

**Ministry of Public Works
BAPPENAS
The Government of West Java
Republic of Indonesia**

The Preparatory Survey on the Project for West Java Regional Solid Waste Treatment and Final Disposal

Final Report

March 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

**PADECO Co., Ltd
Kajima Corporation
Kyudenko Corporation
Shimizu Corporation
Taisei Corporation
Chodai Co., Ltd.
JGC Corporation
Maeda Corporation
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Yachiyo Engineering Co., Ltd.**

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Abbreviations

3R	Reduction, Reuse, Recycle
AAJI	Asosiasi Asuransi Jiwa Indonesia (Indonesia Life Insurance Association)
AAJSI	Asosiasi Asuransi Jaminan Social Indonesia (Social Security Insurance Association of Indonesia)
AASI	Asosiasi Asuransi Syariah Indoneisa (Islamic Insurance Association of Indonesia)
AAUI	Asosiasi Asuransi Umum Indonesia (General Insurance Association of Indonesia)
ABAI	Asosiasi Broker Asuransi & Reasuransi Indonesia (Insurance and Reinsurance Broker Association of Indonesia)
ANDAL	EIA
API	Importer Identification Number
APIU	General Importer's Identification Number
API-P	Producer Importer's Identification Number
API-T	Limited Importer's Identification Number
APKAI	Asosiasi Penilai Kerugian Asuransi Indonesia (Association of Indonesian Insurance Loss Assessars)
ASTM	American Society for Testing and Materials
BAPPEDA	Regional Planning Development Agency, West Java Province
BAPPEDAL	Environmental Impact Management Agency:
BAPEPAM	Badan Pengawas Pasar Modal (Insurance Bureau of the Capital Markets and Financial Institutions Supervisory Agency)
BPPDAN	Government Central Statistic Department.
BGP	Bio Gas Plant
BKPM	Investment Coordinating Board
BMAI	Badan Mediari Asuransi Indonesia (Indonesian Insurance Mediation Body)
BOD	Biochemical Oxygen Demand
BOT	Build Operate Transfer
BPLHD	Environmental Protection Agency, West Java Province
BPPT	Agency for the Assessment and Application Technology
BPS	Statistics Indonesia
BPSR	Regional Solid Waste Management Division:
BTO	Build Transfer Operate
CA	Contracting Agency
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CPI	Consumer Price Index

COD	Chemical Oxygen Demand
OGL	Comprehensive General Liability Insurance
DBFO	Design Build Finance and Operate
D/D	Detailed Design
DEPPERINDAG	Ministry of Industry and Trade
DEPTAN	Ministry of Agriculture
DER	Debt Equity Ratio
DSC	Debt Service Cost
DSCR	Debt Service Coverage Ratio
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement, and Construction
FATF	Financial Action Task Force
FDI	Foreign Direct Investment
FDS	Final Disposal Site
FS	Feasibility Study
GLR	Genuine Local Revenue
GDP	Gross Domestic Product
GDRP	Gross Domestic Regional Product
HGB	Right to Build
HGU	Right to Cultivate
HP	Right to Use
HMSRS	Right of Ownership over a Condominium Unit
IAR	Property All Risks
IGES	The Institute for Global Environmental Strategies
IIGF	PT Indonesia Infrastructure Guarantee Fund
IRR	Internal Rate of Return
ITB	Institut Teknologi Bandung
JHK	<i>Jaminan Hari Tua</i> (Old Age Security)
JICA	Japan International Cooperation Agency
JK	<i>Jaminan Kematian</i> (Death Security)
JKK	Jaminan Kecelakaan Kerja (Occupational Accident Security)
JPK	<i>Jaminan Pemeliharaan Kesehatan</i> (Health Insurance)
KA-ANDAL	Implement Plan
KIMRUM	Human Settlement and Hosing Agency, West Java Provincial Government
KLH	Kementerian Negara Lingkungan Hidup (Ministry of Environment)

LTR	Local Taxes Revenue
MOF	Ministry of Finance
MOU	Memorandum of Understanding
NIK	Customs and Excise Identification Number
ODA	Official Development Aid
O&M	Operation and Management
PFI	Private Finance Initiative
PLP	Directorat Pengembangan Penyehatan Lingkungan Permukiman (Directorate of Environmental Sanitation Development)
PPP	Public Private Partnership
PT SMI	PT Sarana Multi Infrastrukt
PU	Departemen Pekerjaan Umum (Ministry of Public Works)
RDF	Refuse Derived Fuel
RKL	Environmental Management Plan
ROE	Return on Equity
RTL	Environmental Monitoring Plan
SBI	Central Bank of Republic of Indonesia
SPC	Special Purpose Company
SIUP	Trade Business License
TDS	Total Dissolved Solids
TDP	Company Registry Certificate
TOR	Terms of Reference
UNCRD	United Nations Center for Regional Development:
UNTCAD	United Nations Conference on Trade and Development

1. Introduction

1.1 Background of the Study

1.1.1 Indonesia's National Development Agenda and the Need for PPP Infrastructure Projects

While the rate of economic growth of Indonesia remained at 6% in 2007 and 2008, with the global financial crisis, the rate in 2009 fell to 4.3%. The goal of the Government of Indonesia is to achieve an average of 7% in the years 2010 to 2014, infrastructure investment and maintenance, which is a bottleneck to growth, is the key to achieving this goal. Given such circumstances, the Government of Indonesia estimates that Rp 1,429 trillion (USD 143 billion) of infrastructure investment is required from 2010 through 2014. However, the infrastructure investment amount possible by the Government of Indonesia during this period is Rp 451 trillion, covering only 31% of the required amount. The Government hopes the remaining Rp 978 trillion will be covered by private funds in the form of PPP Projects and others. The Indonesian Government realizes that the implementation and development of PPP is essential for future growth, and is proactively promoting PPP related legislation, system construction, active private sector involvement in PPP projects

In terms of the waste treatment and disposal sector, population increase and growth in economic activity has resulted in the increase of waste volume, especially in the urban areas. However, sufficient budget has not been allocated for waste management and open dumping continues to be performed, resulting in serious environmental problems (such as odor, fire, water pollution, and collapse) at and around the final disposal sites. Garbage disposal in Indonesia involves merely the transport of 60% of the total waste to landfill. The current system is generally open dumping, and it can be said that there is no final disposal site where sufficient leachate treatment and tightening solid intermediate covers are conducted. In most regional cities, large amounts of waste are not processed due to the lack of administrative competency for waste treatment and infrastructure maintenance. Furthermore, processing methods at the landfill sites are inappropriate, and environmental measures are inadequate.

In West Java Province, the subject region of this project, a region-wide urban mixed waste of approximately 5,500 tons/day without separation is dumped in approximately 40 landfill sites in the form of open dumping. The West Java Provincial Government manages each municipal waste management system within the province, with the following goals: 1) to make all final disposal sites into sanitary landfills, 2) to have the three designated areas of Bandung Metropolitan Area, Bodobekku (Bogor City, Depok City, and Bekasi City), etc. possess their own final disposal site, 3) to process 20% of the waste generation by a compost system, and 4) to have a collaborative framework for waste management for effective operation.

1.1.2 Indonesia's National Policy on Waste Management, PPP Infrastructure Projects, and Prioritization

In the Mid-term National Development Plan, Indonesia has raised the issue of waste management improvements as an important goal in the environmental field, promoting 3R (Reduction, Reuse, Recycle) and the growth of sanitary landfills in big cities. In 2008, a waste management act aimed at general waste (Act Regarding Waste Management No.18/2008) was enacted. This management act stipulates the role and authority of each entity for municipal waste, furthermore, promotes waste reduction, the construction of waste treatment facilities, and the establishment of partnerships with the private sector. Furthermore, the Act stipulates that municipally managed final disposal sites currently conducting open dumping systems must develop a plan to close the landfill within one year from the enactment of the decree, and actually shut down within five years. The urgency for new landfill construction is

acknowledged by both the federal and provincial government, and some funding has been allotted from the government budget, however, in order to reduce the financial burden of the largely rising construction costs, the application of private financing is required.

1.2 Objectives of the Study

The objective of this study is to promote adequate disposal of wastes and to improve living and hygienic environments in the coverage areas, by constructing and operating two sites for solid waste treatment and final disposal, which will dispose of domestic mix wastes from urban areas of Bandung, Bogor, and Depok.



Source: West Java Aser 2007

Figure 1-1 Location of the Project

1.3 Study Methodology

(1) Basic Approach

This study aims to clarify feasibility of the final disposal site development plan as a PPP project, and improve maturity of the plan by considering the following items;

- Optimize the modality of the project scope as PPP project by reviewing demarcation among private and public, procurement scope, and implementation programs.
- Remove or minimize barriers and constraints for investors, by analysis of PPP regulation, implementation program, capacity of implementation organization, etc.
- Confirm the final disposal site development plan acceptable for both environmentally and socially
- Consider the 3R system installation and development, involving local authority and local communities.
- Clarify uncertainties in the disposal site planning by engineering approaches
- Propose recycling process by installation of new processing technologies
- Design the qualified processing system and construction program with numerical analysis

- Analyze the risks related to the project, and clarify a risk sharing approach among the Private and public entities
- Optimize the financial structure by operator's cash flow and investment model
- Coordinate the program with other development partners, particularly the World Bank.

(2) Tasks

In order to analyze and evaluate the feasibility of West Java Regional Solid Treatment and Final Disposal Project, the proposed survey shall cover following items.

