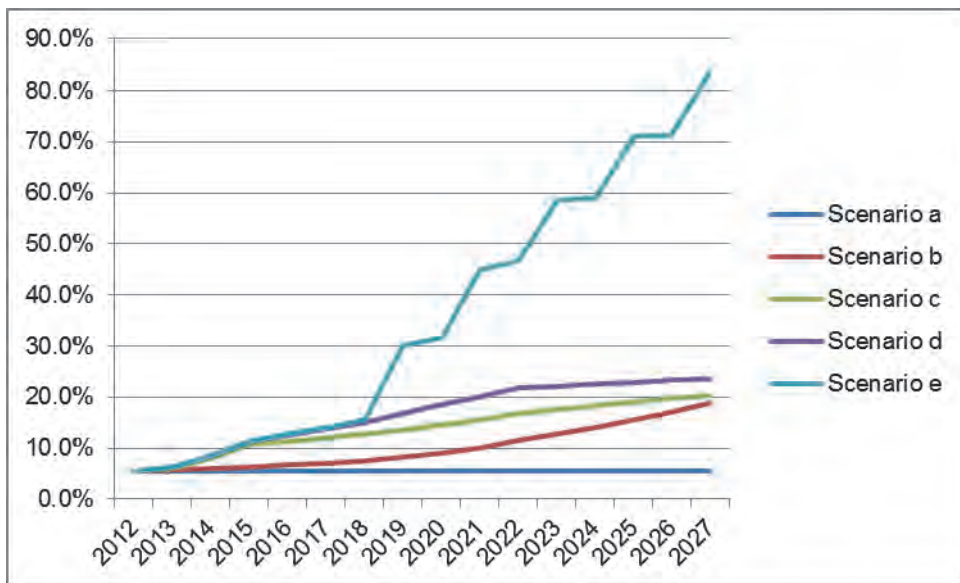


Figure 2-4: Minimization Rates of Scenarios

b. Costs

Scenario II was selected as the scenario for final disposal. Combining Scenario II with the 5 Minimization Scenarios and applying the Master Plan unit costs, the total cost of each combination is calculated as shown on the following Table and Figure.

Between Scenarios a, b, c and d, the difference in the total cost is less than 10%, while the total cost of Scenario e increases significantly. In particular, the annual cost of the final stages of the term of the project is very large in comparison with the other Scenarios. This is mainly due to the introduction of incineration.

Table 2-6: Total Cost of Minimization Scenarios

Unit: millions of pesos

Scenario	Millions of pesos	Difference
Scenario II a	7,180,751	0.0%
Scenario II b	7,500,893	4.5%
Scenario II c	7,683,182	7.0%
Scenario II d	7,761,028	8.1%
Scenario II e	9,291,551	29.4%

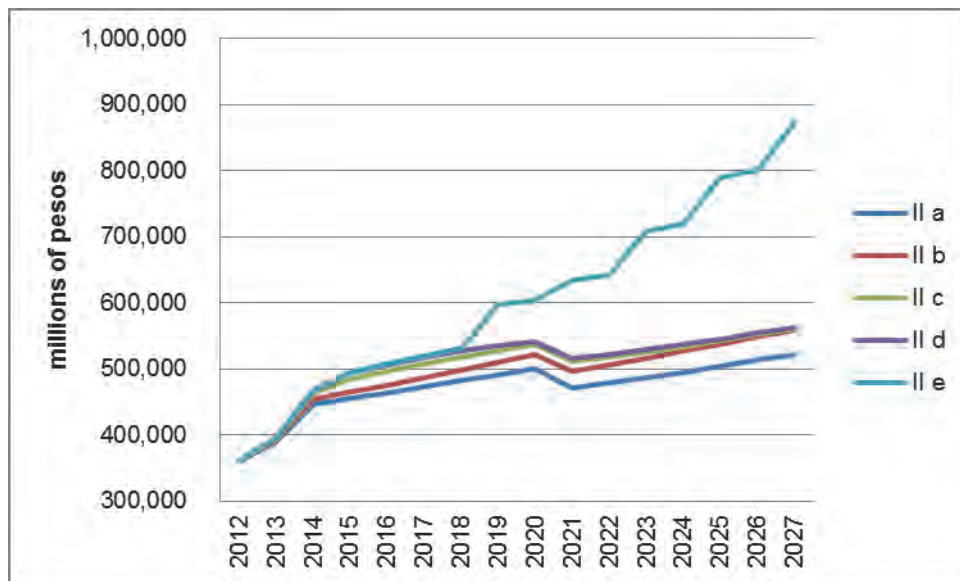


Figure 2-5: Total Cost of Each of the Minimization Scenarios

c. Assessment of Minimization Scenarios

The following Table summarizes the assessment of the Minimization Scenarios.

Table 2-7: Assessment of the Minimization Scenarios

Scenario	Strength / Timescale	Weakness / Threat
Scenario a	No friction with society would occur because there would be no change.	The present situation of the recyclers and the recovery of potentially recyclable materials, MPR would not improve.
Scenario b	No considerable friction would be caused, because changes would be introduced progressively. Taking into account the combination of solid waste in the city, the minimization goals would be achieved technically. The cost would also increase progressively.	The present situation of the recyclers and the recovery of MPR would improve. However, the speed of improvement would be slow. This slow speed would not require a change of attitude on the part of the citizens.
Scenario c	Taking into account the composition of solid waste in the city, the minimization goals would be achieved from the technical point of view. The speed of changes required by this Scenario would have an impact that would change the attitude of the citizens involved.	Friction would be caused even though the changes would be made gradually. The cost would increase in the early years.
Scenario d	This Scenario is in accordance with the new Zero Garbage and Inclusion Plan policies.	Considering the composition of the solid waste in the city, it would be difficult to achieve the materials recycling goal. Friction would be caused, because the changes would be introduced rapidly. The cost would increase quickly in the early years.
Scenario e	This Scenario is in accordance with the new Zero Garbage and Inclusion Plan policies. Moreover, the goals exceed those proposed in the draft POT amendment.	Considering the composition of solid waste in the city, it would be difficult to achieve the materials recycling goal. Friction would be caused because the changes would be introduced rapidly. The introduction of incineration would face opposition. Bogota's society could not cover the high cost.

2.2.3 Selection of a Scenario

Regarding final disposal, Scenario II is recommended, because:

- In the event of an accident in the landfill or on the road to it, the degree of risk of suspension of the entire garbage collection service would be very low in comparison with the other Scenarios.
- The total cost is less than that of Scenario 0 and almost the same as Scenario I.
- Competition between operators would be promoted. The price and quality of the service would be maintained as a result of such competition.
- In general the landfills would benefit from scale economy, that is, a larger landfill would be built and operated at lower cost. Consequently, a lower final disposal rate would be applied to the municipalities of Cundinamarca which would take their waste to the new landfills, instead of paying that applicable to the small landfill.

In the case of minimization, Scenario c is recommended, because:

- The minimization goals are technically viable taking into account the composition of solid waste in the city, although these goals are more prudent than the goals established in Zero Garbage, the Inclusion Plan and the draft amendment of the POT.
- The speed of the changes required on this Scenario would have an impact that would change the attitude of the citizens to the minimization of solid waste.
- This Scenario would bring an increase in cost, but it would nevertheless be sustainable; Scenario 0 = 7,452,221 million pesos, Scenario c = 7,683,321 million pesos, and increase of 3.1%.

Therefore, the combination of Scenario II and Scenario c, that is **Scenario IIc**, is recommended for Bogota D.C.

Table 2-8: Principal Components, Scenario IIc

System	Components
Minimization	<ul style="list-style-type: none"> • Material recycling • Composting • CDW recycling
Final Disposal	<ul style="list-style-type: none"> • Doña Juana • Western landfill • Northern landfill

Table 2-9: Distribution of Solid Waste to the Final Disposal Sites, Scenario IIc

Final Disposal	- 2020	2021 - 2025	2026 - 2030	2031 - 2042
Doña Juana	100%	50%	30%	30%
Western	0%	50%	50%	50%
Northern	0%	0%	20%	20%

Table 2-10: Percentage of Solid Waste to the Recycling System, Scenario IIc

Source	2012 (present)	2015 (short)	2018 (medium)	2027 (long)
Material recycled	-	-	-	-
Households	5.0 %	6.5 %	8.0 %	12.5 %
Small/Large	10.0 %	11.5 %	13.0 %	20.0 %
Composting	-	-	-	-
Market Place	0.0 %	30.0 %	60.0 %	100.0 %
Grass and trees	0.0 %	60.0 %	90.0 %	100.0 %
Combined cdw	0.0 %	100.0 %	100.0 %	100.0 %
Incineration	0.0 %	0.0 %	0.0 %	0.0 %
RDF	0.0 %	0.0 %	0.0 %	0.0 %

Table 2-11: Minimization Goals, Scenario IIc

Year	2012	2015	2018	2027
Minimization Rate	5.4%	10.8%	12.7%	20.3%

3 The Master Plan

3.1 General Objectives

Solid Waste Management, SWM, has been developed in line with social requirements, which change over the course of time. In general, the first requirement is to improve citizens' quality of life by removing the solid waste produced in the city. The second is to dispose of the solid waste collected appropriately, without environmental deterioration at the site of disposal and its surroundings. The third is to minimize the production of waste by reducing, reusing and recycling materials; these are the 3Rs for the efficient use of natural resources.

Article 3 of Decree 1713 defines certain basic principles for the provision of the garbage collection service, which are considered the general objectives of the plan under Resolution 1045. These principles coincide with the requirements mentioned and are also in accordance with the institutional objectives of UAESP on the MRS: "To achieve a clean City that strengthens its public sector and its inhabitants' quality of life" and "To achieve a City that reduces, separates and uses solid waste and mitigates any negative impacts" through the 2012 - 2016 STRATEGIC INSTITUTIONAL PLAN.

Taking the foregoing into account, this Master Plan has established the following "General Objectives".

General Objectives

- 1. Guarantee the quality and continuity of the garbage collection service to the users*
- 2. Minimize the amount of solid waste*
- 3. Guarantee the proper final disposal of unexploited/unused solid waste*

In general, PMIRS includes hazardous waste. Therefore, consideration of "**Control of hazardous nature of waste**" as another general objective when updating the PMIRS is recommended.

3.2 Objectives and Specific Goals

The specific objectives and goals which form the basis of the general objectives have been defined through a joint effort between the counterpart and the JICA teams, which are explained as follows:

1. To guarantee the quality and continuity of the waste collection service to the users

With regard to the general objective of “**Guaranteeing the quality and continuity of waste collection service to the users**”, the following two specific objectives have been established:

1.1 Maintaining coverage of the urban area

At present, 100% of the urban zones of the city enjoy the RBL [*collection, sweeping and cleaning*] service. However, it is necessary to continue to provide adequate service to all the urban zones in the future, thus maintaining and increasing service quality and guaranteeing its provision for new urban development zones.

1.2 Extending coverage of the rural area

Rural zones require the provision of the garbage collection service in accordance with their present situation, which may be different from the service provided for urban zones. At present, approximately 30% of the rural zones are covered by the garbage collection service. In the future, it will be necessary to increase coverage to 100% and maintain it.

2. Minimizing the amount of solid waste

This Master Plan proposes the minimization of solid waste by recycling materials, composting and recycling construction and demolition waste and numerical goals have been set. However, minimization requires different methods, which relate to different parties. This Master Plan does not reject the implementation of different efforts, but rather recommends these measures, taking into account the need for the formation and maturing of society’s recycling culture. Therefore, raising awareness among the community is considered one of the most important measures for success.

2.1 Promoting material recycling

This specific objective seeks to promote the recycling of materials such as plastics and paper and materializing the Inclusion Plan, which is in accordance with

Constitutional Court rulings, which requires affirmative actions to be taken for independent recyclers in the management of solid waste.

At present, the recycling of materials is carried out informally by recyclers. Therefore, the first phase is to set up a register of recyclers, approximately 13,800 of whom are covered by the census, establish weighing centers in some existing warehouses, where the registered recyclers can take potentially recyclable materials, and the organization of the system of payment to the recyclers for the provision of the potentially recyclable materials collection service (87,000 pesos per ton).

The second phase, consisting of structuring a system that consists of separate collection and separation plants, is being undertaken alongside the first phase. This Master Plan includes the establishment of 36 separation plants with a capacity of 30 tons per day, a similar capacity to that of the Alquería Gathering/Collection Center, by the year 2027. However, considering the use of land in Bogota D.C., it is clearly difficult to build this type of new facilities. In addition, there are many warehouses with similar functions and, therefore, using existing warehouses will be a more realistic measure. Consequently, what is important is to succeed in establishing a system of collection and separation of 1,074 tons of potentially recyclable materials per day by the year 2027, implementing separate collection and organizing reception facilities, that is, warehouses or separation plants for these materials.

2.2 Developing and extending the composting system

Development and expansion of the composting system

What is sought is to minimize organic waste from grass cutting, pruning trees and market places, which are already collected selectively, using composting.

In the year 2013, a pilot composting project with this organic waste, for which there is already a well established collection system, must be carried out with the three types of organic waste referred to above. Based on the data and lessons that can be learned from the pilot project, separation at source and expansion of composting coverage must be strengthened.

This Master Plan, includes the organization of three composting plants with a capacity of 100 tons per day by the year 2027. However, the public sector will not necessarily have to build these plants. What is important is to achieve composting the 276 tons of organic waste per day which will be produced by the year 2027 using private plants as well.

2.3 Developing and expanding the combined cdw recycling system

At present, 800 tons of combined cdw from small-scale works carried out at homes and offices is generated; this amount is equivalent to 12% of the total quantity of solid waste generated. The Doña Juana Landfill is a final disposal site for ordinary waste and, therefore, theoretically it should not be used for the disposal of construction and demolition waste. However, there are different materials in combined cdw, such as paper, plastics and paints, which is why it is being deposited there.

In order to promote separation in areas closest to the sources, this Master Plan proposes the establishment of 12 drop-off points with the capacity to receive 60 tons per days and to carry and separate potentially recyclable materials which have been temporarily stored at the drop-off points in 3 plants with a capacity of 200 tons a day by the year 2027. As to the drop-off points, these do not necessarily have to be facilities with the design set out in the Master Plan, as a container can simply be placed at a nearby source or site. The public sector would not have to organize recycling plants, as the private sector could do so. Thus, the aim must be to dispose of 1,055 tons of combined cdw by the year 2027.

2.4 Raising awareness and training users in the reduction, reuse, separation at source and differentiated disposal of solid waste.

Environmental education focused on the reduction, reuse and separation at source of solid waste is being provided at all the schools in Bogota D.C. (2,376), in order to create a culture of waste minimization and to train leaders in the process. At the same time, per the Institutional Environmental Management Plan, PIGA, waste separation will be carried out in the schools.

3. Guaranteeing appropriate final disposal of unexploited/unused solid waste

The following specific objectives have been established in order to achieve this goal of “Guaranteeing proper final disposal of unexploited/unused solid waste”:

3.1 Ensuring the operation of RSDJ

It used to be estimated that the Doña Juana landfill could be used until the year 2030 without introducing any minimization measure. However, for it to be possible to do so, the treatment of leachates has to be improved and that of gas continued. It will also be necessary to carry out several technical studies in order to put forward a safe disposal plan.

3.2 Reducing the present vulnerability of the present final disposal system

For Bogota D.C., a large city of over 7 million inhabitants, there is only one landfill, named Doña Juana. Therefore, should any accident happen inside the landfill or on the access roads to it, the entire solid waste management system would come to a standstill and the city would be inundated with waste, which would be harmful to citizens' health. To prevent this type of risks, the construction of two more landfills has been planned with a view to using the three landfills simultaneously.