[1] Study of the Facilities

- Trends of socio-economic situation of Indonesia and West Java
- Information collection and analysis of current waste disposal in West Java
- Information collection of related laws
- Information and sample collection of content of waste
- Information collection of design standards
- Demand forecast
- Setting design conditions
- Basic Design
- Formulation of implementation plan
- Estimation of the project cost
- Study of composting and power generation
- Study of CDM
- Study of broadband waste management system (civil 3R)

[2] Study of Environmental and Social Impacts

- Social and environmental information collection
- Social survey
- EIA support
- Land acquisition support

[3] Study of PPP Scheme

- Information collection of laws related to PPP and of the capacity of provincial government
- Study of project scope between private and public entities
- Study of the operation and management scheme
- Analysis of risk hedging
- Study of insurance
- Study of related contracts for PPP
- Financial analysis of the implementation agency
- Financial evaluation of the private portion
- Study of financing structure
- Study of procurement package of the SPC

[4] Other

- Proposal of framework for the project implementation
- Formulation of the project schedule
- Proposal of the procurement package
- Economic evaluation of the project
- Identification of operation and effect indicators
- Preparation of Draft Final Report
- Preparation of Final Report

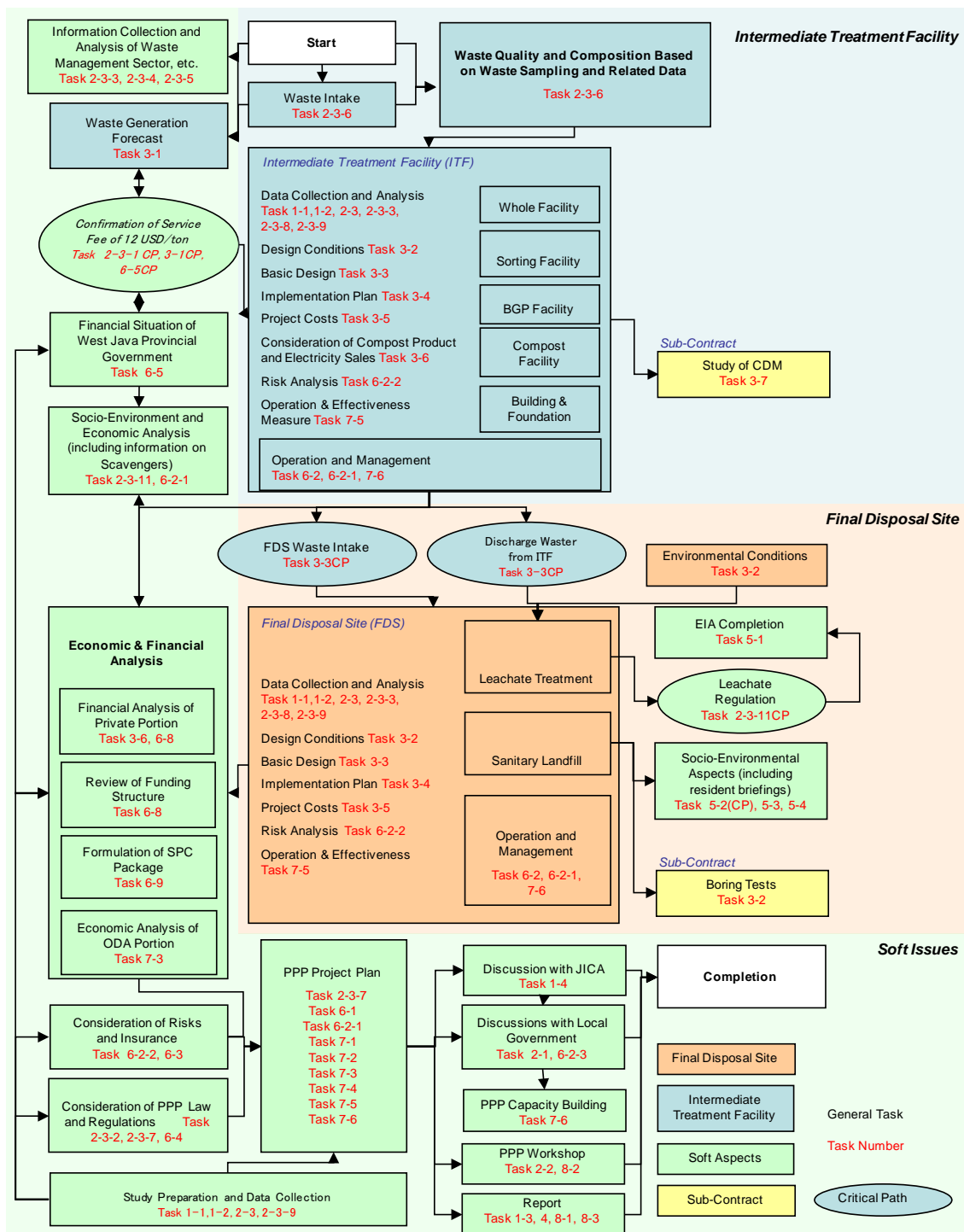


Figure 1-2 Task Program and Flow of the Project

2. Overview of Indonesia and the Waste Sector

2.1 Socio-Economic Conditions

2.1.1 Republic of Indonesia

Basic Information

Indonesia is an island country located in South East Asia with a land area of 1.9 million square kilometers (5 million square kilometers including the sea area exclusive of the economic zone) and a population of 238 million in 2010. The population breakdown based on the 2010 census is show in Table 2-1.

**Table 2-1 Population of Indonesia
(2010 Census)**

Province	Population ('000)
Aceh	4,487
North Sumatera	12,985
West Sumatera	4,846
Riau	5,543
Jambi	3,089
South Sumatera	7,446
Bengkulu	1,713
Lampung	7,596
Bangka Belitung	1,223
Riau Islands	1,686
DKI Jakarta	9,588
West Jawa	43,022
Middle Jawa	32,381
DI Yogyakarta	3,452
East Jawa	37,476
Banten	10,644
Bali	3,891
West Nusa Tenggara	4,497
East Nusa Tenggara	4,679
West Kalimantan	4,393
Central Kalimantan	2,203
South Kalimantan	3,626
East Kalimantan	3,551
North Sulawesi	2,266
Central Sulawesi	2,633
South Sulawesi	8,033
Southeast Sulawesi	2,231
Gorontalo	1,039
West Sulawesi	1,158
Maluku	1,531
North Maluku	1,035
West Papua	761
Papua	2,852
Indonesia Total	237,556

Source: 2010 Population Census, Central Statistical Agency Indonesia

Economy

Indonesia's growth in 2009 was the third highest among the G-20 group of countries, primarily due to strong initial economic conditions (such as low debt levels), high dependence on domestic demands, and a diversified export base. Indonesia's near-term economic momentum is positive with the World Bank's growth forecast for 2011 upgraded to 6.4 percent, and anticipated to 6.7 percent in 2012¹.

Table 2-2 Projected Growth (2009–2012)

Item	2009	2010	2011	2012
Gross Domestic Product (Annual Percent Change)	4.6	6.1	6.4	6.7
Consumer Price Index* (Annual Percent Change)	2.6	6.3	6.0	6.2
Budget Balance** (Percent of GDP)	-1.6	-0.6	-1.8	n.a.
Major Trading Partner Growth (Annual Change)	-1.0	6.6	4.4	4.8

Note: * Q4 on Q4 inflation rate, ** 2011 figure is approved budget

Source: Ministry of Finance, BPS via CEIC, Consensus Forecasts Inc., and World Bank

As indicated in Table 2-2, annual Gross Domestic Product (GDP) growth is above six percent year-on-year, economic growth in Indonesia is relatively sustained in comparison to other countries in the region. Headline Consumer Price Index (CPI) inflation has increased to the six percent level, primarily due to the rising food prices of staple foods such as grain (which increased 23 percent year-on-year in 2010). The rise in food products can pose a risk to the progress of poverty reduction, and measures to close the gap between the economic spectrums continue to be an important national agenda².

Economic Structure

As shown in Table 2-3, the largest employment sector in Indonesia is in Agriculture, employing about 41% of the labor force summarized in Table 2-4. Furthermore, the rapid emergence and growth of the middle class has and will continue to contribute to the enhancement in consumerism, employment quality as well as improvements in health and education services.

Table 2-3 Economic Structure (2007)

Sector	% of Employed
Agriculture	41.2
Industry	18.8
Other	40.0

Source: UN Data, United Nations Statistics Division

Table 2-4 Employment (2008)

Sector	% of Employed
Unemployment	8.4% of Labor Force
Labor Force Participation (Adult Male)	86.1% (of pop)
Labor Force Participation (Adult Female)	49.4% (of pop)

Source: UN Data, United Nations Statistics Division

Foreign Trade

Indonesia' foreign trade is no exception in experiencing the affects of the recent global economic crisis. As shown in Figure 2-1 shows, exports in 2009 fell by 14% to USD 119.5 billion and imports by 28% to USD 84.3 billion. The overall trade balance remains positive, recovering from the sharp decline in 2008.

¹ Economic Intelligence Unit

² World Bank, *Indonesia Economic Quarterly*, March 2011



Note: Billion USD by year
Source: UN Comtrade

Figure 2-1 Total Imports, Exports, and Trade Balance (1995–2009)

Tables 2-5 and 2-6 show the composition of top trades by product and trading partner. As evident, the four economies of Japan, China, US, and Singapore play a substantial role in foreign trade in Indonesia. Furthermore, the rising commodity prices observed in 2010–2011 are similar to that of 2008, providing an opportunity to the commodity-producing country³.

Table 2-5 Top Trade by Products (2009)

Major Exports	% Total	Major Imports	% Total
Mineral Products	17.4	Machinery & Electrical Equipment	26.7
Fats, Oils & Waxes	10.4	Oil & Gas	13.6
Liquefied Natural Gas	7.7	Base Metals	10.0
Crude Petroleum & Products	6.7	Chemicals	9.8

Source: *Economic Intelligence Unit*

Table 2-6 Top Trade Partners (2009)

Leading Markets	% Total	Leading Suppliers	% Total
Japan	15.9	Singapore	16.1
China	9.9	China	14.5
United States	9.4	Japan	10.2
Singapore	8.8	US	7.3

Source: *Economic Intelligence Unit*

Investment Environment and Risks

The global financial markets have responded to the economic developments in Indonesia including its strong economic growth, macro policy management, and rising domestic demand. As shown in Table 2-7, rating agencies have reflected such conditions to their sovereign ratings, in which Fitch upgraded Indonesia's rating to BB+ (one notch below investment grade) in January 2010, and both S&P and Moody's upgraded their ratings to two notches below investment grade.

³ World Bank, *Indonesia Economic Quarterly*, March 2011

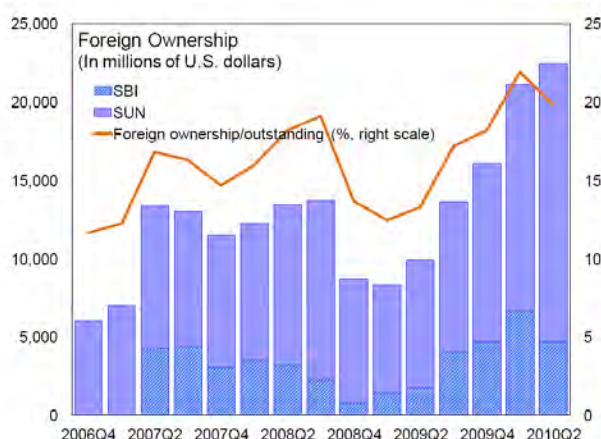
Table 2-7 Comparison of South East Asia Sovereign Ratings

Moody's	S&P	Fitch	Moody's	S&P	Fitch	Definitions
Baa1	BBB+	BBB+	THA	THA		Investment Grade
Baa2	BBB	BBB			THA	
Baa3	BBB-	BBB-	IND	IND	IND	
Ba1	BB+	BB+			IDN	Non-Investment Grade
Ba2	BB	BB	IDN	IDN	PHL	Speculative
Ba3	BB-	BB-	PHL	PHL		

IND = India; IDN = Indonesia; PHL = Philippines; THA = Thailand

Source: International Monetary Fund *Indonesia: 2010 Article IV Consultation – Staff Report; Staff Statement; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for Indonesia*, September 2010.

Indonesia has withstood the swings in global risk aversion following the instability in the European markets, and has been experiencing a positive net inflow of foreign capital since Q3 of 2009. Recovery in global liquidity and risk appetite as well as growth and yield differentials have led to large portfolio inflows into government bonds (SUNs) and short-term Bank Indonesia (SBI), with foreign ownership at over 20 percent of the outstanding stock⁴.



Source: International Monetary Fund *Indonesia: 2010 Article IV Consultation – Staff Report; Staff Statement; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for Indonesia*, September 2010.

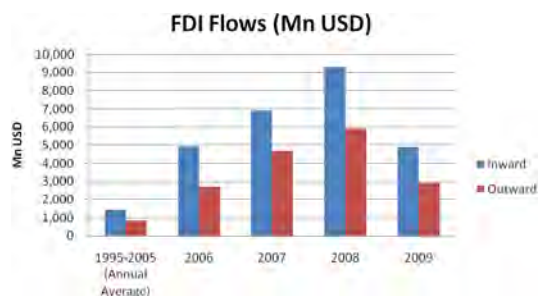
Figure 2-2 Indonesia Portfolio Inflows

Foreign Direct Investments

As shown in Figures 2-3 and 2-4, Foreign Direct Investments (FDI) inflows experienced a sharp decline following the global economic crisis in 2009. However, FDI have shown significant growth in Q1 of 2010, largely due to investments in the power sector⁵. FDI stock remains on an upward trend as shown in Figures 2-5 and 2-6, however still remains lower than some other countries in the region.

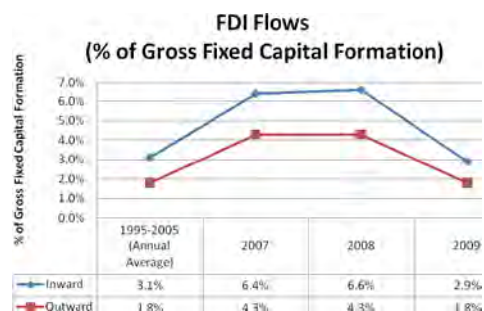
⁴ International Monetary Fund *Indonesia: 2010 Article IV Consultation – Staff Report; Staff Statement; Public Information Notice on the Executive Board Discussion; and Statement by the Executive Director for Indonesia*, September 2010

⁵ Same as above



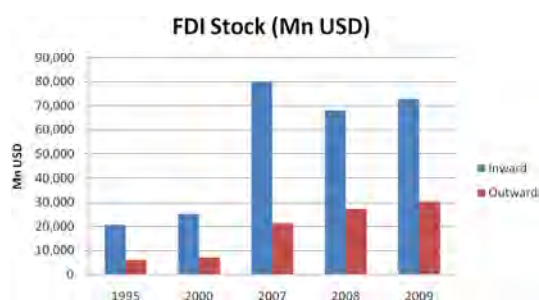
Source: UNCTAD, *World Investment Report 2010*

Figure 2-3 FDI Flows (Mn USD)



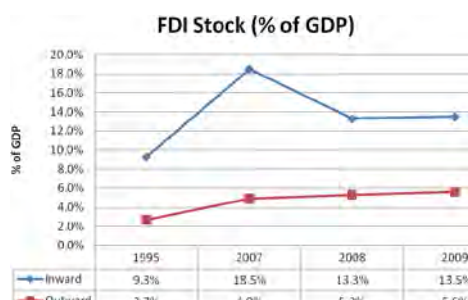
Source: UNCTAD, *World Investment Report 2010*

Figure 2-4 FDI Flows (% of Gross Fixed Capital Formation)



Source: UNCTAD, *World Investment Report 2010*

Figure 2-5 FDI Stock (Mn USD)

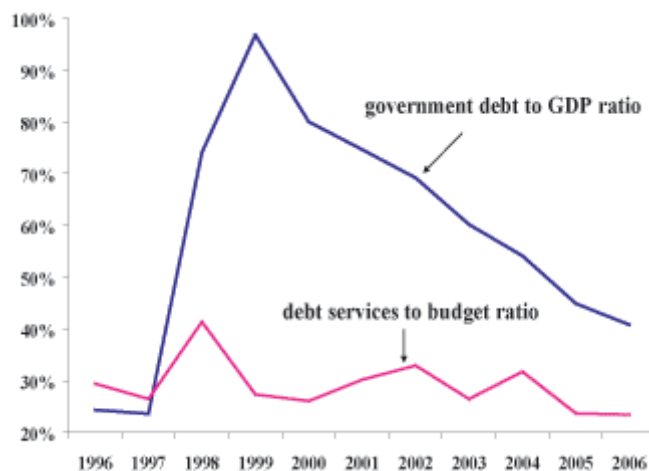


Source: UNCTAD, *World Investment Report 2010*

Figure 2-6 FDI Stock (% of GDP)

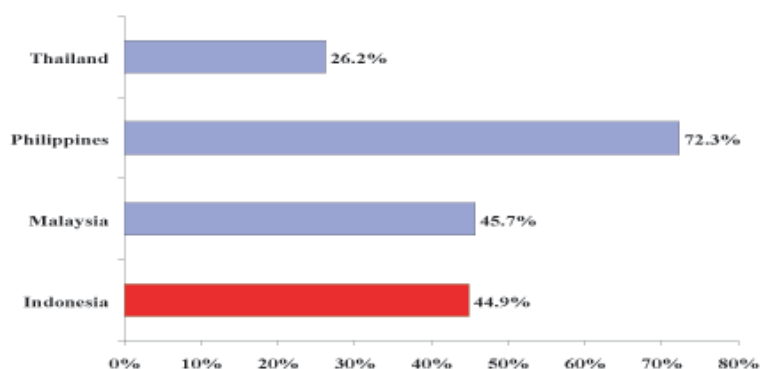
Public Debt

Indonesia has managed its government debt burden well in the past decade. The ratio of public debt to GDP has fallen from 100 percent in 1999 to approximately 40% in 2006 as shown in Figure 2-7. As Figure 2-8 shows, Indonesia's public debt burden is par with regional competitors, however aims to decrease public debt further in the following through various efforts including the promotion of PPP and facilitation of private investments in infrastructure projects.



Source: World Bank

Figure 2-7 Indonesia Easing Debt Burden



Source: World Bank

Figure 2-8 Regional Public Debt Burden

2.1.2 West Java Province

Population

The population in the West Java Province has been increasing since 2001 and reached 39.9 million in 2005. The most populated area within the West Java Province is Bandung Regency with 4.26 million followed by Bogor Regency with 4.1 million.

Table 2-8 Population of West Java Province (2005)

Regency/City	Population		
	Male	Female	Total
Regency			
Bogor	2,085,587	2,015,347	4,100,934
Sukabumi	1,136,359	1,088,634	2,224,993
Cianjur	1,069,408	1,029,236	2,098,644
Bandung	2,108,890	2,155,044	4,263,934
Garut	1,182,875	1,138,195	2,321,070
Tasikmalaya	867,460	826,019	1,693,479
Ciamis	781,746	760,915	1,542,661
Kuningan	549,024	547,479	1,096,503
Cirebon	1,060,299	1,047,619	2,107,918
Majalengka	596,024	595,466	1,191,490
Sumedang	534,711	532,650	1,067,361
Indramayu	898,038	862,248	1,760,286
Subang	708,731	713,242	1,421,973
Purwakarta	398,864	380,796	779,660
Karawang	1,029,477	956,097	1,985,574
Bekasi	99,508	960,872	1,060,380
City			
Bogor	429,627	415,151	844,778
Sukabumi	146,496	141,264	287,760
Bandung	1,171,169	1,144,726	2,315,895
Cirebon	139,849	141,240	281,089
Bekasi	998,654	996,216	1,994,870
Depok	688,390	685,470	1,373,860
Cimahi	247,812	245,886	493,698
Tasikmlaya	293,326	300,832	594,158
Banjar	85,558	88,018	173,576
West Jawa	20,192,207	19,768,662	39,960,869

Source: 2008 Japan Ministry of Environment, *Indonesia West Java Waste Treatment Program CDM Project Feasibility Study*

Economic Conditions

West Java Province experienced a Gross Domestic Regional Product (GDRP) growth of 6% in 2006, primarily owing the strength of the manufacturing, agriculture, and transport sectors as shown in Table 2-9.