The following table provides a summary of the specific objectives and goals:

Table 3-1: Master Plan Objectives and Goals

No.	General/Specific Objectives	Present	Short Term 2013-2015	Medium Term 2016-2018	Long Term 2019-2027
1	Guarantee the quality and continuity of the garbage collection service to the users.				
1.1	Maintain coverage of the urban area	100%	100%	100%	100%
1.2	Increase coverage of the rural area	30%	100%	100%	100%
2	Minimize the amount of solid waste				
	(total minimization rate)	(5.4%)	(10.8%)	(12.7%)	(20.3%)
2.1	Promote recycling of materials (material recycling minimization rate)	Informal Alqueria (5.4%)	85 tons/day to the system (6.2%)	427 tons/day to the system (6.2%)	1,074 tons/day to the system (9.7%)
2.2	Develop and extend the composting system (composting minimization rate)	- (0.0%)	25 tons/day to the system (1.1%)	58 tons/day to the system (2.0%)	249 tons/day to the system (2.8%)
2.3	Develop and extend the combined cdw recycling system (cdw minimization)	- (0.0%)	redirect 100% from Doña Juan landfill 850 tons/day to the system (3.5%)	901 tons/day to the system (4.5%)	1,055 tons/day to the system (7.7%)
2.4	Raise awareness and train users to succeed in achieving the reduction, reuse, separation at source and differentiated disposal of solid waste				
3	Guarantee the proper final disposal of unused/unexploited solid waste				
3.1	To ensure the operation of the Doña Juana landfill	Optimization Phase I	Phase II (17 million tons)		Master Plan (38 million tons)
3.2	To reduce the vulnerability of the current final disposal system	-	-	-	2 new landfills

3.3 Basic Focus

The following concepts must be understood in order to achieve the objectives and goals referred to above.

Client First

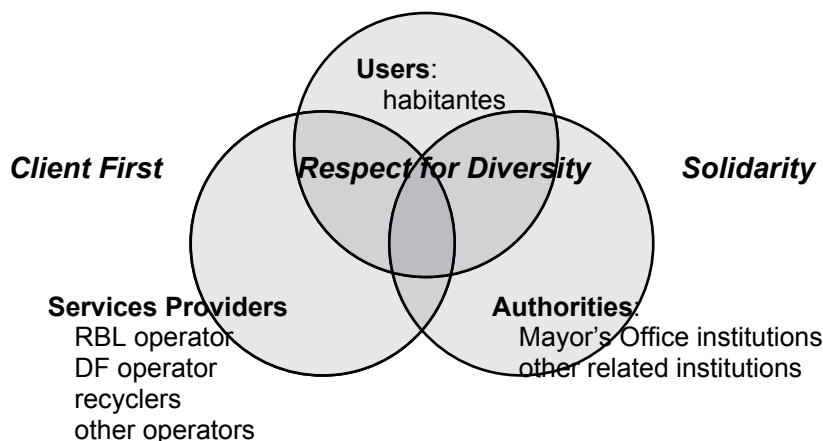
Clients, that is, the citizens of Bogota D.C., are the target of the garbage collection service. Therefore, in the provision of the service, maintenance and improvement in health and the standard of living of the citizens, both present and future, must be the first priority. Work is also required on materialization of a system of solid waste management that is transparent, fair and efficient for the citizens.

Respect for Diversity

Formalization of the recycling of potentially recyclable materials is a great challenge for Bogota D.C. To make it a reality, it is vital for all the parties to fulfill their function as individuals, households and offices that generate waste, as well as the recyclers. Each of these parties is under different conditions and is of a different nature. The appropriate recycling method may also be different according to the type of community. This means that there is no single solution for recycling materials. Personalized measures must be designed and implemented in order to respect the diversity of the actors and the community.

Solidarity

In order to achieve the Solid Waste Flow shown in the following section, it is indispensable for each of the systems, from generation to final disposal, to operate well, but, at the same time, it is necessary for all these systems to function in a balanced manner. For this, it is a necessity for each of the parties, including the waste generators, providers and/or operators of the service and the authorities to recognize their function and share responsibility for solid waste management. For the purpose, it is important to promote a social culture aimed in this direction.



3.4 Key indicators

The following table shows the key indicators of the Master Plan.

Table 3-2: Key Indicators in the Master Plan

Component	Unit	Present 2012	Short 2015	Medium 2018	Long 2027
1 Population					
Population	thousand	7,565	7,875	8,184	9,114
2 Flow of solid waste					
Production	tons/day	6,704	7,135	7,566	8,859
Collection	tons/day	6,340	6,659	6,973	7,784
Recycled material, total	tons/day	366	473	592	1,074
Present	tons/day	366	0	0	0
Transition	tons/day	0	389	165	0
Plant	tons/day	0	85	427	1,074
Composting	tons/day	0	103	180	276
CDW recycled	tons/day	0	850	901	1,055
Final disposal	tons/day	6,304	6,368	6,604	7,065
Minimized quantity	tons/day	364	767	962	1,794
3 RBL service coverage					
Urban area	%	100	100	100	100
Rural area	%	30	100	100	100
4 Minimization rate					
Material recycled	%	5.4	6.2	6.2	9.7
Composting	%	0.0	1.1	2.0	2.8
CDW recycled	%	0.0	3.5	4.5	7.7
Total	%	5.4	10.8	12.7	20.3
5 Infrastructure and equipment					
51 RBL Collection, sweeping and cleaning					
511 Collection truck					
Compacter 25 yd3	nos.	*217	237	251	-
Compacter 16 yd3	nos.		35	36	246
Ampliroll 10 M3	nos.	**219	35	36	46
Van 4,5 Ton	nos.		14	16	11
Dump trucks 12 m3	nos.		36	39	-
512 Transfer Station					
Western station	tons/day	-	-	-	4,500
Northern station	tons/day	-	-	-	2,000
513 Transport					
Tractor-truck	nos.	-	-	-	66
Trailer	nos.	-	-	-	70
52 Recycling					
521 Recycled material					
6 ton Truck	nos.	8	29	143	359
Gathering center (30tons/day)	nos.	1	3	15	36
522 Composting					
Plant (100tons/day)	nos.	-	1	2	3
523 CDW recycling					
Drop-off point (60tons/day)	nos.	-	2	5	12
Recycling plant (200tons/day)	nos.	-	2	3	3
524 Recycling park					
Recycling plant	The need for these infrastructures will be analyzed below with the participation of the private sector				
CATARS					

Component	Unit	Present 2012	Short 2015	Medium 2018	Long 2027
53 Final disposal					
Doña Juana	tons/day	6,340	6,368	6,604	2,119
Western landfill	tons/day	-	-	-	3,532
Northern landfill	tons/day	-	-	-	1,413
6 Cost (Colombian pesos)					
61 Cost per year					
FR, commercial	million \$	50,454	52,521	54,588	60,789
BL, sweeping and clean-up	million \$	65,035	69,217	73,399	85,945
RT, recollection	million \$	197,188	220,853	227,982	216,210
Recycling	million \$	0	73,852	90,950	116,236
DT, final disposal	million \$	44,668	65,341	67,769	76,031
PMIRS	million \$	3,703	3,940	4,177	4,888
Total	million \$	361,048	485,724	518,865	560,099
62 Unit cost					
Per generation	\$/ton	147,548	186,508	187,885	173,216
Per population	\$/pers.	47,728	61,683	63,398	61,458
63 Cost increase rate (2012 = 100%)					
Total cost	%	-	35%	44%	55%
Per generation	%	-	26%	27%	17%
Per population	%	-	29%	33%	29%

* Number of compactors for RBL service

** Number of other vehicles for the RBL service

3.5 Principal Facilities

This section shows principal facilities of the Master Plan.

a. Transfer Stations

The plan is to establish two transfer stations; the Western Transfer Station and the Northern Transfer Station. The following is a summary of the facilities:

a.1 Western Transfer Station

Scale: Quantity of waste handled: 4,500 tons/day
 Function: Transfer of waste from collection trucks to large trucks.
 Location: This is in the western sector of Bogota D.C. Details of the location have not been defined.
 Others: It will go into operation as of the year 2021.

a.2 Northern Transfer Station

Scale: Quantity of waste handled: 2,000 tons day
 Function: Transfer of waste from collection trucks to large trucks
 Location: This is in the northern sector of Bogota D.C. Details of the location have not been defined.
 Others: It will go into operation as of the year 2021.

b. Gathering/Collection Center

Scale:	Quantity of waste handled: 30 tons/day
Function:	Recovery, weighing and collecting recyclable materials from separately collected waste
Location:	36 sites in Bogota D.C. Details of the location have not been defined.
Others:	New centers do not necessarily have to be built as the existing warehouses can be used after they have been improved.

c. Composting plant

Scale:	Quantity of waste handled: 100 tons/day
Function:	Composting of organic waste from market places, cut grass and tree pruning
Location:	3 sites inside or outside Bogota D.C. Details of the location have not been defined.
Others:	New composting plants do not necessarily have to be built; private plants can be used or new plants built.

d. CDW Recycling Plant

Quantity:	Quantity of waste handled: 200 tons/day
Function:	Mixed cdw recycling plant
Location:	3 sites inside or outside Bogota D.C., which are to be established within the disposal site for cdw or zones adjacent to these. Details of the location have not been defined.
Others:	These do not necessarily have to be built by the public sector as existing private plants can be used or new plants could be built by the private sector.

e. New Landfills

The plan is to establish two landfills: the Western Landfill and the Northern Landfill. The following is a summary of the facilities:

e.1 Western Landfill

Scale:	Quantity of waste handled: 4,700 ton/day in 2027 Total capacity: approximately 55 million tons
Function:	Final disposal of ordinary solid waste.
Location:	The plan is for the zone to be outside Bogota D.C. to the west. Details of the location have not been defined.
Others:	The landfill will go into operation as of the year 2021.

e.2 Northern Landfill

Scale:	Quantity of waste handled: 2,800 tons/day in 2027 Total capacity: approximately 38 million tons.
Function:	Final disposal of ordinary solid waste.
Location:	The plan is for the zone to be outside Bogota D.C. to the north. Details of the location have not been defined.
Others:	It will go into operation as of the year 2026.

At this stage of the study, none of the locations for installation has been defined. However, the following figure shows a general image of the location of the landfills and the transfer stations, which are large scale facilities.

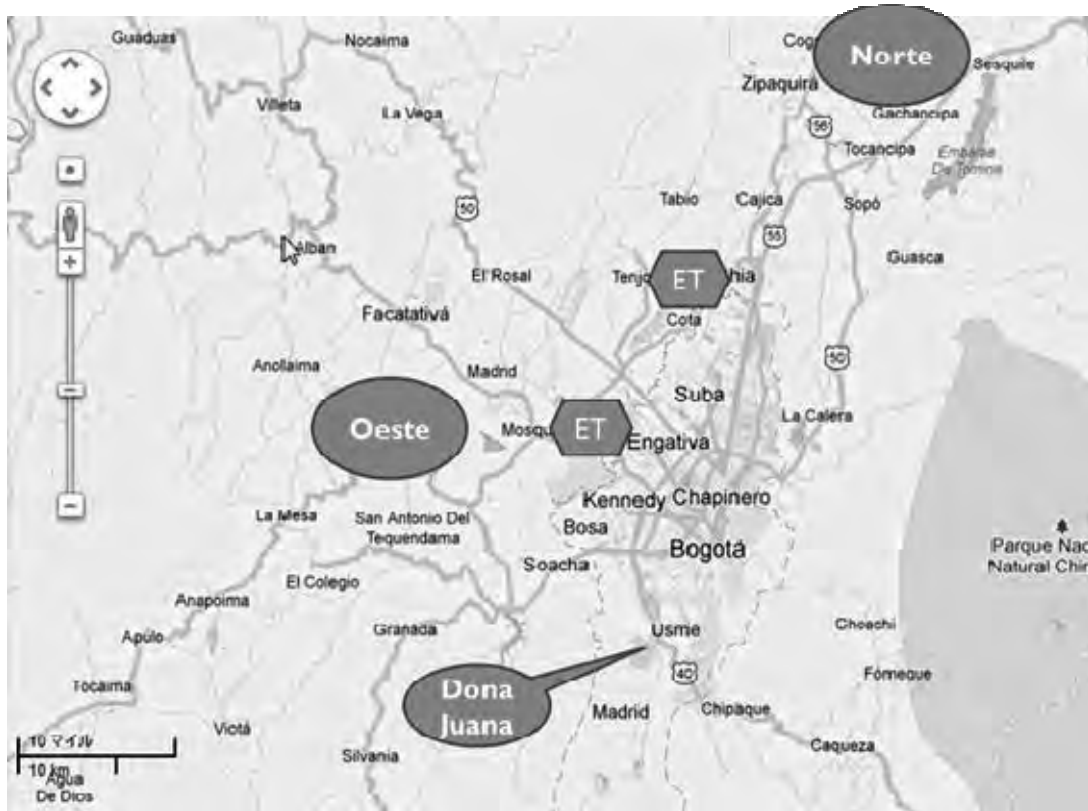
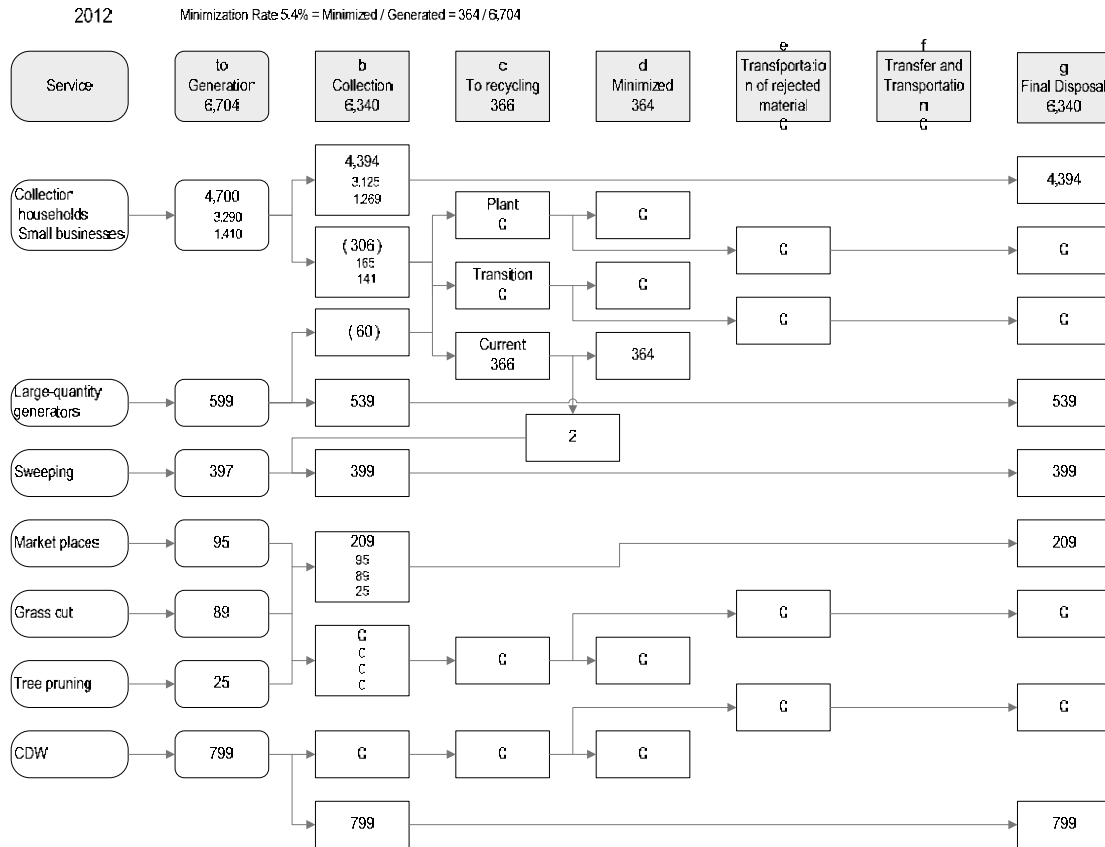