Table 2-9 GDRP of West Java Province (2005–2006)

Industrial Origin	2005	2006
Agriculture	46,431,000	52,653,000
Farm Food Crops	32,209,000	36,747,000
Estate Crops	3,671,000	4,227,000
Livestock and Products	6,171,000	7,137,000
Forestry	641,000	710,000
Fishery	3,739,000	3,832,000
Mining and Quarrying	11,979,000	12,875,000
Oil and Natural Gas	11,109,000	11,832,000
Mining Excluding Oil /Gas	257,000	259,000
Quarrying	613,000	785,000
Manufacturing Industry	173,068,000	214,242,000
Oil and Gas Industry	7,442,000	13,105,000
Industry Excluding Oil/Gas	165,626,000	201,137,000
Electricity, Gas and Water Supply	11,259,000	12,689,000
Electricity	10,061,000	11,303,000
Gas	734,000	899,000
Water Supply	463,000	486,000
Construction	11,453,000	14,349,000
Trade, Hotel and Restaurant	74,281,000	91,885,000
Wholesale and Retail Trade	62,831,000	79,170,000
Hotel	1,633,000	1,751,000
Restaurant	9,817,000	10,964,000
Transport and Communication	20,712,000	27,831,000
Transport	17,318,000	23,813,000
Railway Transport	458,000	440,000
Road Transport	14,870,000	21,086,000
Sea Transport	404,000	433,000
River and Ferry Transport	1,000	1,000
Air Transport	596,000	738,000
Services Allied to Transport	990,000	1,114,000
Communication	3,394,000	4,018,000
Finance, Dwelling and Business Service	11,790,000	12,755,000
Bank	3,481,000	3,450,000
Other Financial Intermediaries	1,141,000	1,789,000
Ownership of Dwellings	5,439,000	5,729,000
Business Services	1,729,000	1,786,000
Service	28,297,000	34,278,000
GRDP Including Oil and Natural Gas	389,269,000	473,557,000
GRDP Excluding Oil and Natural Gas	370,718,000	448,620,000

Source: 2008 Japan Ministry of Environment, *Indonesia West Java Waste Treatment Program CDM Project Feasibility Study*

2.2 Waste Disposal Sector

2.2.1 National Sector

(1) Main Ministries of the Central Government

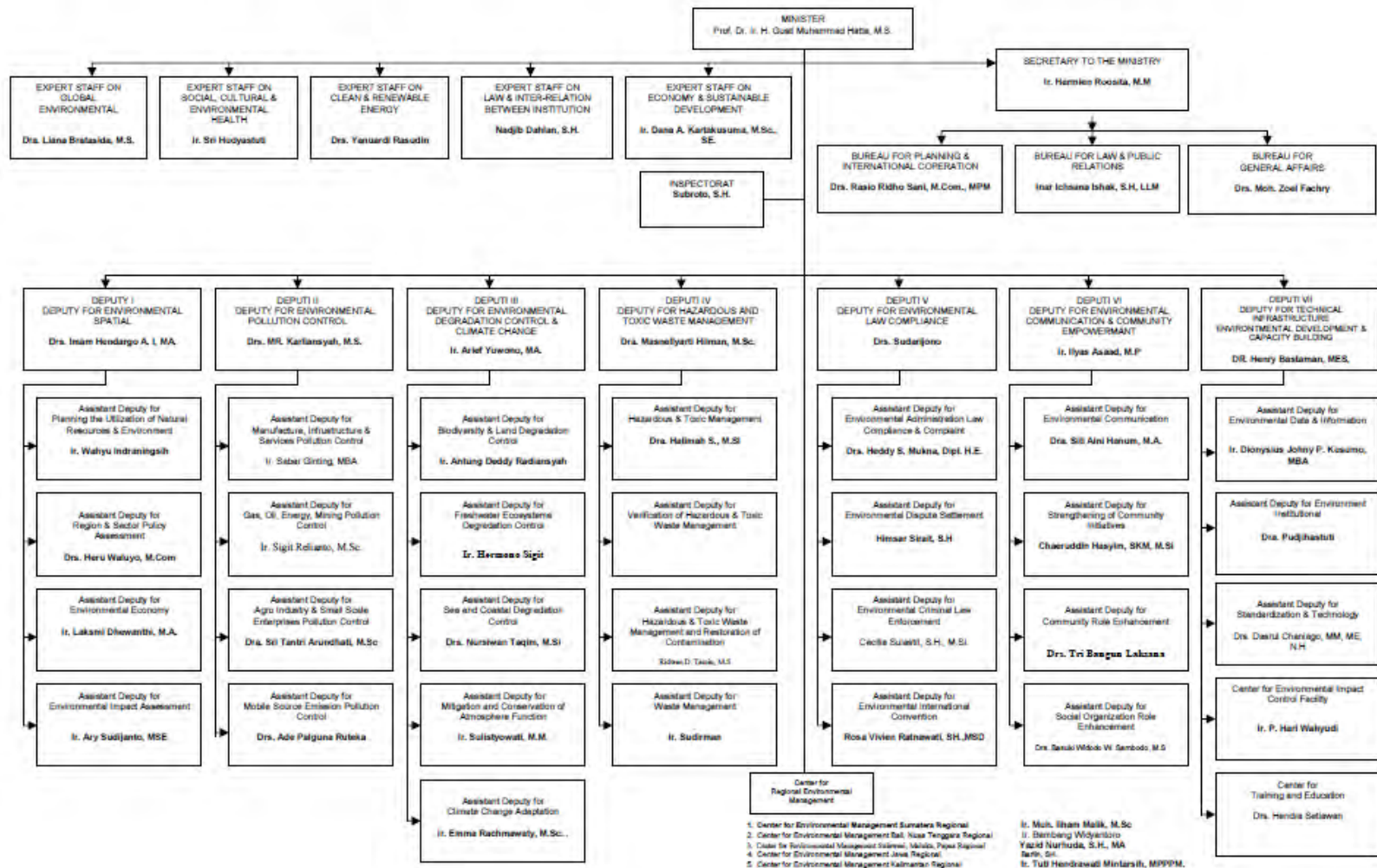
Ministry of Environment and Ministry of Public Works have mainly jurisdiction over the national waste management.

1) Ministry of Environment (Kementerian Negara Lingkungan Hidup: KLH)

In 1978, Environmental Development Agency (PPLH) was established and reformed several times, and Ministry of Environment (KLH) was established by merger of PPLH and Environmental Impact Management Agency (BAPPEDAL) in 2002. From this merger, KLH started to have jurisdiction over the household waste management. According to the Presidential Decree No. 2, 2002, the role of KLH is to implement surveys and to establish policies on environmental management and prevention of environmental negative impact. Figure 2-9 shows the organization chart of KLH. The number of workers for the KLH headquarters and 5 local offices are 719 persons and 359 persons respectively. The headquarters of KLH have 7 deputies. Among them, Deputy for Hazardous and Toxic Waste Management (Deputy IV) handles waste management.

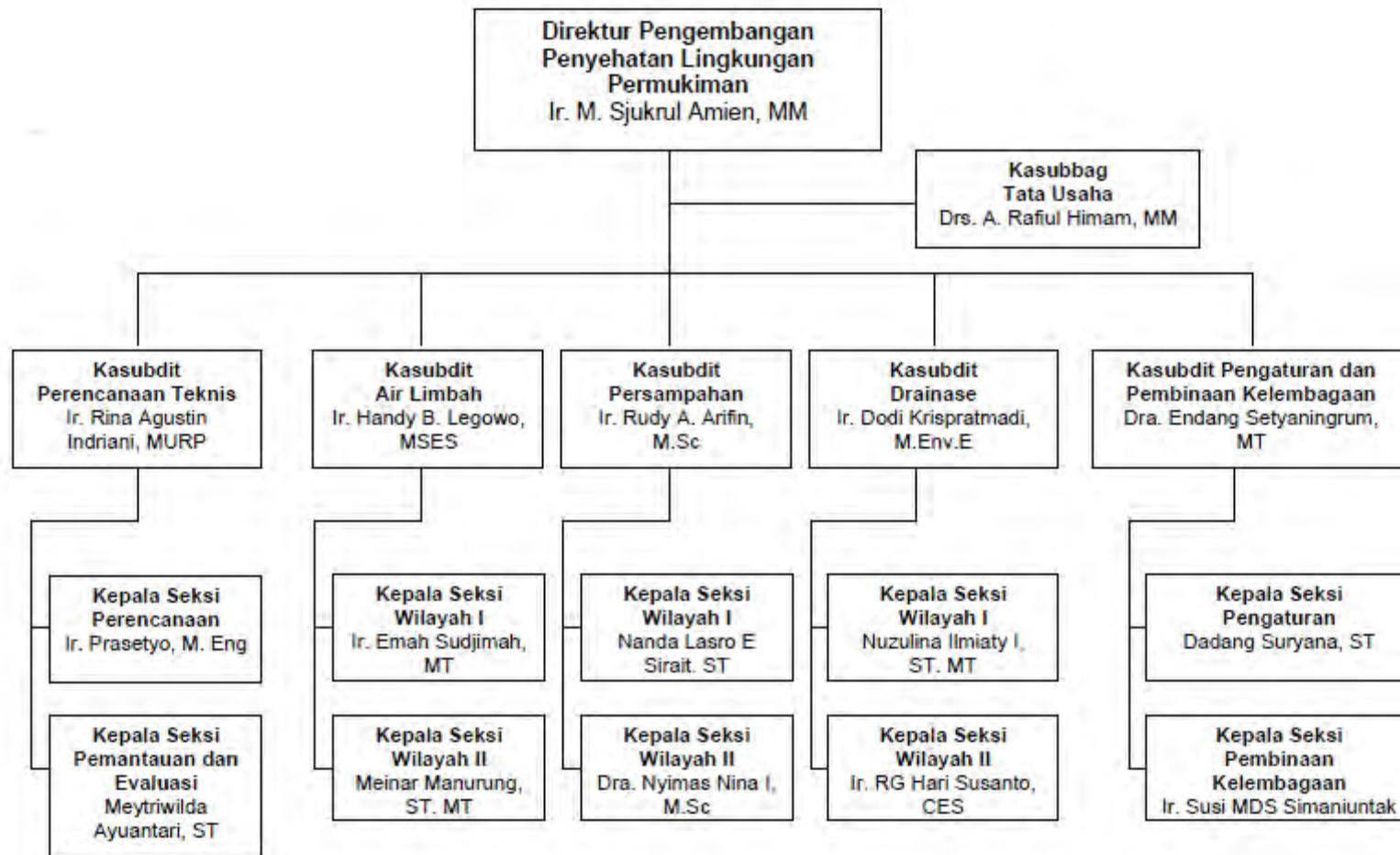
2) Ministry of Public Works (Departemen Pekerjaan Umum: PU)

Management of household wastes in each city and regency is implemented by the local government (province, city or regency). Ministry of Public Works (PU) supports, manages and supervises the waste management by the local government. This role of PU is the same after the enforcement of Act of the Republic of Indonesia No. 18 Year 2008 regarding Waste Management in 2008 (hereinafter referred to as Act No. 18). In PU, Directorate of Environmental Sanitation Development (Direktorat Pengembangan Penyehatan Lingkungan Permukiman: PLP) in Directorate General of Human Settlements (Ditjen Cipta Kaya) handles waste management. Figure 2-10 shows the organization chart of PLP. PLP has 5 Sub-Directorates. Among them, Sub Directorate of Solid Waste System Development, which has 15 workers (including 5 engineers), is in charge of waste management. PU has the local construction agencies in main local cities. PU provides technical and financial support to local governments through these local construction agencies in order to close the open dumping sites, to construct waste treatment plants, etc.