Figure 3-1: Image of the Location of the future Transfer Stations and Landfills

3.6 Solid Waste Flow

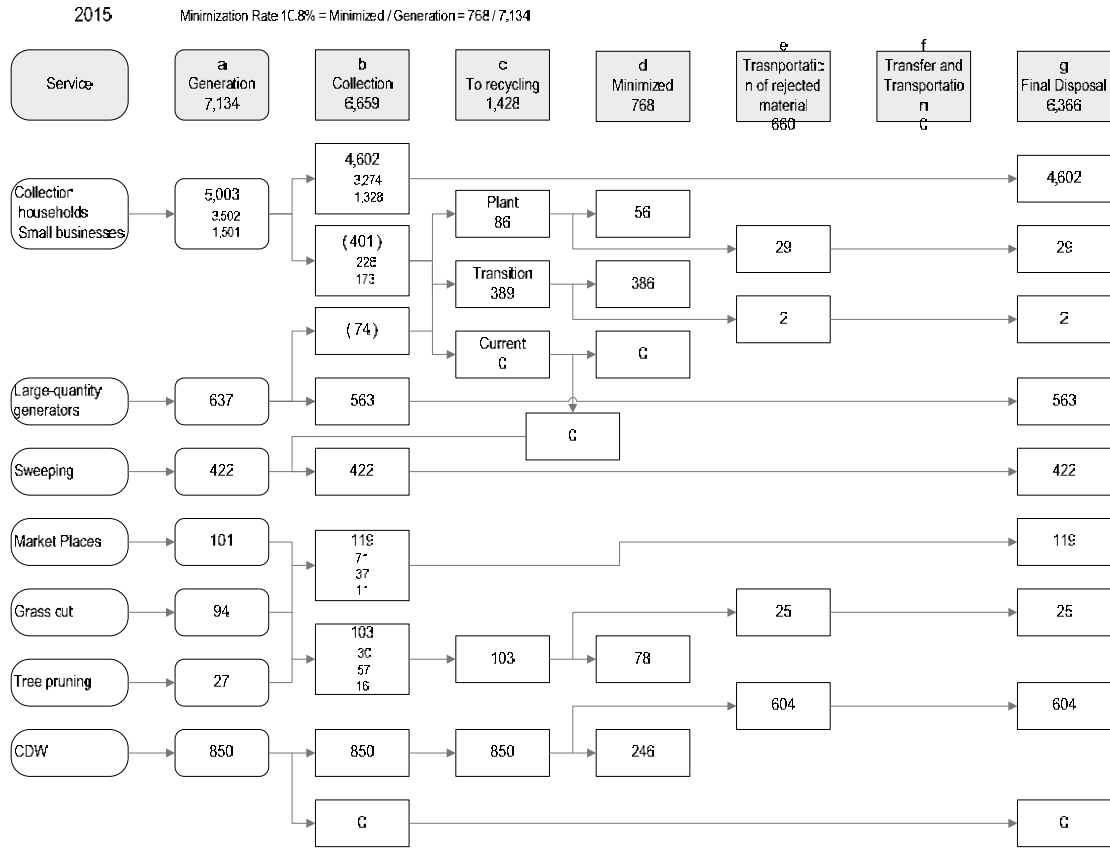
This section shows the solid waste flows in 2012 (present), 2015 (short term goal year), 2018 (medium term goal year) and 2027 (long term goal year).



Item	Tons/day	Note	
a	Generation	6,704	The entire quantity of waste produced.
b	Collection	6,340	This does not include the quantity which is to go to material recycling processes.
c	Recycling	366	Includes material recycling, composting and combined cdw recycling.
d	Minimization	364	The quantity minimized in the foregoing recycling processes.
e	Transportation of rejected material	0	Transportation of materials rejected in the recycling processes to the final disposal site or the transfer station.
f	Transfer and Transportation	0	The quantity of waste that reaches the transfer station and is carried by trailer to the final disposal site.
g	Final Disposal	6,340	The quantity of waste that arrives at the final disposal site.
Minimization rate		5.4%	$d / a = 364 / 6,704 = 5.4\%$

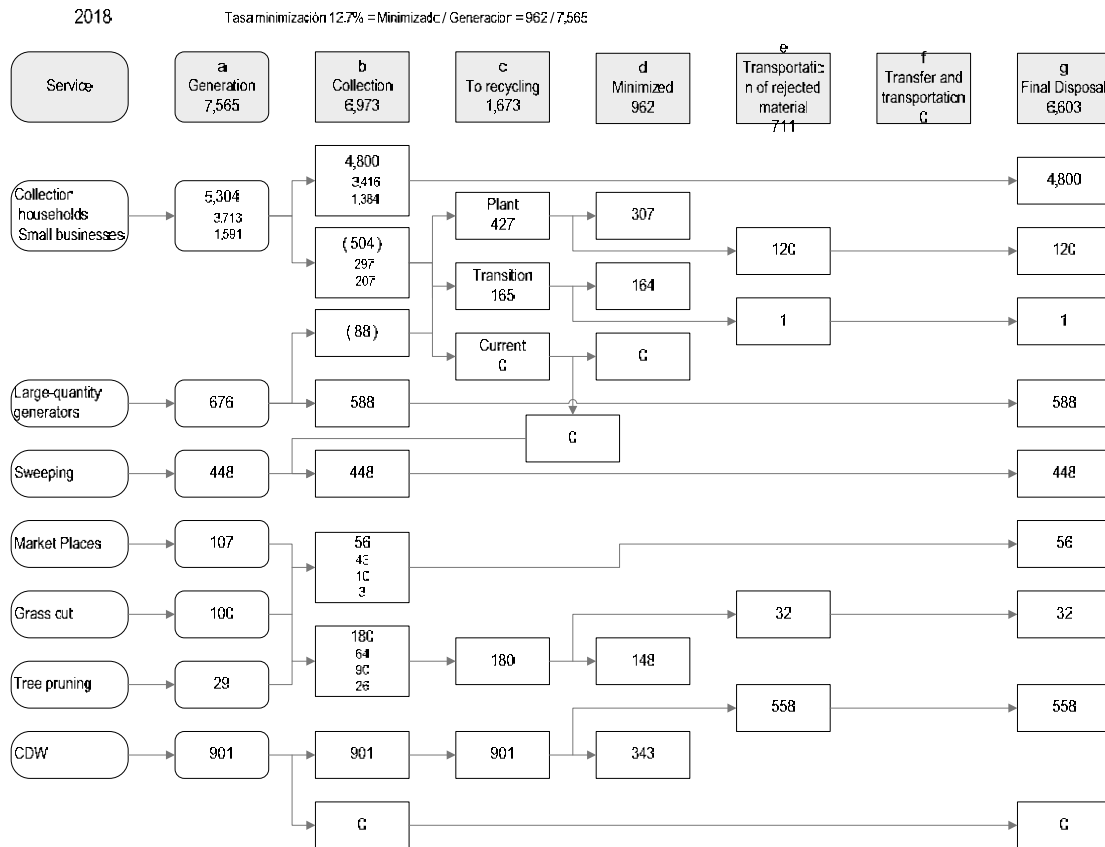
Figure 3-2: Solid Waste Flow, Current in 2012

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Item	Tons/day	Note
a Generation	7,134	The entire quantity of waste produced.
b Collection	6,659	This does not include the quantity which is to go to material recycling processes.
c Recycling	1,428	Includes material recycling, composting and combined cdw recycling..
d Minimization	768	The quantity minimized in the above recycling processes.
e Transportation of rejected material	660	Transportation of materials rejected in the recycling processes to the final disposal site or the transfer station.
f Transfer and Transportation	0	The quantity of waste that reaches the transfer station and is carried by trailer to the final disposal site.
g Final Disposal	6,366	The quantity of waste that arrives at the final disposal site.
Minimization rate	10.8%	$d / a = 768 / 7134 = 10.8\%$

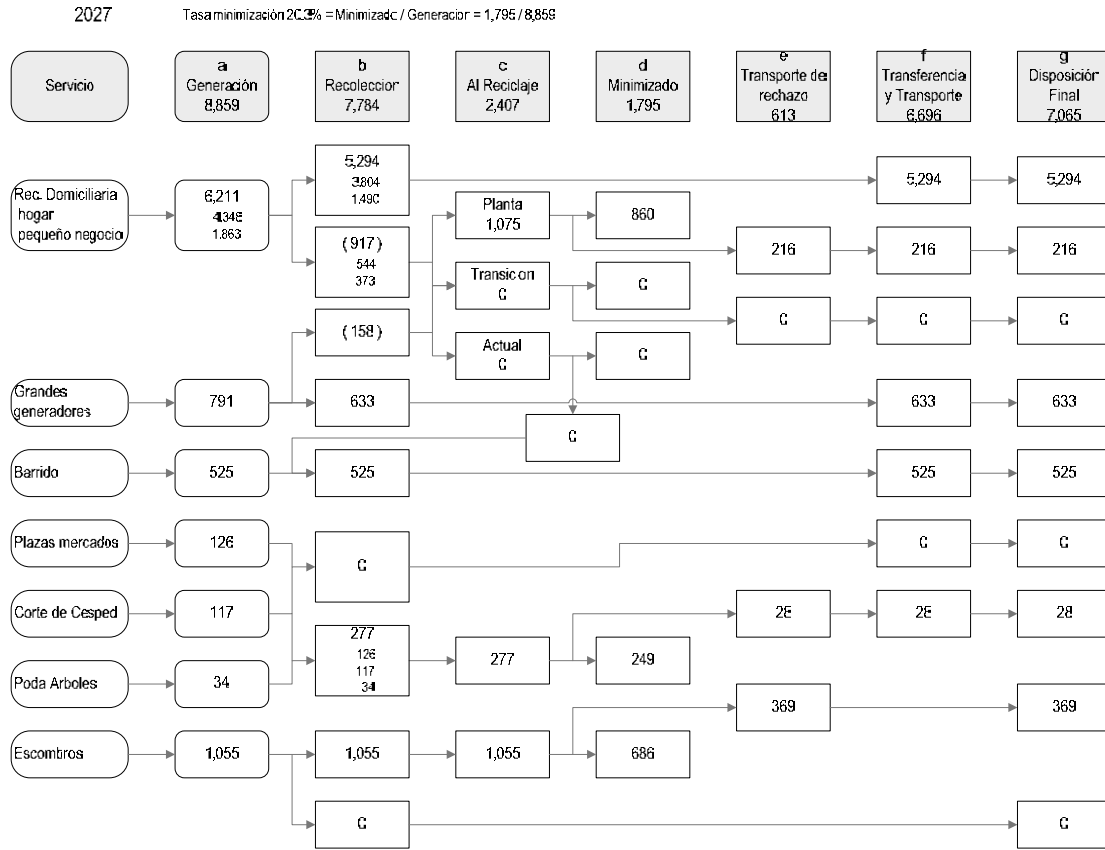
Figure 3-3: Solid Waste Flow, Short Term in 2015



Item	Tons/day	Note
a Generation	7,565	The entire quantity of waste produced.
b Collection	6,973	This does not include the quantity which is to go to material recycling processes.
c Recycling	1,673	Includes material recycling, composting and combined cdw recycling.
d Minimization	962	The quantity minimized in the above recycling processes.
e Transportation of rejected material	771	Transportation of materials rejected in the recycling processes to the final disposal site or the transfer station.
f Transfer and Transportation	0	The quantity of waste that reaches the transfer station and is carried by trailer to the final disposal site.
g Final Disposal	6,603	The quantity of waste that arrives at the final disposal site.
Minimization rate	12.7%	$d / a = 962 / 7,565 = 12.7\%$

Figure 3-4: Solid Waste Flow, Medium Term in 2018

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Item	Tons/day	Note
a Generation	8,859	The entire quantity of waste produced.
b Collection	7,784	This does not include the quantity which is to go to material recycling processes.
c Recycling	2,407	Includes material recycling, composting and combined cdw recycling.
d Minimization	1,795	The quantity minimized in the above recycling processes.
e Transportation of rejected material	613	Transportation of materials rejected in the recycling processes to the final disposal site or the transfer station.
f Transfer and Transportation	6,696	The quantity of waste that reaches the transfer station and is carried by trailer to the final disposal site.
g Final Disposal	7,065	The quantity of waste that arrives at the final disposal site.
Minimization rate	20.3%	$d / a = 1,795 / 8,859 = 20.3\%$

Figure 3-5: Solid Waste Flow, Long Term in 2027

4 Components of the Master Plan

4.1 Collection, Sweeping and Cleaning (CSC – RBL in Spanish)

4.1.1 Categorization and Definition of Collection Services

The Table below states the categories and definitions of the service for the collection of solid waste. Within this classification, hazardous waste would be off the jurisdiction of the UAESP; therefore, the practical application requires adequate adjustments.

Table 4-1: Categorization and Definition of Collection Services

Type of Waste	Categorization of the services	Definition of the services
Non Hazardous	Household	The service for household collection includes the collection of waste produced by the residential users and by small generators corresponding to non-residential generators whose production of compacted solid waste is less than one cubic meter per month.
	Commercial and Institutional	The goal of this service is the waste from the large-quantity generators as large shopping malls, supermarkets, hotels, institutions and industries that generate nonhazardous waste. Waste from residential complexes or tall buildings are excluded from this category in the urban area since, in this case, there is concentration of waste at one specific place only.
	Large-quantity Generators	The service to the large-quantity generators must be undertaken with the required frequency, and the collection shall be carried out at the place where they keep the storage warehouse, as long as it meets the provisions of Decree 1713 of 2002, or of the regulation amending or complementing it. The operator shall be responsible for assessing, in each case, the access and the maneuverability of the garbage collection trucks in order to make the adjustments, as much as possible, vis-à-vis the conditions of the large-quantity generator.
	Sweeping	The goal of this service is the waste generated by activities in the street, avenues, in the parks, and in other public areas. This service falls under the responsibility of the District.
	Market	The goal of this service is the waste from municipal markets located in the District where the commercialization of meat, vegetables, fruit, etc. takes place.
	Lawn Mowing	This service includes the collection and transport, up to the treatment or final disposal place, of the waste generated by this activity in all the public green areas of the Capital District located in: i) road dividers including, besides, the other roads for vehicle traffic, pedestrian paths and cyclist paths; ii) traffic circles, roundabouts or similar structures; iii) green areas of sidewalks that are not under the responsibility of the inhabitants, owners or administrators of the neighboring properties, pursuant to the provisions of the Police Code; iv) public parks that are defined in the Zoning Plan of the Capital District that are partially or wholly within the urban perimeter, environmental protection areas and public space areas incorporated by the Capital District. Anyway, the only areas to be taken care of are those within the urban perimeter.
	Tree Pruning	This service includes tree pruning in the public roads and areas.
	Construction and Demolition Waste (CDW)	The goal of this service is the construction and demolition waste and earthworks not surpassing 1m3 which falls under the responsibility of the UAESP.