Source: Prepared by the Survey Team with the data provided by KLH

Figure 2-9 Organization Chart of KLH (as of October, 2010)



Source: Data provided by PU

Figure 2-10 Organization Chart of PLP (as of January, 2011)

(2) Other Related Agencies of the Central Government

Main implementation agencies for the national waste management and 3R are KLH and PU, however, the following agencies also take part in the waste management and 3R in various ways.

Ministry of Industry and Trade (DEPPERINDAG) Ministry of Agriculture (DEPTAN)	Extended and Shared Producer Responsibility (EPR), Eco-labeling, etc.
Agency for the Assessment and Application Technology (BPPT)	Development of waste management technology for composting and others
Statistics Indonesia (BPS)	Collection of statistical data for waste management, etc.

(3) Sharing of Responsibility between KLH and PU

PU has the responsibility to provide technical and financial support, guide and supervise the waste management by local governments. This role is not changed after the enforcement of Act No. 18. However, KLH set to the new activities, which PU had not handled, such as reduction of waste, promotion of 3R, management of wastes from enterprises, etc.

(4) Sharing of Responsibility between the Central and Local governments

Each City or Regency Government has a responsibility to manage household wastes in the jurisdiction area, and Provincial Government has a responsibility to manage the regional waste management, in which several cities and/or regencies involve. On the other hand, KLH and PU have authority to establish national laws and policies, to manage and supervise the local governments, to implement monitoring the projects, etc. This sharing of responsibility is mentioned in Government Regulation, No. 38 of 2007 on Division of Government Businesses between the Government, Provincial Governments and Regency/Municipal Government.

Act No. 18 does not clearly mention the responsibility of City, Regency and Provincial Governments including the regional waste disposal management at present (as of April, 2011). The future Ministerial regulations and local regulations will describe this sharing of responsibility according to Act No. 18.

2.2.2 West Java Province

As mentioned above, management of household wastes in city or regency is implemented by each City or Regency Government. Only the regional waste management is implemented by West Java Provincial Government.

(1) Implementation Agencies of West Java Province

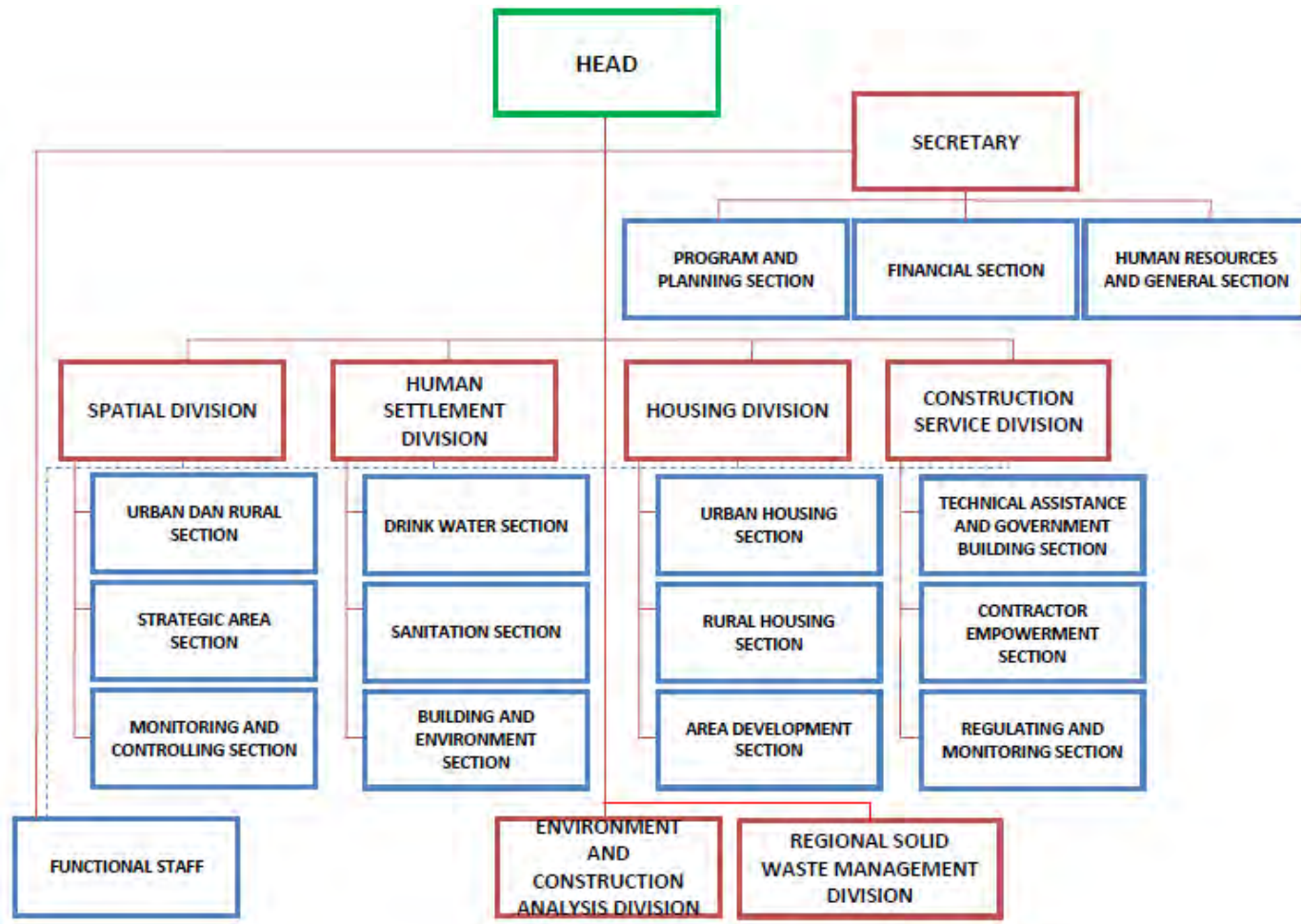
Waste management in West Java Province is implemented by Human Settlement and Housing Agency in West Java Provincial Government (Dinas Permukiman Dan Perumahan Pemerintah Provinsi Jawa Barat: KIMRUM), which is one of the local construction agencies of PU (workers of KIMRUM are employed by West Java Province). The organization chart of KIMRUM is shown in Figure 2-11. The main role of KIMRUM is the following 2 tasks;

- i) Operation and management of the regional waste disposal site (including planning, organization establishment and financial management)
- ii) Support of each city or regency on waste management

For the task i), Regional Solid Waste Management Division (BPSR) was established. The organization chart of BPSR is shown in Figure 2-12. In KIMRUM, Sanitation Section (PLP) of

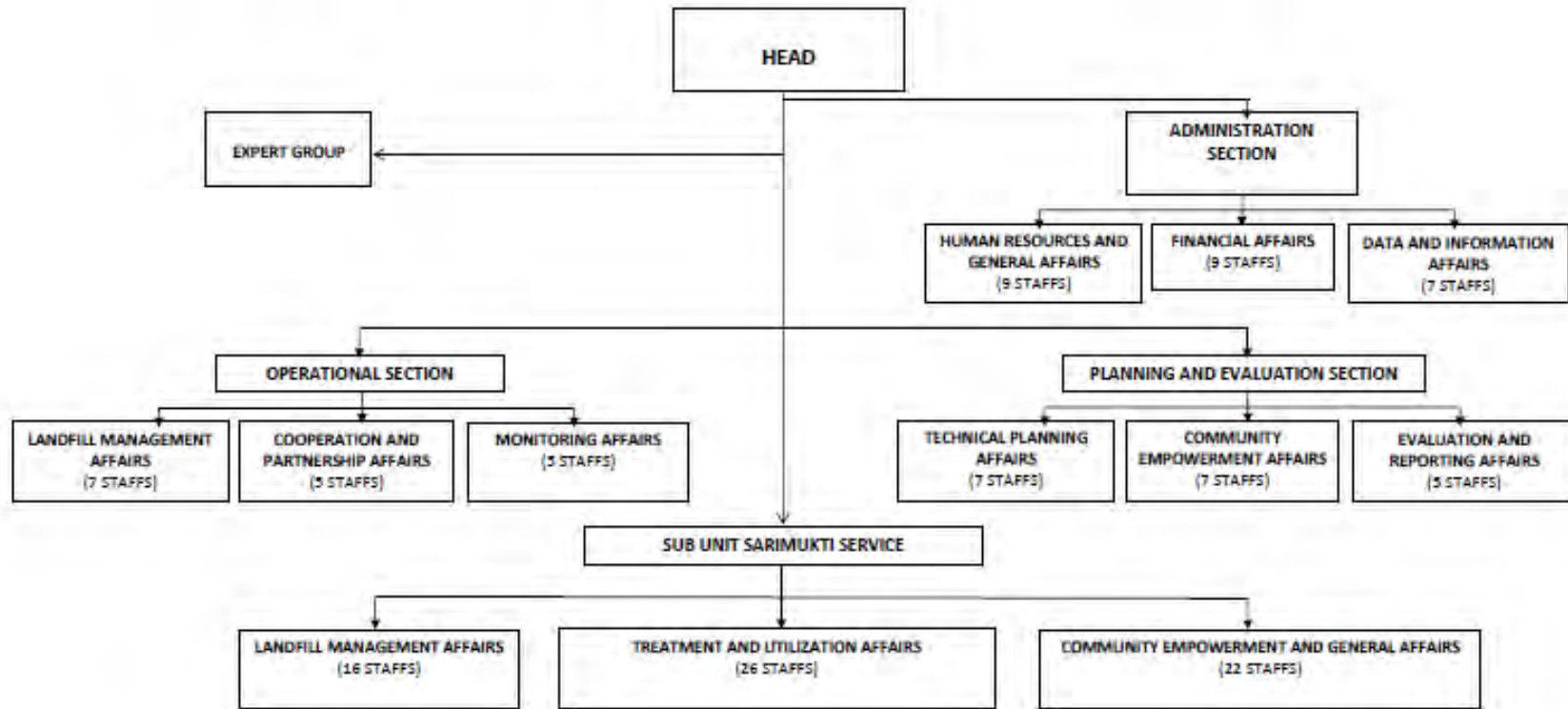
Human Settlement Division is in charge of the task ii). The total number of workers of KIMRUM is 439 persons including 126 workers of BPSR.