Table 4-2: Collection and Transport System (2013-2020)

Service	Collection	Transfer Station	Transport
1. Household	Compactor Trucks – 25 yd ³	–	Direct Transport
2. Commercial and Institutional	Compactor Trucks – 25 yd ³	–	Direct Transport
3. Large-quantity generators	Ampliroll - 10 M ³	–	Direct Transport
4. Sweeping	Compactors – 16 yd ³	–	Direct Transport
5. Market	Ampliroll 10 M ³	–	Direct Transport
6. Lawn Mowing	Van – 4.5 Tons	–	Direct Transport
7. Tree Pruning	Van – 4.5 Tons	–	Direct Transport
8. Construction and Demolition Waste (CDW)	Truck - 12 m ³	–	Direct Transport

Table 4-3: Collection and Transport System (2021-2027)

Service	Collection	Transfer Station	Transport
1. Household	Compactors – 16 yd ³	New	Trailers (85 yd ³)
2. Commercial and Institutional	Compactors – 16 yd ³	New	Trailers (85 yd ³)
3. Large-quantity Generators	Ampliroll - 10 M ³	New	Trailers (85 yd ³)
4. Sweeping	Compactors – 16 yd ³	New	Trailers (85 yd ³)
5. Market	Ampliroll - 10 M ³	New	Trailers (85 yd ³)
6. Lawn Mowing	Van – 4.5 Tons	New	Trailers (85 yd ³)
7. Tree Pruning	Van – 4.5 Tons	New	Trailers (85 yd ³)
8. Construction and Demolition Waste (CDW)	Ampliroll - 10 M ³ , or Dump Truck with containers (5 and 10 m ³)	New	Trailers (85 yd ³)

4.1.2 Collection and Transport

4.1.2.1 Collection and Transport

a. Group of Localities

Within what is considered the new concession period, it was defined that the only landfill to be used will be Doña Juana, up to year 2021. From then onwards, two (2) additional Transfer Stations, and two (2) Landfills, to the north and to the west, respectively, would be operating. Figure 4-1 shows the distribution of the waste per area serviced by Doña Juan and by the two Transfer Stations.

Table 4-4: Localities Grouped by Facilities Servicing them by 2021

Group	Locality	Facilities Used
G1	Usaquén	Transfer Station to the North
	Suba	
G2	Fontibón	Transfer Station to the West
	Engativá	
	Chapinero	
	Santa Fe	
	Barrios Unidos	
	Teusaquillo	
	Los Mártires	
	Candelaria	
	Bosa	
Kennedy		

G3	Tunjuelito	Doña Juana Landfill
	Puente Aranda	
	Ciudad Bolívar	
	San Cristóbal	
	Usme	
	Antonio Nariño	
	Rafael Uribe	

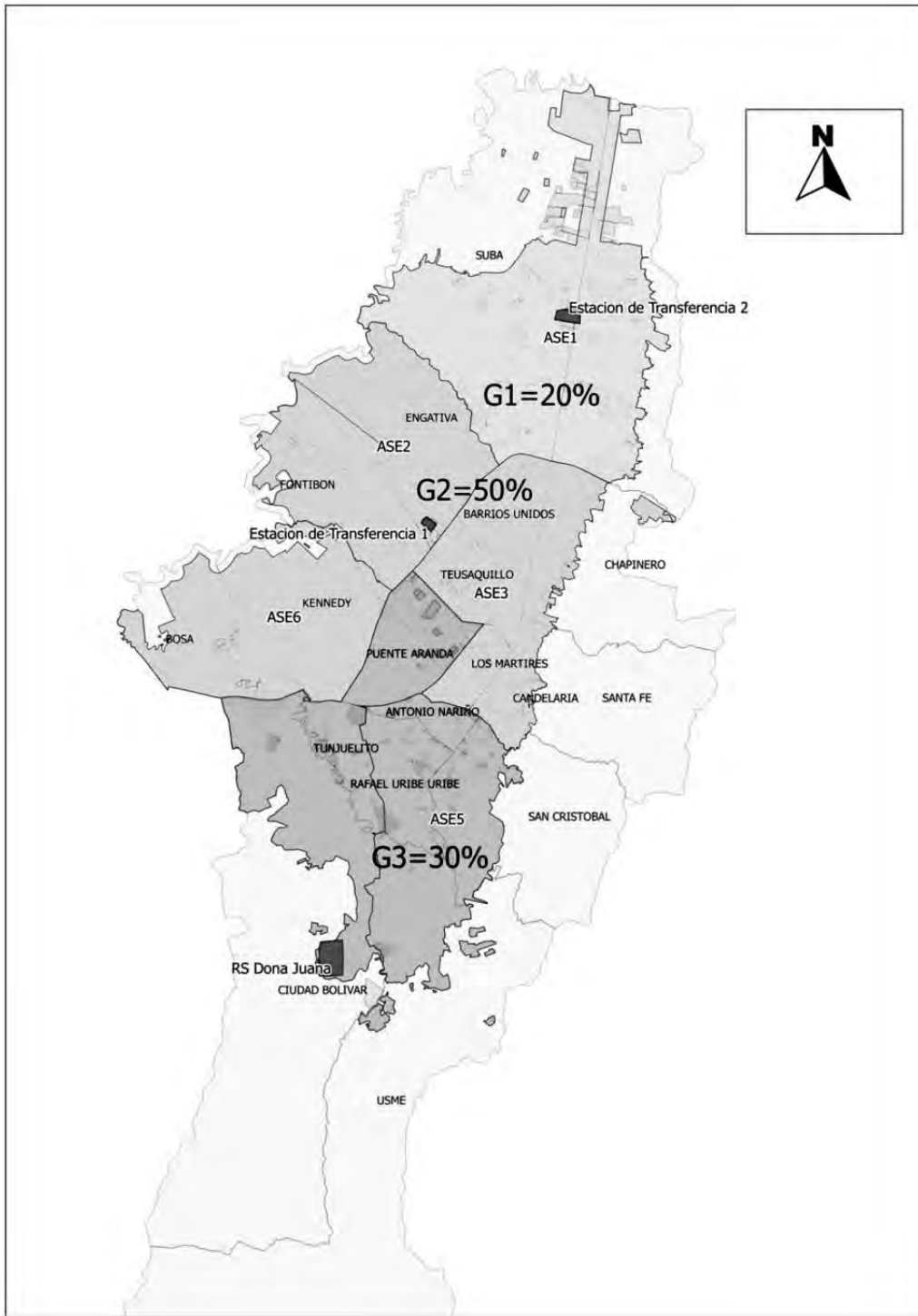


Figure 4-1: Localities Grouped by Facilities

b. Necessary Equipment

The numbers of necessary vehicles for each service appear in the tables below. There is a comparison between the scenario with and without transfer stations. If transfer stations are not built, the collection and transport system shall be similar to the current one in which 25 yd³ large-capacity trucks predominate, while for the event of introducing the Transfer Stations, it is suggested to introduce lower-capacity trucks. For example, 16 yd³ trucks that could make more trips to the transfer station representing a lower-impact vehicular problem for the District.

b.1 Without Transfer Station

Table 4-5: Total Number of Vehicles Required without Transfer Station (2014-2020)

	2014	2015	2016	2017	2018	2019	2020
Compactor Truck - 25 yd ³	233	237	241	247	251	255	259
Compactor Truck - 16 yd ³	35	35	35	36	36	36	38
Ampliroll - 10 m ³	35	36	36	36	38	39	39
Trucks - 12 m ³	36	38	39	39	40	40	41
Van – 4.5 Tons	14	15	16	16	17	17	17
Grand Total	353	361	367	374	382	387	394

Reserve 5%
Lifetime 7 years

Table 4-6: Total Number of Vehicles Required without Transfer Station (2021-2041)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Compactor Truck - 25 yd ³	293	297	300	303	306	311	315	319	325	330	335	339	345	350	356	360	366	371	375	381	386
Compactor Truck - 16 yd ³	43	44	45	45	46	47	47	49	49	49	51	51	52	53	53	55	55	56	56	58	59
Ampliroll - 10 m ³	44	44	45	45	45	46	47	47	49	49	49	51	51	52	52	53	55	55	55	56	56
Trucks - 12 m ³	47	47	49	49	51	51	52	52	53	55	55	56	56	58	59	59	60	60	61	63	64
Van – 4.5 Ton	19	19	19	19	19	21	21	21	21	21	22	23	23	23	23	23	23	24	24	24	25
Grand Total	446	451	458	461	467	476	482	488	497	504	512	520	527	536	543	550	559	566	571	582	590

Reserve 5%
Lifetime 7 years

4 Components of the Master Plan

Table 4-7: Annual Acquisition of Vehicles (2014-2020)

	2014	2015	2016	2017	2018	2019	2020
Compactor Truck - 25 yd ³	233	4	4	6	4	4	4
Compactor Truck - 16 yd ³	35	0	0	1	0	0	2
Ampliroll - 10 m ³	35	1	0	0	2	1	0
Trucks - 12 m ³	36	2	1	0	1	0	1
Van - 4.5 Ton	14	1	1	0	1	0	0
Total	353	8	6	7	8	5	7

Reserve 5%
Lifetime 7 years

Table 4-8: Annual Acquisition of Vehicles (2021-2041)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Compactor Truck - 25 yd ³	267	8	7	9	7	9	8	271	14	12	14	11	15	13	277	18	18	19	15	21	18
Compactor Truck - 16 yd ³	40	1	1	1	1	1	2	42	1	1	3	1	2	3	42	3	1	4	1	4	4
Ampliroll - 10 m ³	40	1	1	0	2	2	1	40	3	1	0	4	2	2	40	4	3	0	4	3	2
Trucks - 12 m ³	42	2	3	0	3	0	2	42	3	5	0	4	0	4	43	3	6	0	5	2	5
Van - 4.5 Tons	16	1	1	0	1	2	0	16	1	1	1	2	2	0	16	1	1	2	2	2	1
Total	405	13	13	10	14	14	13	411	22	20	18	22	21	22	418	29	29	25	27	32	30

Reserve 5%
Lifetime 7 years

b.2 With Transfer Station

Table 4-9: Total Number of Vehicles Required with Transfer Station (2021-2041)

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Compactor Truck - 16 yd ³	229	230	233	236	239	241	246	250	253	257	261	265	269	273	278	282	284	289	293	297	301
Ampliroll - 10 m ³	42	43	43	43	43	46	46	46	47	48	48	49	50	51	52	52	52	54	54	54	56
Van – 4.5 Tons	9	9	9	9	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	13
Trailer-truck	62	62	63	63	65	66	66	68	69	70	70	72	73	74	75	76	77	79	79	80	81
Trailer	65	65	66	67	68	69	70	70	72	73	74	76	76	77	79	80	81	82	83	84	86
Total	407	409	414	418	424	433	439	445	452	459	464	473	479	486	495	501	505	515	520	526	537

Reserve 5%
Lifetime 7 years

Table 4-10: Annual Acquisition of Vehicles

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Compactor Truck - 16 yd ³	229	1	3	3	3	2	5	233	4	7	7	7	6	9	238	8	9	12	11	10	13
Ampliroll - 10 m ³	42	1	0	0	0	3	0	42	2	1	0	1	4	1	43	2	1	2	1	4	3
Van – 4.5 Tons	9	0	0	0	0	2	0	9	0	0	0	0	2	0	9	0	0	0	0	2	2
Trailer-truck	62	0	1	0	2	1	0	2	1	1	70	2	2	1	3	2	1	4	1	2	71
Trailer	65	0	1	1	1	1	1	0	2	1	74	2	1	2	3	2	2	1	3	2	76
Total	407	2	5	4	6	9	6	286	9	10	151	12	15	13	296	14	13	19	16	20	165

Reserve 5%
Lifetime 7 years

4.1.2.2 Transfer Stations

a. Location

Bogotá is one of the largest cities in Latin America which grows to the north and to the south. The current site for final disposal, Doña Juana, is located to the south so the trucks collecting in the north and in the center of the District have to make long trips in order to discharge the waste at Doña Juana.

Therefore, there has been an assessment carried out concerning the break-even point, at the pre-feasibility level, in order to determine the distance up to which it is profitable to use a regular 25 yd³ compactor truck vs. using an 85 yd³ trailer-truck and a transfer station for the transport of the waste.

a.1 Transfer Station for the North (G1)

It was defined that the Transfer Station (TS) to the north should handle 20% of the waste produced by 2027 with a security margin added. As a consequence, it should handle 2,000 tons/day.

Doña Juana is around 32 kilometers from the center of the area of influence; on the other hand, the break-even point distance where a transfer station is required equals 21 kilometers, which clearly indicates that a Transfer Station is feasible for the attention of Group 1 (See Table 4-4).

a.2 TS for the West (G2)

On the other hand, the TS to the west should handle 50% of the waste by 2027 with a security margin added. Consequently, its capacity was stated at 4,500 tons/day.

Doña Juana is about 21 kilometers from the center of the area of influence, while the Mondoñedo landfill is located at a distance of 28 kilometers. Nonetheless, the distance from the break-even point equals 17 kilometers, which clearly indicates that a Transfer Station is feasible for the attention of Group 2.

b. Conceptual design of the transfer stations

The new transfer and transport system will have two transfer stations: one for 2,000 tons/day and another one for 4,500 tons/day. The waste would arrive by 16 yd³ compactor trucks which would have a lesser impact on the feasibility vis-à-vis greater capacity trucks (25 yd³) that predominate in the current system. Besides the transfer station there would be 85 yd³ trailer-trucks.

Each transfer station is equipped with two scales. The transfer station to the north will have six (6) chutes that can receive three trucks each. The transfer station to the west will have ten (10)

chutes with the already mentioned capacity. The conceptual layout and the design are indicated below.

Table 4-11: New Transfer and Transport System

Component	Characteristics
Transfer stations	TS capacity for G1: 2,000 tons/day TS capacity for G2: 4,500 tons/day Direct discharge
Transfer transport	Trailer-truck and trailer - 85yd ³
Collection service	Compactor truck - 16 yd ³

4 Components of the Master Plan

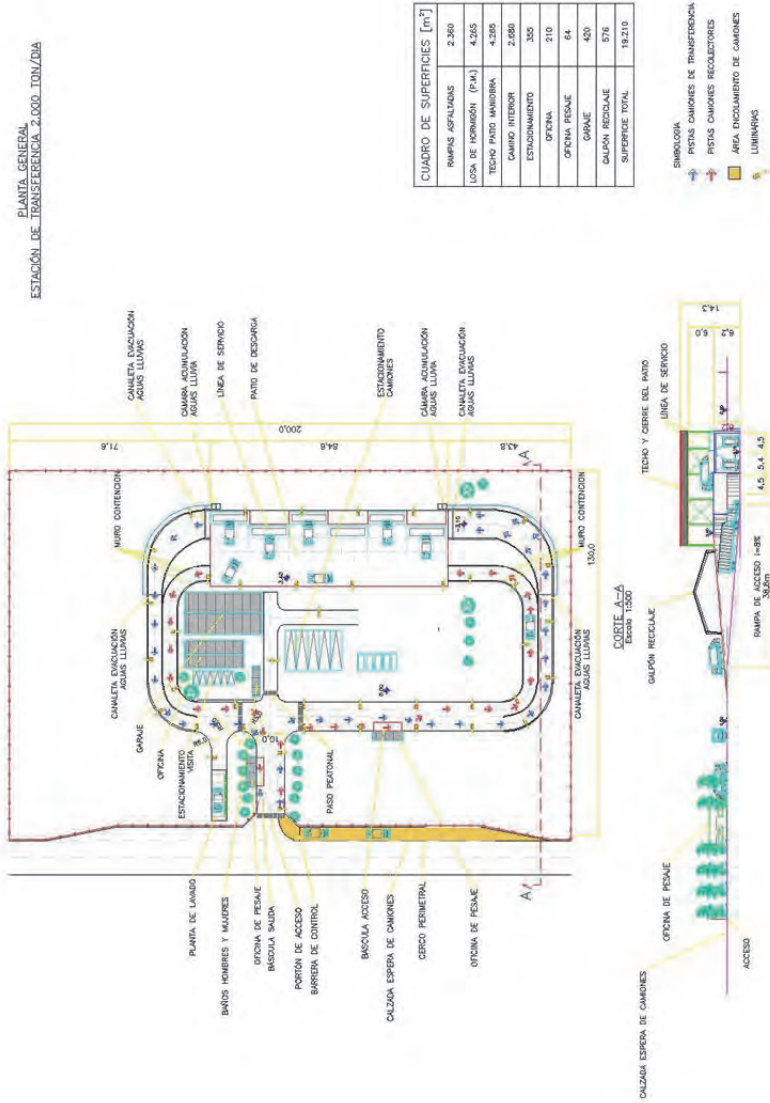


Figure 4-2: Transfer Station Layout – 2,000 Tons/day - North of the District

4.1 Collection, Sweeping and Cleaning (CSC – RBL in Spanish)

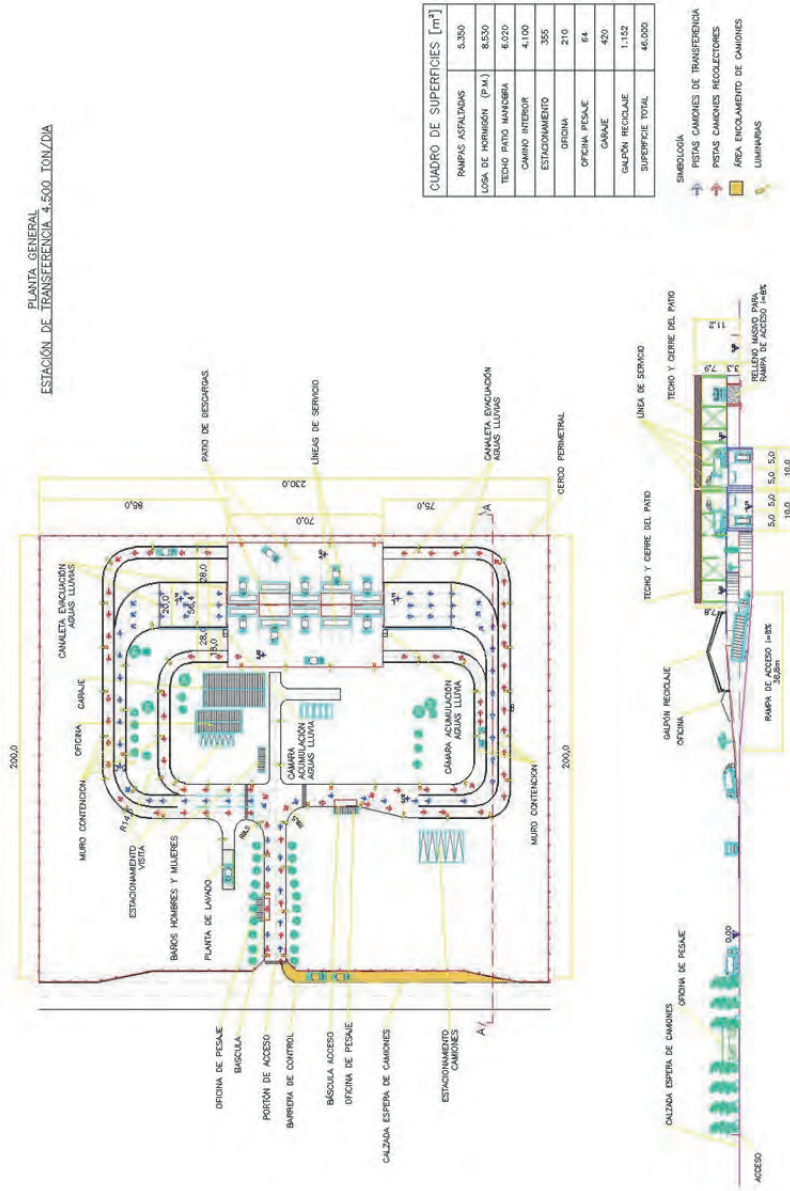


Figure 4-3: Transfer Station Layout – 4,500 Tons/day – West of the District

4.2 Recycling

4.2.1 Recycling goal

To promote the recycling of waste left over after reducing generation and making good use of such waste.

In Bogota D.C. recycling will be promoted through the following measures:

- Selective collection of waste
 - Collection of potentially recyclable materials (PRM) by registered recyclers.
 - Provision of selective waste collection services by duly registered and authorized **Recyclers' Organizations Authorized for the Provision of Services (ORA**, acronym in Spanish), after receiving training in administrative and technical matters.
- Composting of organic waste from marketplaces, lawn mowing and yard waste.
- Recycling of cdw
- Other recycling activities

Table 4-12 shows the recycling target rate and Figure 4-4 shows the evolution of the recycling rate goal for each one of the above mentioned measures.

- Short term goal (for the year 2015): 10.8%
- Medium-term goal (for 2018): 12.7%
- Long-term goal (for 2027): 20.2%

Table 4-12: Recycling Rate Goal (%)

Recycling Activity	2012 Current	2015 Short term	2018 Medium term	2027 Long term
Selective collection of potentially recyclable materials	5.4	6.2	6.2	9.7
PRM recovery by recyclers (current)	5.4	0.0	0.0	0.0
PRM recovery by registered recyclers and ORAs	0.0	5.4	2.2	0.0
Selective PRM collection service	0	0.8	4.1	9.7
Organic waste composting	0.0	1.1	2.0	2.8
Cdw recycling	0.0	3.5	4.5	7.7
Total target rate	5.4	10.8	12.7	20.3

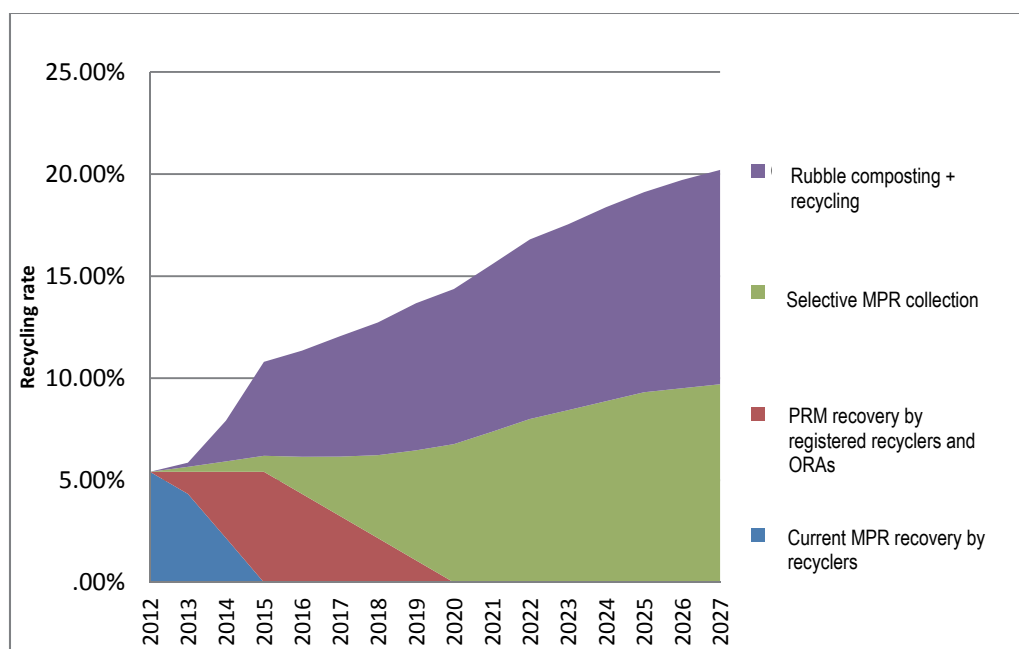


Figure 4-4: Evolution of Recycling Rate Goal by Measure

4.2.2 PRM separate collection

4.2.2.1 Expansion strategy

a. Short term (2013-2015)

- Structure the PRM recovery system through registration of recyclers included in the census and creation of ORAs.
- Strengthen the understanding of and collaboration of users regarding waste separation as well as review and structure the operation and administration model for the gathering center by the ORAs through the Alqueria Model Project (AMP).
- As part of the expansion strategy for the selective collection service, for the area covered by the existing 73 routes, awareness raising for the community will be strengthened through the activities proposed under the AMP, in order to expand the collection coverage currently being provided in a linear format.

b. Medium term (2016-2018)

- Transition from PRM collection on recyclers' individual routes to selective PRM collection service by ORAs
- Expansion of the Alqueria model

c. Long term (2019-2027)

- Provision of public service for waste integrated use incorporating from the PRM selective collection and classification to the operation and management of the collection/packing by the ORAs.

4.2.2.2 Structuring the collection and transport system

a. Collection and transport system

Table 4-13 shows a summary of the collection and transport system for each planning term.

For the short-term, the collection of potentially recyclable materials will continue to use the existing method on the individual routes of registered recyclers, and for the sectors covered by the existing 73 routes the selective collection service will be provided by ORA.

For the medium and long term, with the expanded selective collection service for potentially recyclable materials, the system will move to the structured collection and transport system based on the AMP evaluation results. Consequently, this Master Plan shows the basic AMP collection and transport system.

Table 4-13: Summary of collection and transport system for each planning term

Term	Collection agent	Collection routes	Collection equipment	Collection fee	Dissemination of information to users
Short (2013-2015)	Registered recyclers	Individual routes	Carts, horse-drawn carts	87,000 pesos/ton	Communication through general mass media
	ORA	Sectors covered by the 73 selective routes	Container dump truck (6 t)	Contract with Capital District	Awareness raising on waste separation by community meetings and individual home visits
Medium (2016-2018)	ORA	Sectors covered by the 73 selective routes and other expanded areas	Container dump truck (6 t)	Contract with Capital District	Awareness raising on waste separation by community meetings and individual home visits
Long (2019-2027)	ORA	Sectors covered by the 73 selective routes and other expanded areas	Container dump truck (6 t)	Contract with Capital District	Awareness raising on waste separation by community meetings and individual home visits

b. Vehicle selection

Even though loading capacity is an issue to be considered, an open loading truck is recommended for collection purposes in order to ensure efficiency in both the classification and quality of classified waste at the gathering centers. The vehicle should also have the adequate structure to operate in rainy conditions and avoid the scattering of collected waste along the route. In order to facilitate loading and unloading operations at the gathering centers, it should be a dump-truck type.

c. Required number of vehicles

The required number of vehicles for the collection of potentially recyclable materials has been calculated. The table below indicates the calculation parameters.

The results of the calculation indicate that the number required will be 29, 143 and 359 units for 2015, the short-term target year, 2018, the medium term target year and 2027, the long-term target year, respectively.

Table 4-14: Basic conditions for the vehicle to be used in selective collection of potentially recyclable materials

Item	Amount	Note
Type of vehicle	Container dump truck	
Vehicle loading capacity (weight)	27m ³ (6 ton rating)	
Apparent density	0.056 tons/m ³	Value measured at Alqueria
Maximum load when loading waste	1.5t/trip	27×0.056
Collection trips per day per vehicle	2 trips/day	
Sum of load amount per vehicle	3.0 tons/day	1.5×2
Required number of vehicles		(Amount of potentially recyclable materials) / 3.0 ton

Table 4-15: Evolution of the amount of potentially recyclable materials collected and required number of vehicles

Year	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Amount of PRM (t/day)	27	55	85	194	308	427	561	700	756	814	874	935	997	1,036	1,074
Number of vehicles	9	19	29	65	103	143	187	234	253	272	292	312	333	346	359

Table 4-16: Required number of vehicles for target years

Year	2015 Short term	2018 Medium term	2027 Long term
Amount of collection of potentially recyclable materials for the selective collection service (tons/day)	85	427	1,074
Required number of vehicles	29	143	359

4.2.2.3 Organization of gathering centers

a. Organization guideline

For the extended collection of potentially recyclable materials the organization of registered warehouses and new gathering centers should be developed.

a.1 Short term (2013-2015)

The warehouses registered should be converted in the gathering centers of potentially recyclable materials to be recovered by registered recyclers and ORAs. In this fashion the amount of recovered materials can be properly identified. The existing warehouses have limited areas, therefore they operate as space used for the selection of recyclable materials that arrive with a certain degree of separation, to be stored and shipped to other larger gathering centers or recycling companies. With the extended selective collection service registered warehouses should be merged and converted in gathering centers.

a.2 Medium and long term (2016-2027)

The land surface of existing warehouses is very limited and quite often less than 200m², which makes it difficult to be utilized as gathering centers where, according to the Alqueria model, other activities from classification to transformation or pre-transformation of materials will be carried out. In addition, it is difficult to obtain land for gathering centers with a capacity of 30 tons/day in the city (a land plot of over 5,000m² is required).

In the future, with the expanded selective collection service, gathering centers with a capacity of 30 tons a day should be organized in each one of the 6 ASEs by integrating registered warehouses or as new developments, based on the Alqueria collection/packing model.

The required number of gathering centers is calculated based on the amount of potentially recyclable materials collected per ASE in 2027. According to the results 36 gathering centers will be required for 2027.

Table 4-17: Calculation of the required number of gathering centers
(with a 30 tons/day capacity)

ASE	District	Population		Collected amount of potentially recyclable materials *3		Required number of gathering centers (corresponding to facilities with a scale of 30 tons/day)
		Year 2015*1	Year 2027*2	By district	By ASE	
		(Persons)	(Persons)	(tons/day)	(tons/day)	
1	USAQUÉN	494,066	626,595	72	243	8
	SUBA	1,174,736	1,489,849	171		
2	FONTIBÓN	380,453	428,704	49	162	5
	ENGATIVÁ	874,755	985,696	113		
3	CHAPINERO	137,870	155,355	18	99	5
	SANTA FE	110,053	124,010	14		
	BARRIOS UNIDOS	240,960	271,520	31		
	TEUSAQUILLO	151,092	170,254	20		
	LOS MÁRTINES	98,758	111,283	13		
	CANDELARIA	24,096	27,152	3		
4	TUNJUELITO	200,048	225,419	26	148	5
	PUENTE ARANDA	258,414	291,187	33		
	CIUDAD BOLIVAR	687,923	775,169	89		
5	SAN CRISTÓBAL	406,025	457,519	53	172	5
	USME	432,724	487,604	56		
	ANTONIO NARIÑO	108,941	122,757	14		
	RAFAEL URIBE U	375,107	422,680	49		
6	BOSA	646,833	820,341	94	250	8
	KENNEDY	1,069,469	1,356,345	156		
	SUMAPAZ	6,460	6,656	1	1	0
Total		7,878,783	9,356,097	1,074	1,074	36
*1 : Predicted population based on DEMOGRAPHICS						
*2 : The population growth index between 2005 and 2015 is 2% per year in ASE1 and 6.1% in ASE2 to 5. This growth rate for each ASE is used to predict the 2027population.						
*3 : The amount of waste collected in each district in the year 2027, is divided into the total amount collected in the population						

b. Organization schedule for gathering centers

The following schedule for the organization of gathering centers is established in accordance with the expanded selective collection of potentially recyclable materials:

3 gathering centers for the short term, 19 for the medium term and 36 for the long term will be required.