As other related agencies, Regional Planning Development Agency, West Java Province (BAPPEDA) prepares the provincial plans, and Environmental Protection Agency, West Java Province (BPLHD) has responsibility of Environmental Impact Assessment and other environmental protection matters.



Source: Data provided by KIMRUM

Figure 2-11 Organization Chart of KIMRUM

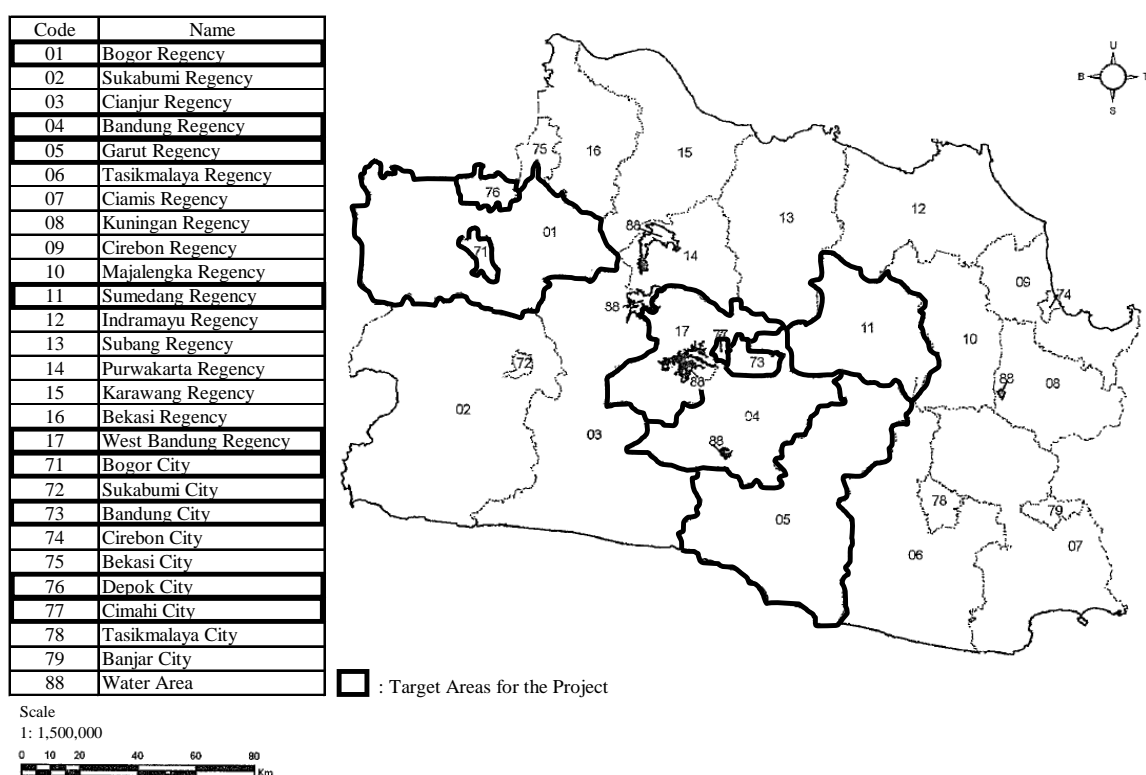


Source: Data provided by BPSR

Figure 2-12 Organization Chart of BPSR

(2) Implementation Agencies in Target Cities and Regencies

The target areas of this Project are 9 areas (Bandung City, Cimahi City, West Bandung Regency, Bandung Regency, Sumedang Regency, Garut Regency, Depok City, Bogor City and Bogor Regency) as shown in the following Figure. Based on the results of the interview surveys with these 9 areas, implementation agencies for waste management in these areas are summarized as follows, however, the financial situations are different among these agencies. Only in Bandung City, the financial balance was shown as revenue and expenditure because the implementation agency was an enterprise. But this enterprise did not provide a clear answer on the detail of this revenue because it was not special agency only for waste management. On the other hand, in other cities and regencies, each financial balance was shown as budget and actual cost because implementation agencies were public organization. And all target cities and regencies did not provide clear answers on the detail amount and/or ratio of their budget and actual cost only for waste management because implementation agencies in these cities and regencies were not special agencies only for waste management.



Source: Prepared by the Survey team with the statistic data of West Java Province "Peta Indeks Wilayah 2010"

Figure 2-13 Target Areas in West Java Province

1) Bandung City

Solid Waste Enterprise of Bandung City (Perusahaan Daerah Kebersihan, Pemerintah Kota Bandung) implements waste management in Bandung City. Their roles are to clean the jurisdiction area, to collect, transport and treatment wastes, and to provide public health service in the waste management field. The number of workers is 1,689 persons and their organization chart is shown in Figure 2-14. Their financial record of the last 5 years is shown in Table 2-10.

Table 2-10 Financial Record of Solid Waste Enterprise of Bandung City

Unit: Million Rp.

	2006	2007	2008	2009	2010
Revenue	46,631	63,434	64,591	57,732	23,881
Expenditure	46,241	54,791	57,202	59,490	16,626

Source: Prepared by the Survey team with the statistic data of West Java Province "Peta Indeks Wilayah 2010"

2) Cimahi City

Sanitary and Gardening Agency of Cimahi City (Dinas Kebersihan Dan Pertamanan, Pemerintah Kota Cimahi) implements waste management in Cimahi City. In February, 2011, the former implementation agency, Sanitary Environmental and Cleaning Agency of Cimahi City (Dinas Penyehatan Lingkungan Dan Kebersihan: DPLK), changed the name as Sanitary and Gardening Agency of Cimahi City, but the basic role and organization were not changed. Figure 2-15 shows the organization chart of Cimahi City Government and indicates Sanitary and Gardening Agency of Cimahi City as the red box. Sanitary and Gardening Agency of Cimahi City has 72 officers and 144 cleaners. Their main role is to manage and treat the wastes transported to the transfer stations. Their financial record of the last 5 years is shown in Table 2-11.

Table 2-11 Financial Record of Solid Sanitary and Gardening Agency of Cimahi City

Unit: Million Rp.

	2006	2007	2008	2009	2010
Budget	75	362	584	821	928
Actual Cost	141	383	639	860	932

Source: Prepared by the Survey Team with data provided by Sanitary and Gardening Agency of Cimahi City

3) West Bandung Regency

In 2007, Bandung Regency was divided into 2 regencies; West Bandung Regency and Bandung Regency. Human Settlement and Spatial Agency of West Bandung Regency (Dinas Cipta Karya Dan Tata Ruang) implements waste management in West Bandung Regency. Their organization chart is shown in Figure 2-16. Mainly Environment Division and Technical Assistant Unit of Cleaning have a responsibility of waste management and the number of workers is 155 persons. Human Settlement and Spatial Agency of West Bandung Regency has the following 4 roles;

- i) To collect wastes from houses, transport wastes through transfer stations and dispose at the disposal sites
- ii) To facilitate the activities of waste management and 3R
- iii) To acquire the gratis land for the transfer station and disposal site
- iv) To plan and construct transfer stations

Their financial record of the last 3 years is shown in Table 2-12.

Table 2-12 Financial Record of Human Settlement and Spatial Agency of West Bandung Regency

Unit: Million Rp.

	2008	2009	2010
Actual Cost for Waste Management	1,516	2,192	2,337

Source: Prepared by the Survey Team with data provided by Human Settlement and Spatial Agency of West Bandung Regency

4) Bandung Regency

Human settlement, Regional Planning and Hygiene Agency of Bandung Regency (Dinas Permukiman Tata Wilayah, dan Kebersihan, Kabupaten Bandung) implements waste management in Bandung Regency. This agency also implements the public awareness activities on 3R and environmental education with NGO and other organizations. Only the transportation of wastes to the disposal site is implemented by 4 technical assistant units (UPTD). The agency has 14 officers in 3 sections; Section of waste management cooperation, Section of treatment service and Section of facility development. UPTDs have 353 workers including 59 drivers. The financial record of the last 5 years is shown in Table 2-13.

Table 2-13 Financial Record of Human settlement, Regional Planning and Hygiene Agency of Bandung Regency

	Unit: Million Rp.				
	2006	2007	2008	2009	2010
Actual Expenditure (excluding the salary of staff)	6,205	7,062	7,800	8,483	8,765

Source: Prepared by the Survey Team with data provided by Human settlement, Regional Planning and Hygiene Agency of Bandung Regency

5) Sumedang Regency

Environmental Management Planning Agency of Sumedang Regency (Badan Lingkungan Hidup, Kabupaten Sumedang) implements waste management in Sumedang Regency. Their organization chart is shown in Figure 2-17 and they have 221 workers. Their main roles are to collect wastes from houses, to transport wastes through the transfer station and to implement environmental education. Their financial record of the last 5 years is shown in Table 2-14.

Table 2-14 Financial Record of Environmental Management Planning Agency of Sumedang Regency

	Unit: Million Rp.				
	2006	2007	2008	2009	2010
Actual Expenditure	1,670	5,052	4,577	4,413	4,512

Source: Prepared by the Survey Team with data provided by Environmental Management Planning Agency of Sumedang Regency

6) Garut Regency

Human Settlement Planning Agency of Garut Regency (Dinas Perumahan, Tata Ruang dan Cipta Karya, Kabupaten Garut) implements waste management in Garut Regency. Their organization chart is shown in Figure 2-18 and they have 319 workers. Their main roles are to collect and transport wastes from houses, and to dispose wastes at the disposal site. Their financial record of the last 4 years is shown in Table 2-15.

Table 2-15 Financial Record of Human Settlement Planning Agency of Garut Regency

	Unit: Million Rp.			
	2007	2008	2009	2010
Actual Expenditure	4,452	3,477	3,569	4,596

Source: Prepared by the Survey Team with data provided by Human Settlement Planning Agency of Garut Regency

7) Depok City

Sanitary and Gardening Agency of Depok City (Dinas Kebersihan dan Pertamanan Kota Depok) implements waste management in Depok City. The number of workers is 861 persons. Hygiene Service Division of this agency prepares plans and implements collection and

transportation of wastes. Technical Assistant Unit of Landfill implements treatment and disposal of wastes.