Table 4-18: Evolution of the amount of potentially recyclable materials (PRM) collected and schedule for the organization of gathering centers

Year		Short-term			Medium-term			Long-term								
		13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Amount of PRM collected (tons/day)		27	55	85	194	308	427	561	700	756	814	874	935	997	1036	1074
Amount of PRM recovered (tons/day)		17	35	56	132	216	307	415	532	590	651	699	748	798	828	860
Gathering centers developed	Per year	1	1	1	4	4	4	4	5	2	2	2	2	2	1	1
	Cumulative total	1	2	3	7	11	15	19	24	26	28	30	32	34	35	36

4.2.3 Recycling organic waste

Organic waste of marketplace, lawn mowing and yard can be recycled as compost. The table below shows the amount of organic waste generated to be recycled and the recycling rate.

The recycled amount and rate over the amount of organic waste to be recycled are: 79 tons/day (76%) in the short term, 148 tons/day (82%) in the medium term, and 249 tons/day (90%) in the long term.

Table 4-19: Generated and recycled amounts and recycling rate for target organic waste to be recycled

Year	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Short term			Medium term			Long term								
Amount of generated target organic waste to be recycled (tons/day)	11	51	103	127	154	180	208	223	238	254	259	264	267	272	277
Marketplace	5	15	30	41	53	64	77	89	102	115	118	120	122	124	126
Lawn mowing	5	28	57	67	79	90	102	104	106	108	110	112	113	115	117
Yard waste	1	8	16	19	22	26	29	30	30	31	31	32	32	33	34
Amount of target organic waste recycled (tons/day)	8	37	79	100	123	148	175	192	210	229	233	237	241	245	249
Marketplace	4	11	23	32	42	53	64	77	90	104	106	108	109	111	113
Lawn mowing	3	21	43	53	63	74	86	89	93	97	99	100	102	104	106
Yard waste	1	6	12	15	18	21	25	26	27	28	28	29	29	30	30
Recycling rate (%)	70	73	76	79	80	82	84	86	88	90	90	90	90	90	90

4.2.4 Recycling of Mixed Construction and Demolition Waste

a. Target Waste

a.1 Quantity of Mixed Construction and Demolition Waste

Target waste is Mixed Construction and Demolition Waste (MCDW) which is generated from construction and demolition in houses and small businesses. Waste that is generated in large scale construction works of buildings and/or roads and sludge that is from wastewater treatment plant are not considered in this section. The following table shows quantity of the MCDW.

Table 4-20: Quantity of MCDW

Unit: ton/year

Year	Total Generation	Generation of MCDW	To plant	Recovered /escombrera	Refuse to SL	Minimize. rate
2013	2,499,426	297,785	14,889	3,424	11,465	0.1%
2014	2,551,862	304,032	152,016	39,524	112,492	1.5%
2015	2,604,300	310,280	310,280	89,981	220,299	3.5%
2016	2,656,735	316,527	316,527	101,289	215,238	3.8%
2017	2,709,172	322,774	322,774	112,971	209,803	4.2%
2018	2,761,607	329,022	329,022	125,028	203,994	4.5%
2019	2,814,044	335,269	335,269	137,460	197,809	4.9%
2020	2,866,479	341,516	341,516	150,267	191,249	5.2%
2021	2,918,917	347,764	347,764	163,449	184,315	5.6%
2022	2,971,353	354,011	354,011	177,006	177,005	6.0%
2023	3,023,787	360,258	360,258	190,937	169,321	6.3%
2024	3,076,226	366,506	366,506	205,243	161,263	6.7%
2025	3,128,661	372,753	372,753	219,924	152,829	7.0%
2026	3,181,097	379,000	379,000	234,980	144,020	7.4%
2027	3,233,534	385,248	385,248	250,411	134,837	7.7%

To plant: quantity that goes in the recycling plant
 Recovered/escombrera: quantity of materials that is recovered or goes to licensed disposal site of CDW.
 Refuse to SL: refuse that goes to Sanitary Landfill.
 Minimization rate: percentage of minimization, quantity of recovered/escombrera divided by quantity of total generation

a.2 Classification and Quantity of the MDCW in 2027

Weight and volume of the MDCW in 2027 is shown by type in the following table. Facilities described in this section are designed based on the figures in the table.

Table 4-21: Classification of Construction Waste at Construction and Demolition Sites

No.	Main Separation Categories	Sub-categories	Amount of Construction Waste Created		
			Total Amount (tons/day)	Total Volume (m ³ /day)	
1	Waste for recycling (Creation of products through recycling.)	Concrete	287.1	261.0	
2		Brick (pieces of solid brick, blocks and tiles)	194.8	177.1	
3		Hardwood (pine, oak, cedar, tabebuia rosea, etc.)	23.0	38.3	
4	Waste for temporary storage (When a certain volume of storage has been reached, the materials will be given away or sold. Separation is not done at the storage site.)	Earth	Dust	199.0	153.1
			Sand	13.7	12.5
			Additions (stones and gravel)	0.8	0.7
5		Plastic	Thermoformable plastic (PET, PVC, PP, PS, HDPE, LDPE, etc.)	9.8	19.6
6		Metals	Copper (wire, certain kinds of hinges, etc.)	1.5	1.1
			Steel (screws, plates, pieces of steel rods, etc.)	1.2	0.2
	Iron		0.1	0.1	
	Aluminum		0.0	0.0	
		Brass (certain kinds of hinges, doorknobs, etc.)	0.0	0.0	
Total waste stored in the temporary storage facility			731.0	663.7	
7	Waste that is not recycled (Transported from the demolition site to the final disposal site.)	Ceramics (floor tiles, wall tiles, pieces of bathroom fixtures, etc.)	96.4	96.4	
		Stoneware (pipes, tiles, etc.)	45.2	45.2	
		Granite (countertops, flooring, walls, etc.)	26.0	26.0	
		Glass	21.3	35.5	
		Asphalt	12.6	18.0	
		Drywall	11.2	11.2	
		Textiles (Canvas, rugs, carpeting, etc.)	9.7	32.3	
		Marble (countertops, flooring, walls, etc.)	7.0	8.8	
		Rubber	6.1	10.2	
		Polystyrene foam	4.3	4.8	
		Particle board (plywood, MDF, laminates, etc.)	3.0	10.0	
		Bamboo (coffee grounds)	2.2	1.8	
		Thermoformable plastic (PF, PU, NBR, SBR, etc.)	2.1	10.5	
		Paper (Bags from cement, plaster, etc.)	0.8	1.0	
		Cardboard	0.2	2.0	
		Organic waste (food, grass cuttings, tree prunings, etc.)	0.1	0.1	
Light bulbs (dangerous waste)	0.0	0.0			
Other waste	31.7	26.4			
Total non-recycled waste			279.9	340.2	
8	Non-suitable waste (Highly dangerous asbestos waste will be separated and transported to the final disposal site and buried in a location to be determined.)	Asbestos-Cement (roof tiles, gutters downspouts, etc.)	44.1	44.1	
Total non-recycled waste + waste not suitable for recycling			324.0	384.3	
Total Construction Waste			1,055.0	1,048.0	

Source: Own preparation based on "UAESP, Diagnosis of Integrated Management of Construction and Demolition Waste in Bogota City – 2009"

b. Construction Waste Disposal System in Bogotá D.C.

(1) Classification at source

In small scale construction and demolition sites, waste is classified in eight types as shown in the previous table.

(2) Temporary Storage Facility

Twelve temporary storage facilities shall be built in the city to store waste for recycling at the construction waste recycling facility, and the waste to be sent to the temporary storage facility where recovered materials are stored temporarily until a certain amount has accumulated at which point these are sold or given away for free.

Construction waste to be recycled shall be placed in a container set up for that purpose and when a certain amount has accumulated it shall be transported to the construction waste recycling facility.

(3) Construction Waste Recycling Facility

The city will build three construction waste recycling facilities.

4.3 Final Disposal

The final disposal component under the Master Plan seeks to “*Guarantee correct final disposal of solid waste*”, which means that, throughout the Master Plan, on the one hand, operation of the Doña Juana Landfill (RSDJ) must be ensured and, on the other, the vulnerability of the present final disposal system, which requires a single final disposal site, must be reduced.

From the point of view of infrastructure, the Master Plan includes the following for final disposal:

- Extend the useful life of the RSDJ beyond the target year (2027),
- Inclusion of a landfill in the system in 2021 and possible exploitation of waste in the western sector by way of a regional solution.
- Inclusion in the system of a landfill in the year 2026 and possible exploitation of waste in the western sector by way of a regional solution.

In addition, and as part of the transfer and transportation component, there are plans for the commissioning of two transfer stations, one to the west and the other to the north, in 2021, which will operate in an initial phase with the RS Western and the RSDJ, respectively. As of 2026 the Northern landfill will operate with the Northern landfill.

The following figure shows the operating scheme established in the Master Plan for the transfer, transportation and final disposal component.

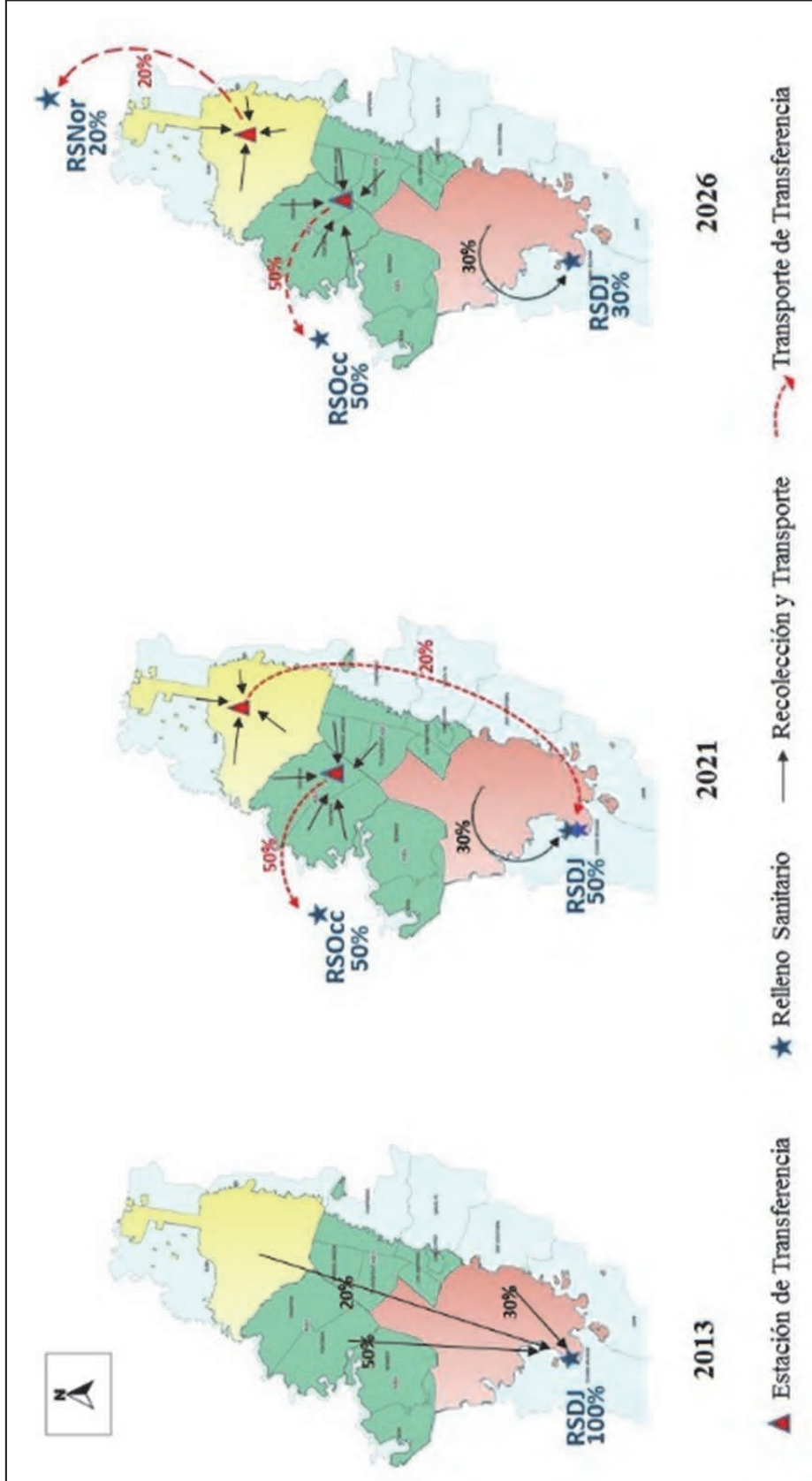


Figure 4-5: Operating Scheme Included in the Master Plan

4.3.1 Doña Juana Landfill (RSDJ)

At present, the RSDJ is operating in the Phase I Optimization Zone (see the following Figure) and the remaining capacity at December 31, 2012, is 2,585,293 m³, equivalent to 2,892,263 tons taking into account a density of 1.07 ton/m³. In addition, and according to the projected waste for the years 2013 y 2014, the entry of 2,351,656 and 2,347,515 tons of waste, respectively, per year and, therefore, Phase I will allow for operation until approximately March 2014.



Figure 4-6: Phase I Optimization Zone

The Master Plan includes the following two strategies aimed at ensuring operation of the RSDJ:

- Increase in the useful life of the RSDJ for a term beyond 2027, the year fixed as the goal of the Master Plan , and
- Adaptation of the RSDJ to current regulations so that it remains operative throughout the duration of the MP.

4.3.2 Occidente (Western) Landfill (RSOcc)

As mentioned above, one of the specific objectives of the MP for the final disposal component is to create new landfills, which could ultimately be included in waste exploitation processes, thereby reducing the vulnerability of the final disposal system. Specifically, the MP includes the commissioning of one landfill in the western sector and another in the northern sector in the years 2021 and 2026, respectively.

Because there are no zones for the implementation of landfills in Bogota, they will necessarily have to be located in Cundinamarca Department, thus becoming a project of a regional nature for the final disposal of solid waste.

Article 5 of Decree 838/2005, issued by the Ministry of the Environment, Housing and Territorial Development (now the Ministry of the Environment and Sustainable Development) establishes that the area where the landfill is to be located must be sufficient to allow its useful life to be compatible with the projected production of solid waste to be discharged into it, taking into account both the receiver municipality and those located within a radius of 60 kilometers of it. It also fixes the minimum useful life for landfills at 30 years.

In the specific case of the landfill projected for the western sector, the municipalities in that zone already have the Nuevo Mondoñedo landfill. However, in the long term it is possible that it will be included in the solution put forward under the Master Plan owing to the end of its useful life.

The municipalities whose waste is at present deposited in the Nuevo Mondoñedo landfill are also considered included as users of the Western landfill and it is estimated that they will contribute a tonnage of 1,104 by the year 2021, which will increase annually by some 1.2%. Based on these figures, the amount of waste from other municipalities has been determined and the total quantity of waste which will be discharged into the RSOcc during its useful life has been calculated. As shown in the above Table, the total amount of waste to be disposed of in the RSOcc in a period of 30 years is 58,674,585 tons, the equivalent, with a density of 1.07 ton/m³, of 54,836,061 m³.