8) Bogor City

Public Space and Cleasing Agency of Bogor City (Dinas Kebersihan dan Pertamanan, Kota Bogor) implements waste management in Bogor City. The number of workers is 488 persons. Their main roles are to prepare plans and transport wastes from transfer stations to the disposal site. At the disposal site, Technical Assistant Unit of Waste Treatment implements waste disposal. The financial record of the last 4 years is shown in Table 2-16.

Table 2-16 Financial Record of Solid Waste Enterprise of Public Space and Cleasing Agency of Bogor City

Unit: Million Rp.

	2006	2007	2008	2009
Actual Expenditure	14,507	16,474	15,200	18,987

Source: Prepared by the Survey Team with data provided by Public Space and Cleasing Agency of Bogor City

9) Bogor Regency

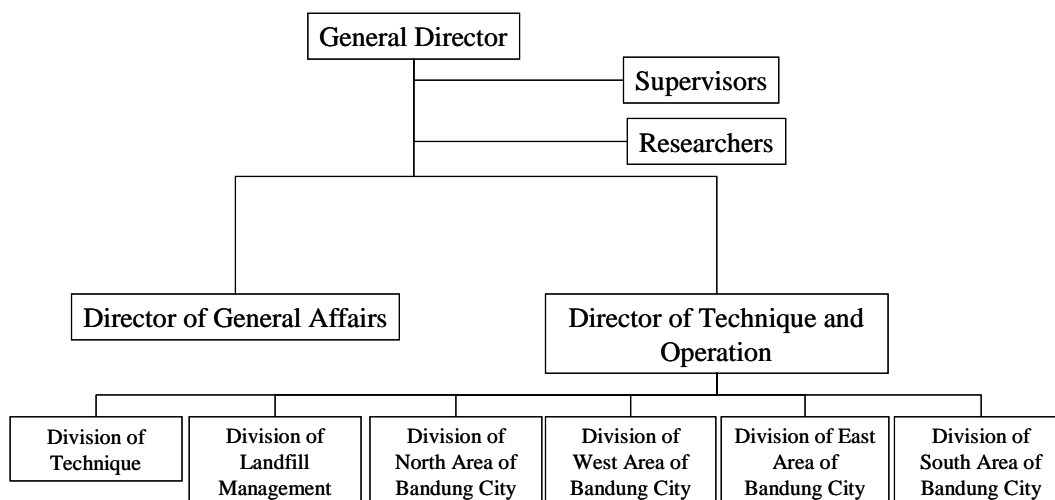
Public Space and Cleasing Agency of Bogor Regency (Dinas Kebersihan dan Pertamanan, Kabupaten Bogor) implements waste management in Bogor Regency. Their organization chart is shown in Figure 2-19 and they have about 350 workers. Their main role is to prepare plans. Transportation of wastes from the transfer stations is implemented by Technical Assistant Unit (UPTD). Public Space and Cleasing Agency of Bogor Regency manages the disposal site in cooperation with Bogor City. The financial record of the last 5 years is shown in Table 2-17.

Table 2-17 Financial Record of Public Space and Cleasing Agency of Bogor Regency

Unit: Million Rp.

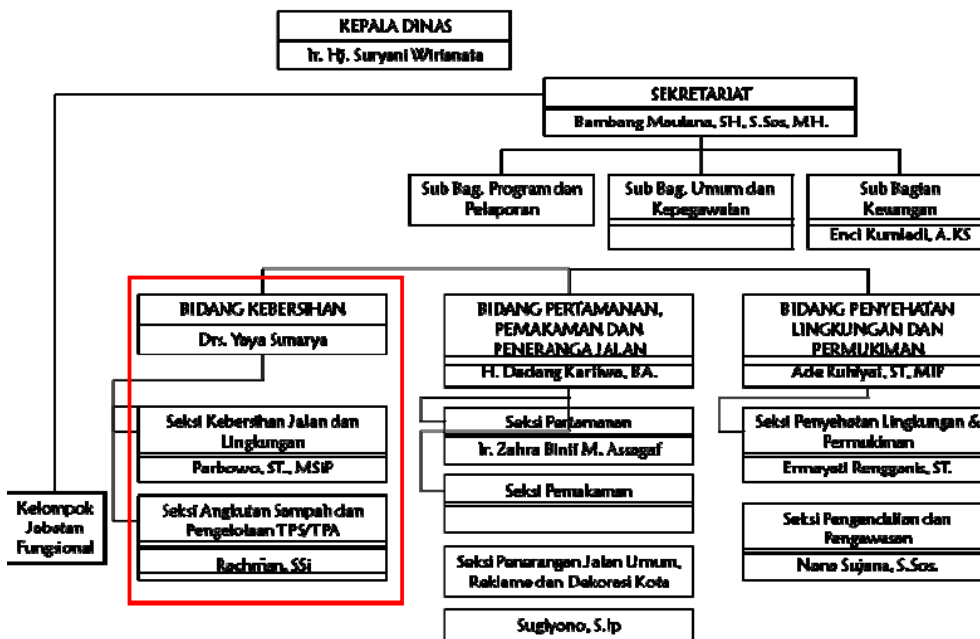
	2006	2007	2008	2009	2010
Actual Expenditure	7,850	8,000	9,000	15,000	10,000

Source: Prepared by the Survey Team with data provided by Public Space and Cleasing Agency of Bogor Regency



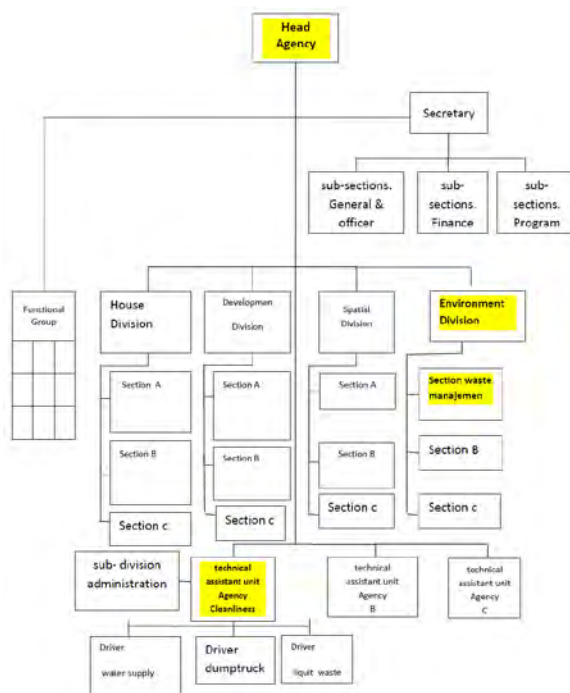
Source: Prepared by the Survey Team with data provided by Solid Waste Enterprise of Bandung City

Figure 2-14 Organization Chart of Solid Waste Enterprise of Bandung City



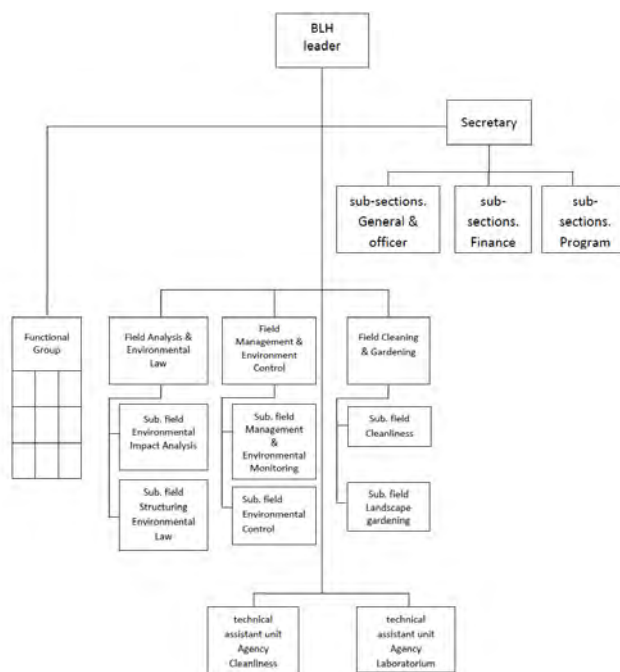
Source: Data provided by Solid Sanitary and Gardening Agency of Cimahi City

Figure 2-15 Organization Chart of Solid Sanitary and Gardening Agency of Cimahi City



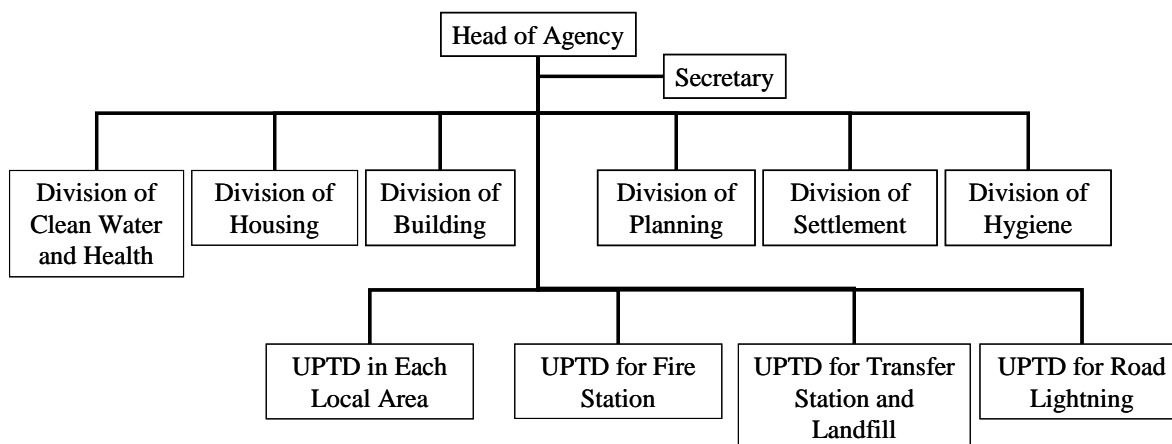
Source: Data provided by Human Settlement and Spatial Agency of West Bandung Regency

Figure 2-16 Organization Chart of Human Settlement and Spatial Agency of West Bandung Regency