Table 4-22: Total Projected Waste Discharged into the RSOcc

Year of Operation	Year	Bogota	Other Municipalities	Annual Total	Accumulation	Annual Total	Accumulation
		Tons/year	Tons/year	Tons/year	Ton	m3	m3
1	2021	1.231.827	403.109	1.634.936	1.634.936	1.527.978	1.527.978
2	2022	1.236.574	407.946	1.644.520	3.279.456	1.536.935	3.064.912
3	2023	1.246.400	412.842	1.659.242	4.938.698	1.550.693	4.615.606
4	2024	1.255.810	417.796	1.673.606	6.612.304	1.564.118	6.179.723
5	2025	1.264.805	422.809	1.687.614	8.299.918	1.577.210	7.756.933
6	2026	1.277.194	427.883	1.705.077	10.004.995	1.593.530	9.350.463
7	2027	1.289.294	433.018	1.722.312	11.727.307	1.609.637	10.960.100
8	2028	1.310.203	438.214	1.748.417	13.475.724	1.634.034	12.594.134
9	2029	1.331.110	443.472	1.774.582	15.250.306	1.658.488	14.252.622
10	2030	1.352.017	448.794	1.800.811	17.051.117	1.683.001	15.935.623
11	2031	1.372.925	454.180	1.827.105	18.878.222	1.707.574	17.643.198
12	2032	1.393.833	459.630	1.853.463	20.731.684	1.732.208	19.375.406
13	2033	1.414.741	465.145	1.879.886	22.611.571	1.756.903	21.132.309
14	2034	1.435.649	470.727	1.906.376	24.517.947	1.781.660	22.913.969
15	2035	1.456.557	476.376	1.932.933	26.450.879	1.806.479	24.720.448
16	2036	1.477.465	482.092	1.959.557	28.410.437	1.831.362	26.551.810
17	2037	1.498.373	487.877	1.986.250	30.396.687	1.856.309	28.408.119
18	2038	1.519.280	493.732	2.013.012	32.409.699	1.881.320	30.289.438
19	2039	1.540.187	499.657	2.039.844	34.449.543	1.906.396	32.195.834
20	2040	1.561.096	505.653	2.066.749	36.516.291	1.931.541	34.127.375
21	2041	1.582.002	511.720	2.093.722	38.610.014	1.956.750	36.084.125

Year of Operation	Year	Bogota	Other Municipalities	Annual Total	Accumulation	Annual Total	Accumulation
		Tons/year	Tons/year	Tons/year	Ton	m3	m3
22	2042	1.602.911	517.861	2.120.772	40.730.786	1.982.030	38.066.155
23	2043	1.623.749	524.075	2.147.824	42.878.610	2.007.312	40.073.467
24	2044	1.644.858	530.364	2.175.222	45.053.832	2.032.918	42.106.385
25	2045	1.666.241	536.729	2.202.969	47.256.801	2.058.850	44.165.235
26	2046	1.686.236	543.169	2.229.405	49.486.206	2.083.556	46.248.791
27	2047	1.706.470	549.687	2.256.158	51.742.364	2.108.559	48.357.350
28	2048	1.726.948	556.284	2.283.232	54.025.596	2.133.861	50.491.211
29	2049	1.747.671	562.959	2.310.631	56.336.227	2.159.468	52.650.679
30	2050	1.768.644	569.715	2.338.358	58.674.585	2.185.381	54.836.061

Source: Own preparation

4.3.3 Northern Landfill (RSNor)

In addition to a landfill going into operation in the western sector, the MP includes, for the long term, specifically the year 2026, the commissioning of a landfill in the north. It will be a regional project that includes part of the population of Bogota and municipalities in the northern sector of Cundinamarca Department.

As stated previously, the northern landfill will receive approximately 20% of Bogota waste for final disposal, while a quantity equal to that of the capital has been calculated for the municipalities of the northern sector of Cundinamarca Department. The following Table shows the quantity of waste that will be discharged into the RSNor over a period of 30 years.

Table 4-23: Projection of Income from Waste to RSNor

Year of Project	Year	Bogota	Other Municipalities	Annual Total	Accumulation
		Tons/year	Tons/year	Tons/year	Tons
1	2026	510.878	510.878	1.021.756	1.021.756
2	2027	515.718	515.718	1.031.436	2.053.192
3	2028	524.081	524.081	1.048.162	3.101.354
4	2029	532.444	532.444	1.064.888	4.166.242
5	2030	540.807	540.807	1.081.614	5.247.856
6	2031	549.170	549.170	1.098.340	6.346.196
7	2032	557.533	557.533	1.115.066	7.461.262
8	2033	565.896	565.896	1.131.792	8.593.054
9	2034	574.260	574.260	1.148.520	9.741.574
10	2035	582.623	582.623	1.165.246	10.906.820
11	2036	590.986	590.986	1.181.972	12.088.792
12	2037	599.349	599.349	1.198.698	13.287.490
13	2038	607.712	607.712	1.215.424	14.502.914
14	2039	616.075	616.075	1.232.150	15.735.064
15	2040	624.438	624.438	1.248.876	16.983.940
16	2041	632.801	632.801	1.265.602	18.249.542
17	2042	641.164	641.164	1.282.328	19.531.870

Year of Project	Year	Bogota	Other Municipalities	Annual Total	Accumulation
		Tons/year	Tons/year	Tons/year	Tons
18	2043	648.858	648.858	1.297.716	20.829.586
19	2044	656.644	656.644	1.313.289	22.142.874
20	2045	664.524	664.524	1.329.048	23.471.922
21	2046	672.498	672.498	1.344.997	24.816.919
22	2047	680.568	680.568	1.361.137	26.178.056
23	2048	688.735	688.735	1.377.470	27.555.526
24	2049	697.000	697.000	1.394.000	28.949.526
25	2050	705.364	705.364	1.410.728	30.360.253
26	2051	713.828	713.828	1.427.657	31.787.910
27	2052	722.394	722.394	1.444.788	33.232.698
28	2053	731.063	731.063	1.462.126	34.694.824
29	2054	739.836	739.836	1.479.671	36.174.496
30	2055	748.714	748.714	1.497.427	37.671.923

Source: Own preparation

4.4 Cost Estimation

4.4.1 Total Cost

The total costs, up to year 2027 (final year), were estimated by applying the unit costs obtained through the abovementioned future waste flow. The table below shows the result:

Table 4-24: MP Total Cost

Unit: million COP

Item	2013	2014	2015	2016	2017	2018
1 Commercial	51,143	51,832	52,521	53,210	53,899	54,588
2 Sweeping and Cleaning	66,429	67,823	69,217	70,611	72,005	73,399
3 Collection and Transport	-	-	-	-	-	-
31 Direct Collection	198,958	235,581	220,853	223,308	225,685	227,982
32 Transfer and Transport	0	0	0	0	0	0
4 Recycling	-	-	-	-	-	-
41 Materials Recycling	4,325	11,237	18,224	22,984	27,345	31,280
42 Composting	445	2,292	4,624	5,664	6,718	7,782
43 CDW Recycling	2,237	25,327	51,004	51,327	51,621	51,888
5 Final Disposal	66,112	65,996	65,341	66,223	67,034	67,769
6 PMIRS and Other	3,782	3,861	3,940	4,019	4,098	4,177
7 Total Cost	393,431	463,949	485,724	497,346	508,405	518,865

-	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	55,277	55,966	56,655	57,344	58,033	58,722	59,411	60,100	60,789
2	74,793	76,187	77,581	78,975	80,369	81,763	83,157	84,551	85,945
3	-	-	-	-	-	-	-	-	-
31	229,755	231,949	0	0	0	0	0	0	0
32	0	0	202,710	204,478	206,574	208,617	210,608	213,420	216,210
4	-	-	-	-	-	-	-	-	-
41	35,424	39,036	38,508	39,522	42,411	45,376	48,418	50,267	52,152
42	8,855	9,375	9,599	10,152	10,331	10,510	10,689	10,869	11,047
43	52,127	52,337	52,521	52,677	52,805	52,905	52,977	53,020	53,037
5	68,339	68,937	70,883	71,156	71,722	72,263	72,780	75,317	76,031
6	4,256	4,335	4,414	4,493	4,572	4,651	4,730	4,809	4,888
7	528,826	538,122	512,871	518,797	526,817	534,807	542,770	552,353	560,099

4.4.2 Unit Cost

The cost vis-à-vis the amount of waste generated (pesos/ton) and the cost per person (pesos/person) were obtained by dividing the abovementioned Master Plan costs by the amount of waste generated and by the population, as shown in the table below:

Table 4-25: Master Plan Unit Cost

Item		2013	2014	2015	2016	2017	2018
1	Per generation (pesos/ton)	157,409	181,808	186,508	187,202	187,661	187,885
2	per population (pesos/person)	51,308	59,701	61,683	62,342	62,914	63,398

-	2019	2020	2021	2022	2023	2024	2025	2026	2027
1	187,924	187,729	175,706	174,600	174,224	173,852	173,483	173,636	173,216
2	63,810	64,133	60,380	60,344	60,550	60,747	60,937	61,302	61,458

5 Conclusion and Recommendations

5.1 Conclusion

a. Current Situation of Solid Waste Management in the City of Bogotá

a.1 Amount Generated and Composition of Solid Waste

The amount of solid waste generated in Bogotá D.C. during year 2011 was 6,665 tons: 357 tons were recovered through informal recycling activities and the other 6,308 tons were taken to and disposed of at the Doña Juana Landfill.

From the total amount of solid waste generated (6,665 tons), 5,296 tons correspond to residential and institutional waste, 357 tons of which were recycled. The remaining 1,369 tons correspond to waste from street sweeping, tree pruning and lawn mowing/ cut grass, from the markets, as well as from construction and demolition activities.

According to the existing characterization study, organic waste equals 60% and potentially recyclable materials –such as paper and plastic- equal 22% of residential solid waste. Potentially recyclable waste ranges between 25% and 46% of the waste from small-quantity generators such as small commercial establishments and restaurants.

Currently, it is assumed that 1,200 tons of potentially recoverable materials are recovered in Bogotá D.C.; the Inclusion Plan uses this figure. Nevertheless, according to the result of the aforementioned characterization study and of other existing studies, it is calculated that, at present, the amount of potentially recyclable materials equals 357 tons.

a.2 Waste Collection Service

In general, the ordinary waste collection service as well as the sweeping and cleaning service of public areas is being properly rendered. Each inhabitant knows the date for the collection of solid waste of the place where he/she lives and takes out the waste on that date. This seems simple but is hardly ever fulfilled in most of the developing countries.

Up to the month of December 2012, the collection, sweeping and cleaning service (CSC) was rendered by four (4) private companies; nevertheless, due to the termination of the contract, one of the them withdrew and it is currently rendered by three (3) private companies and one (1) public company called Aguas de Bogotá, which is an affiliate company of the Empresa de Acueducto y Alcantarillado de Bogotá (EAAB). This measure is deemed transitional and it is expected that the CSC service will be rendered under a new contract from year 2014.

The waste collected in the city is directly taken to the Doña Juan Landfill, which is located to the south of the city. There are no transfer stations in Bogotá. The northern area of Bogotá is more than 30 kilometers away, so it is deemed pertinent to introduce transfer stations.

The density of solid waste at the Doña Juan Landfill is increased by 1.0; the leachate and gas treatment facilities are already built. Although sometimes the quality of the water treated at the leachate plant surpasses the criterion value, or the operation of the gas plant becomes difficult due to the lowering of the Emissions Reduction Certificate ('Certificado de Reducción de Emisiones' – CRE'), in general, they operate properly.

However, it is extremely risky for a big city like Bogotá, with more than 7 million inhabitants, to depend on just one landfill. Should an accident happen at the landfill itself, or en route, and the transport of waste is interrupted, the city will be full of waste and the health of the inhabitants will be seriously affected. Indeed, an accident of this nature happened in 1997.

In general, as already mentioned, the waste collection and disposal services of Bogotá are adequately rendered. The rendering of these services is supported by the administrative and legal framework that makes up the government of the Capital District of Bogotá, the Regulatory Commission for Water and Basic Sanitation ('Comisión de Regulación de Agua Potable y Saneamiento Básico' – 'CRA'), the Superintendence of Residential Public Utilities, etc.

a.3 Special Solid Waste Management

Concerning the management of hazardous solid waste, the responsibility of the generator and the extended responsibility of the producer are relatively well defined and organized, but the set goal tends to be very ambitious.

Efforts are made for the appropriate management of post-consumer products containing hazardous substances such as light bulbs and batteries, expired medicines and used agrochemical products. In the case of Bogotá, the District Environmental Secretariat of Bogotá leads the activities related to this management. Nevertheless, regarding the level of understanding of the inhabitants concerning this type of waste leads them not to identify hazardous waste.

On the other hand, contagious waste generated by health care institutions, such as hospitals, is, in general, adequately dealt with or disposed of by a private entity hired by the UAESP.

a.4 Materials Recycling

The recycling of materials is currently undertaken by informal recyclers in Bogotá. The number of recyclers in Bogotá is over 10,000, and there are more than 1,000 warehouses where these recyclers bring recyclable materials.

The Constitutional Court issued a judgment in 2003, ordering the district government of Bogotá to undertake affirmative actions regarding the recyclers aimed at eliminating discrimination vis-à-vis solid waste management. The UAESP submitted the Inclusion Plan in 2012 as a response to this requirement. This Plan is aimed at organizing and structuring a recovery system for recyclable materials through the separate collection and gathering centers. As of 2013, it is undergoing a transition towards the system defined in the Inclusion Plan; the registry of recyclers and warehouses is being implemented, as well as the payment to recyclers for the collection and transport of potentially recyclable materials.

The recovery of recyclable materials entails complex problems such as the protection of the recyclers who belong to the most vulnerable segment of society, the separation of waste at source undertaken by the inhabitants, the setting-up of separate collection, the adaptation and legalization of existing regulations as the Zoning Plan, as well as the organization of new gathering centers in a city where the use of land is highly advanced.

a.5 Policies and Rules Movement

The current administration that started in 2012 suggested the “Zero Garbage” [*Basura Cero*] policy and it is making different efforts, mainly pursuant to the Inclusion Plan. The “Zero Construction & Demolition Waste” Plan is aimed at recycling large quantities of residual muds generated in large-sized works; the residual water treatment plan is one of said efforts.

As already mentioned, the plan for the rendering of the CSC services is undergoing a transitional stage and it will be under a new contract from 2014. The new contract includes the introduction of collection vehicles, equivalent to or superior than the Euro IV, pursuant to the regulation for the control of emissions that has been established at the national level.

The CRA is reviewing the rates plan, and it wants to include the costs and the rate related to the recovery of recyclable material in the new plan.

So laws and regulations concerning the topic of solid waste management are changing; therefore, it is necessary to be attentive to these changes.

a.6 Fulfillment of the current Integrated Solid Waste Management Plan ('PMIRS')

The PMIRS committee is structured and is made up of the Office of the Mayor of Bogotá, of the Offices of the Local Mayors, and representatives of the recyclers; in addition, the current PMIRS is being monitored and assessed. According to the assessment, the goals related to the CSC services have been fulfilled in general; nonetheless, the ratings of recycling and of the management of solid waste disposal are very low. The assessment by UAESP officers obtained a similar result.

b. Future Challenges

b.1 Overcoming the vulnerability of the current final disposal system

The following two weaknesses (vulnerabilities) are found in the current final disposal system:

- There is only one landfill (Doña Juana) for a city that has over seven (7) million inhabitants; therefore, there are risks that may seriously affect the life and the health of the inhabitants in the event of an accident because the city would be filled with waste.
- According to the Master Plan, the remaining useful life of the Doña Juana landfill goes until 2030. Nevertheless, the Phase II optimization zone, the only remaining free area at the Doña Juana landfill to be used from next year, will be filled by year 2020 if minimization is not accomplished. New waste will then be put over the already buried waste; it is technically unclear if it can be accumulated in this way.

New landfills need to be developed to overcome this type of vulnerability.

b.2 Improving transport efficiency

The northern area of Bogotá is far from the Doña Juana landfill; therefore, the transport of waste takes a long time. The introduction of a transport plan for this area with transfer stations is financially feasible and reasonable.

It is hard to develop a new landfill in the city in the future, and the distance to the landfill will inevitably increase. It will be financially feasible in this case to introduce the transport with transfer stations for the center and for the south of the city.

Due to these reasons, it will be necessary to analyze the possibility of introducing the transport plan with transfer stations, along with the development of new landfills.

b.3 Inclusion of the recycling population in the materials recycling system

Currently, the district government of Bogotá works in the preparation of the Inclusion Plan it submitted before the Constitutional Court. However, there are difficult challenges that prevent the plan from advancing, such as the organization of the recyclers and the interests of the different parties involved. Concerning the Alquería Model Project, it has been planned and prepared, but it has not been implemented due to the foregoing difficulties.

The separate collection mode may be different, depending on whether it involves houses or residential complexes. The approach for the awareness of the inhabitants regarding separation at source may also be different according to the socioeconomic status. Each recycler has different problems; consequently, it is necessary to insist that the administrative authority support each sector and each organization of recyclers so they find and develop an adequate manner instead of insisting on structuring a unique model.

b.4 Minimizing the amount of solid waste taken to the landfill

Pursuant to the environmental license granted to the Doña Juana landfill, the entry of combined construction and demolition waste is not allowed. Nonetheless, as that waste cannot be taken to the existing construction and demolition waste landfills, it is taken to and disposed of at the Doña Juan landfill. Nearly 800 tons of combined construction and demolition waste are generated on a daily basis, and its recycling will contribute not only to the fulfillment of the law but also to increase the useful life of the landfill. To attain this, it is necessary to structure a recycling system starting from the separation at source.

200 tons of waste from lawn mowing/cut grass, tree pruning, and markets are generated per day; this waste is collected separately without combining the residential waste. In other words, it is undertaken both at the separation at source as at the separate collection thus facilitating taking it to intermediate treatment facilities, as the composting plant.

b.5 Hazardous waste

The system for the collection, treatment, and disposal of contagious waste generated in health care facilities, such as hospitals, is already in place; therefore, it must be kept and strengthened from now on.

On the other hand, the management of waste from households and establishments containing hazardous substances, as expired medicines, agrochemical products, as well as electric and electronic devices is at the initial stage, although there are some evident efforts, such as establishing the container for batteries. Consequently, it is necessary to structure a management system for this type of hazardous waste involving the manufacturers and importers of these products.

5 Conclusion and Recommendations

c. Master Plan

c.1 Selecting the Optimum Scenario

Three final-disposal scenarios and five minimization scenarios were established with the purpose of selecting an adequate system for the future management of solid waste in Bogotá D.C. They were compared in terms of their strengths, weaknesses, opportunities and threats, as well as regarding their costs. As a result, the following Master Plan was selected as the most adequate.

c.2 Objectives and Goals

The following three general objectives were selected for the Master Plan:

1. Guarantee the quality and continuity of the garbage collection service to the users.
2. Minimize the amount of solid waste.
3. Guarantee the proper final disposal for unused/unexploited solid waste.

The following specific objectives were defined pursuant to these general objectives:

No.	General/Specific Objectives	Present	Short Term 2013-2015	Medium Term 2016-2018	Long Term 2019-2027
1	Guarantee the quality and continuity of the garbage collection service to the users.				
1.1	Maintain coverage of the urban area	100%	100%	100%	100%
1.2	Increase coverage of the rural area	30%	100%	100%	100%
2	Minimize the amount of solid waste				
	(total minimization rate)	(5.4%)	(10.8%)	(12.7%)	(20.3%)
2.1	Promote recycling of materials (material recycling minimization rate)	Informal Alqueria (5.4%)	85 tons/day to the system (6.2%)	427 tons/day to the system (6.2%)	1,074 tons/day to the system (9.7%)
2.2	Develop and extend the composting system (composting minimization rate)	- (0.0%)	25 tons/day to the system (1.1%)	58 tons/day to the system (2.0%)	249 tons/day to the system (2.8%)
2.3	Develop and extend the combined cdw recycling system (cdw minimization)	- (0.0%)	redirect 100% from Doña Juan landfill 850 tons/day to the system (3.5%)	901 tons/day to the system (4.5%)	1,055 tons/day to the system (7.7%)
2.4	Raise awareness and train users to succeed in achieving the reduction, reuse, separation at source and differentiated disposal of solid waste				
3	Guarantee the proper final disposal of unused/unexploited solid waste				
3.1	To ensure the operation of the Doña Juana landfill	Optimization Phase I	Phase II (17 million tons)		Master Plan (38 million tons)
3.2	To reduce the vulnerability of the current final disposal system	-	-	-	2 new landfills

c.3 Solid Waste Flow

The Master Plan flow of solid waste appears in the table below:

Component	Unit	Present 2012	Short 2015	Medium 2018	Long 2027
1 Population					
Population	thousand	7,565	7,875	8,184	9,114
2 Solid waste flow					
Generation	tons/day	6,704	7,135	7,566	8,859
Collection	tons/day	6,340	6,659	6,973	7,784
Materials recycling – total	tons/day	366	473	592	1,074
Composting	tons/day	0	103	180	276
CDW recycling	tons/day	0	850	901	1,055
Final disposal	tons/day	6,304	6,368	6,604	7,065
Minimized amount	tons/day	364	767	962	1,794

c.4 Master Plan Costs

The costs of the Master Plan were calculated as shown in the table below. The cost per capita increases up to 30% in relation to the current situation.

Component	Unit	Current 2012	Short 2015	Medium 2018	Long 2027
1 Cost per year					
Commercial	Million COP	50,454	52,521	54,588	60,789
Sweeping and Cleaning	Million COP	65,035	69,217	73,399	85,945
Collection and Transport	Million COP	197,188	220,853	227,982	216,210
Recycling	Million COP	0	73,852	90,950	116,236
Final Disposal	Million COP	44,668	65,341	67,769	76,031
PMIRS	Million COP	3,703	3,940	4,177	4,888
Total	Million COP	361,048	485,724	518,865	560,099
2 Cost per unit					
Per generation	COP/ton	147,548	186,508	187,885	173,216
Per population	COP/pers.	47,728	61,683	63,398	61,458
3 Cost increase rate (2012 = 100%)					
Total cost	%	-	35%	44%	55%
Per generation	%	-	26%	27%	17%
Per population	%	-	29%	33%	29%

d. Master Plan Assessment

d.1 Technical Aspect

Most of the technical components of this Master Plan are already in Bogotá D.C., or in Colombia, and their application and operation do not generate technical difficulties. However, the following aspects must be taken into consideration:

- Bogotá has no experience in introducing and operating the transport and transfer system; therefore, it must learn from the examples of other countries and cities.
- The separate collection of recyclable material is not technically difficult. Nevertheless, collection shall be undertaken by recyclers in the case of Bogotá. Therefore, recyclers must be technically supported regarding the design of efficient collection routes.
- Pursuant to the UAESP's plan, the collection vehicles shall have an engine equivalent to or superior than the Euro IV from 2014 on. However, it is important to meet the quality of the fuel requirement in order to obtain the expected emission results.

d.2 Institutional Aspect

The legislation and the administrative system related to the garbage collection service in Colombia are well organized. The CSC service can be rendered without any problem under the current system.

On the other hand, although the recycling of materials is partially undertaken by the informal sector, the promotion of the public recycling system, at a large - scale, is a new challenge for Colombia and for Bogotá. The CRA is preparing a new rate system to cover the recycling service. The Office of the Mayor of Bogotá is reviewing the decree that deals with the warehouses. Consequently, each entity related to this issue is preparing a pertinent regulation or administrative system pursuant to the corresponding competence. As these processes are being prepared simultaneously, it is very important to keep the communication and the coordination between the related entities to establish a consistent system.

Colombia has a quite organized legal framework concerning the management of post-consumer products that have hazardous substances. In the case of Bogotá, a restructuring process of a proper collection and disposal plan has been started under the initiative of the District Planning Secretariat, including the participation of generators and the cooperation of the pertinent areas of the Office of the Mayor. However, said process is just starting and needs to be strengthened.

d.3 Environmental Aspect

The Master Plan makes a contribution to the maintenance and improvement of the life and of the health of the citizens due to the collection of solid waste, the reduction of negative environmental impacts due to the proper disposal of waste and the conservation of resources due to the minimization.

As facilities are necessary for this purpose, it is suggested to build different recycling plants, transfer stations and landfills. Since the location of these facilities has not been defined during the design stage of the Master Plan, concrete environmental impacts cannot be projected. Nevertheless, the potential environmental impacts and the decisions to decrease said impacts were analyzed based on the function of each facility.

d.4 Social Aspect

The Master Plan has set a 20% minimization goal for year 2027. It is difficult to attain this goal without a technical component that has a drastic minimization effect. So, in order to attain it, it is essential to rely on the understanding and action of the inhabitants of Bogotá, who are waste generators, concerning the minimization need. The district started actions aimed at raising awareness concerning minimization in schools and communities pursuant to the “Zero Garbage” policy and the “Inclusion Plan.” It is expected that the minimization culture will be disseminated in Bogotá D.C.

The recycling of materials shall be undertaken by recyclers. Many recyclers have very low income levels; therefore, they have no educational opportunities or formal jobs so they live very unstable lives. Although they are recyclers, each one of them faces different types of problems. It is necessary to offer them a thorough assistance, besides establishing a legal and institutional framework, so that this vulnerable sector can assume the formal recycling of materials. The Office of the Local Mayor, in the locality of Usaquén, and an NGO, in the locality of Bosa, support the local recyclers. It is important to share these experiences throughout the district in order to build a flexible recycling system pursuant to the local situation and the need of the local recyclers.

d.5 Economic and Financial Aspect

First, a financial analysis was performed to find out if the District can assume the costs of the Master Plan. Currently, the costs for solid waste management in Bogotá are covered through the collection of a rate paid by the users. Therefore, it is assumed here that this plan will be used in the future. The 2006-2012 per capita cost was 46,692 pesos. The minimum per capita cost calculated for this project will be 51,308 pesos while the maximum per capital cost will be 64,133 pesos. When compared against the current situation, these values mean 2.5% and

28.2% increases, respectively. On the other hand, it was calculated that the per capita ability to pay ranges from 51,600 to 134,600 pesos (0.5 to 1.3% of the income). Consequently, the costs of the Master Plan can be covered with the rate. In the event that the Master Plan costs increase 20%, the per capita cost will be 76,960 pesos and it will be within the range of the ability to pay. Therefore, it is possible to say that the Master Plan is financially feasible.

Since the Master Plan includes facilities that have a useful life of more than 30 years, such as the landfills and the transfer stations, the economic analysis compared the costs with and without the Master Plan for 20 years, from 2013 to 2042. If we calculate the economic indicators with an 8, 10, and 12% discount rate, we obtain the 1.06 proportion between costs and benefits with an 8% discount. However, other indicators did not evidence any economic pertinence. The link between costs and benefits is negative during the first 10 years; however, it becomes positive after 20 years. As a consequence, this Master Plan is not so attractive as to encourage direct investment from the private sector, which demands the short-term recovery of the capital. Nevertheless, the economic pertinence of this Master Plan could be increased as it generates benefits in the long term, the risk reduction through the public-private alliance, the investment, and the efficient operation.

e. Action Plans

This report includes Action Plans that were designed by the Offices of the Assistant Directors at UAESP. Based on the content of the Master Plan and of the Inclusion Plan, as well as on the discussion with other offices linked to the Office of the Mayor, they are also, therefore, UAESP's work plans. The structure of the plans is not standardized but, taking their initiative into consideration, they are shown as they were submitted.

5.2 Recommendations

a. Establishment of a Solid Infrastructure

The construction of a new infrastructure brings different interests together; therefore, it is hard for the administration to make decisions. The Master Plan sets out the construction and operation of large-sized infrastructure as transfer stations and landfills: they will solidly support the solid waste management system for 30 years. It is expected to fuel an honest discussion between the district government, the departmental government, and other related parties in order to build the infrastructure for solid waste management supporting the metropolitan city of Bogotá, with over 7 million inhabitants.

b. Use of New Minimization Technology

The minimization technologies evolve on a daily basis. There will be a feasible technology for Bogotá within the framework of those technologies. It is important to promote the participation of the private sector towards minimization and recycling that can introduce and assume, much faster, this type of technological innovation. This Master Plan sets out the idea of composting and recycling construction and demolition waste; this does not necessarily mean that the public sector would have to set up these facilities – the private sector could participate. It is through the rendering of CSC services and managing the landfill that the UAESP has the know-how to make the most of the private sector.

Undertaking minimizing-oriented and recycling activities not included in the Master Plan, has not been excluded either. It is expected that the generation and the maturing of the minimizing-oriented culture will lead to different minimizing-oriented and recycling activities.

c. Building Trust

The fulfillment of the Inclusion Plan is not a technical challenge for Bogotá D.C. in relation to recyclers; it is rather a social challenge concerning all the citizens. Citizens separate waste at source properly; recyclers collect separate recyclable materials. It seems easy to achieve but, as actually observed not only in Bogotá but in other countries and cities, it is quite hard to achieve this coordination. It is important to emphasize the mutual trust between the generators and the collectors from the lessons learned from some successful examples; in other words, between the community and the recyclers. Recyclers tend to be excluded from society, so it is hard for them to have access to it on their own. As seen in the localities of Bosa and Usaquén, it will be important that the authority or an NGO supports the building of trust between both parties, and that the district government sets up a mechanism to promote this type of activities.

d. Ensuring the Financial Feasibility of the Recycling Components

Although the financial pertinence of the Master Plan was proven, the cost of each recycling component surpasses the calculated income level. Pursuant to the formula for the calculation of the rates and the current and ongoing cost for the construction of the CRA, the value for the remuneration of recycling is the result of adding the collection cost and the cost for the disposal of ordinary waste. Nevertheless, this value cannot cover the recycling components included in the Master Plan, particularly the cost for the recycling of materials, which is considerably higher than the value of the remuneration. It is necessary to foster a transparent discussion and to make a fair decision vis-à-vis the citizens as to how to close that gap: either collect the difference from the citizens as an additional rate, or look for another source of income.

e. Updating of the PMIRS

The goal of the JICA Project was to set a Master Plan to meet the challenges faced or to be faced by Bogotá D.C., now and in the future, to facilitate the updating of the PMIRS to the UAESP. Therefore, the next step will be the updating of the PMIRS.

This Master Plan focuses on the ordinary waste which concerns the UAESP, but the PMIRS works with all types of solid waste, including hazardous waste, and construction waste generated from large works which do not fall under the responsibility of the UAESP. Consequently, it is expected that the updating of the PMIRS will take place through an articulate interaction of the different offices, such as the District Environment Secretariat, which has authority over said waste, and the District Planning Secretariat, which coordinates the definition of the regulations.

Once the PMIRS is updated, this Master Plan will have legal support and the budget can be allocated to the activities set in the Action Plans; it will also rely on the cooperation of other organizations. That is where the true structuring of the solid waste management system starts vis-à-vis the next 30 years.