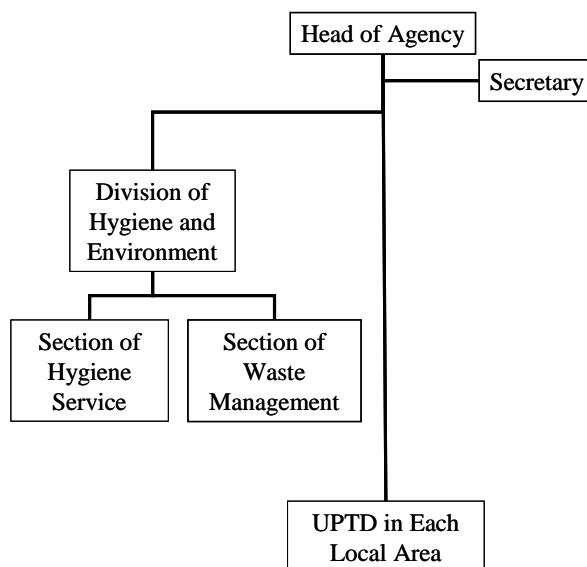
Source: Prepared by the Survey Team with data provided by Environmental Management Planning Agency of Sumedang Regency

Figure 2-17 Organization Chart of Environmental Management Planning Agency of Sumedang Regency



Source: Prepared by the Survey Team with data provided by Human Settlement Planning Agency of Garut Regency

Figure 2-18 Organization Chart of Human Settlement Planning Agency of Garut Regency



Source: Prepared by the Survey Team with data provided by Public Space and Cleansing Agency of Bogor Regency

Figure 2-19 Organization Chart of Public Space and Cleansing Agency of Bogor Regency

2.3 Geography and Climate

2.3.1 Republic of Indonesia

Indonesia consists on more than 17,000 islands. Its land area is about 1,890 thousands square kilometers, and it is about fifth times of land area of Japan. It lies between latitudes 11 degrees south and 6 degrees north and longitudes 95 degrees east and 141 degrees west. It is extended 5,110 kilometer from east to west and 1,900 kilometers from north to south and located between the Indian Ocean and the Pacific Ocean. The country shares land borders with Papua New Guinea, East Timor and Malaysia, and shares borders with Palau, India, Philippines, Singapore and Australia. Therefore the country is located on the edges of the Pacific, Eurasian and Australian tectonic plates which is the numerous site of volcanoes, most of lands are mountainous which have the highest peak between 3,000 m and 3,800 m from the sea level. Main islands of this country are Sumatra, Java, Borneo, Sulawesi and New Guinea.

The climate of Indonesia is almost entirely tropical. The country has two seasons, wet and dry season. The average temperatures are 28°C in the coastal plains, 26°C in the inland and mountain areas, and 23°C in the higher mountain regions. Temperature in Indonesia does not change much all year round, and day length also does not change much; the difference between the longest day and the shortest day of the year is only forty-eight minutes.

The main variously climate of Indonesia is rainfall. Indonesia has heavy rainfall, particularly in west Sumatra, northwest Borneo, west Java and western New Guinea. The area's relative humidity ranges between 70% and 90%. Winds are moderate and generally predictable, with monsoons usually blowing from the south and east in June through September and from the northwest in December through March.

2.3.2 West Java Province

West Java is located on the island of Java and borders Jakarta and Banten province to the west, and Central Java to the east. To the north is Java Sea. To the south is the Indian Ocean. The land

area is about 35 thousands square kilometers. Unlike most other provinces in Indonesia, the provincial capital Bandung is located in a mountainous area.

West Java province, a part of Ring of fire, has many volcanoes, and it divided into 3 areas, lowland in the northern coastal area, mountain area which height is more than 1,500 meters above sea level, and the region of sloping hillside in the middle altitude of 100 to 1,500 meters above sea level. The highest mountain is Mt. Ciremay in the northeast area. The major rivers are the Citarum River and the Cimanuk River, which flow in the Java Sea.

West Java has a tropical climate, and its climate changes area to area. The temperature of the North Coast is more than 30 degrees, but it bellows 10 degrees in the mountain area. The average rainfall of West Java is about 2,000 mm per year, but it might reach 3,000 mm to 5,000 mm in the mountain area.

3. Project Development Strategy

3.1 Background and Demand for the Project

3.1.1 Background

In West Java Province, the subject region of this project, a region-wide urban mixed waste of approximately 5,500 tons/day without separation is dumped in approximately 40 landfill sites in the form of open dumping. In big cities such as Bandung and Bogor, such open dumping landfill sites cause serious problems including deterioration of the surrounding environment, health condition of local residents and security around the area.

Leuwigajah landfill site locating in suburb of Bandung City was the biggest site of the area and accepted most part of waste from the City. However, loaded waste in the form of open dumping collapsed in February 2005, and the waste flew into residential and agricultural areas like a snow slide and killed 141 people. After the accident, waste from Bandung area was dumped into existing small landfill sites, but waste reached capacity soon. Therefore, Sarimukti final disposal site was newly constructed, which was expected to close operations in 2011 originally. However, it will be operated to the capacity limit coming until 2015, because project formulation for the next disposal site is delayed. Currently, it is necessary to construct new disposal sites and start operation earlier in order to handle waste disposal in West Java Province. The West Java Provincial Government plans projects using PPP scheme in Legok Nangka around Bandung Metropolitan Area and in Nambo around Bogor City and Depok region.

Up to now, BAPPENAS, Ministry of Public Works, and the West Java Provincial Government have continuously discussed implementation of the project by PPP. These organizations desire realization of the projects and have strong interests on PPP/PFI approach which effectively introduce private funding, because it matches the national policy of the Indonesian Government. Though income risk of SPC is a major risk in project finance, the Indonesian Government has given informal consent to expense fixed service fee to SPC. The West Java Provincial Government has already conducted Pre-FS presuming PPP scheme and desires implementation as PPP projects using Yen loan.

3.1.2 Interests of Other Donors

The World Bank has considered implementation of urban social infrastructure development in the West Java Province, particularly in the Bandung Metropolitan Region, including facilities for drinking water, sewerage and waste management. Regarding the waste management development, the World Bank had designated prioritization to the project for FDS development with sanitary landfill technology, including i) new FDS development in Legok Nangka, ii) rehabilitation of Leuwigajah landfill site, and iii) general assistance for operation and management of the FDSs.

The JICA study team and JICA recognized such overlapping interests with the World Bank in the waste management sector, and JICA and GoI repeatedly requested the World Bank for internal coordination before starting this F/S.

The JICA study team was notified by BAPPENAS and WJPG that the GoI finally decided¹ to implement the project by applying the JICA PPP scheme and sent a letter for acknowledgement for the decision. Major preference in GoI for selection of the schemes was the scheme with speed in implementation.

¹ It seems, however, the World Bank still pursue opportunities in this sector in the West Java, and it considers possibility of fund raising for government expenditure in the implementation phase.

3.2 Current Conditions and Policies Pertaining to This Project

(1) ~ (3) of this section summarize national policy, regulation, performance of waste collection/disposal/ recycle, and statistics concerning waste disposal of Indonesia, and (4) ~ (6) summarize those of West Java Province. And (7) lists consideration items necessary as project directions.

(1) Main Policies in Indonesia

1) Act of the Republic of Indonesia No. 18 Year 2008 regarding Waste Management in 2008 (hereinafter referred to as Act No. 18)

A new law for waste management was enforced as Act No. 18 under the circumstance that the existing waste management system could not catch up with the current waste management issues and lessons of the landslide accident in Leuwigajah disposal site in 2005 in West Java province, and so on.

The main features of Act No. 18 are as follows;

- To divide Municipal Solid Wastes (hereafter referred to as MSW) into 3 categories; household waste, household-like waste and specific waste (Household-like waste is “household waste” derived from commercial area, industrial areas, social facilities, and/or other facilities. Specific waste is waste contains hazardous and toxic materials, waste derives from disaster, and so on.)
- To manage wastes by “Reduction” and “Handling” (Reduction means reduce, reuse and recycle. Handling means separation, collection, transportation, intermediate treatment and final disposal.)
- To impose Extended and Shared Producer Responsibility (EPR) on the manufacturers until their products would be disposed
- To introduce the license system for waste treatment business
- To require all local governments to prepare the safety closure plan of open dumping sites within 1 year, and to close open dumping sites within 5 years

Act No. 18 shows only the principles and explain that the details for operation would be mentioned in the future ministerial regulations and local regulations. Act No, 18 requires the Governmental Regulation for 12 items. KLH summarized these items into 2 categories; 1) Waste Handling and 2) Waste Reduction and have prepared the new Governmental Regulation. At present (as of January, 2011), the coordination among related agencies was finished, and the enforcement would be in 2011.

2) 3R Strategy of KLH

3R Strategy of KLH was prepared mainly by Bandung Institute of Technology (ITB) with the support of United Nations Center for Regional Development (UNCRD) and the Institute for Global Environmental Strategies (IGES). This strategy is not positioned as a political official document, but just a reference document.

The main contents of the strategy are as follows;

- To establish a new organization as a advisory body
- To arrange laws and policies
- To arrange technologies and information system
- To develop the roles of stakeholders (Central Government, Provincial Government, City and Regency Government, Scavengers, Enterprise, Community and Research Institute) and their relationship

- To prepare financial measures (Central and Local Governments will bear the cost of 3R for MSW, Manufacturers will bear the cost of 3R for the industrial wastes based on EPR.)
- To promote international cooperation

From 2007, KHL started the following activities for 3R promotion.

1. Implementation of 3R Promotion Program in 3 cities
2. Preparation and delivery of several public awareness booklets for all local governments (contents: promotion of separation, method of home composting, 3R implementation guideline for cities and so on for City or Regency Governments and general publics)
3. TV commercial for 3R promotion, campaign with universities and private companies, promotion of “Day of Waste” to reduce the use of plastic bags, and so on
4. Public awareness for preparation of EPR regulation
5. Subsidy for equipment procurement by DAK (specific purpose subsidy)

3R Promotion Program was implemented in Jomgang (East Java Province), Magelang (Central Java Province) and Singaparna (West Java Province) for 3-year plan from 2007. 3R system in this program is to construct a recycling facility and to separate, sell the valuable wastes and implement composting. Among 3 cities, Jomgang continued a good operation relatively, however, other 2 cities had operation problems.

Regarding DAK, KLH had provided the subsidy only for equipment of water quality check and others for environmental conservation. From 2007, KLH started to provide the subsidy for crushers and composting equipment,

3) Waste Management Policy and Strategy by PU (PU Ministerial Regulation No. 21, 2006)

PU sets National Policy and Strategy on the Development of Waste Management System as Ministerial Regulation No. 21, 2006.

The outlined Target Values to be achieved by 2010 are as follows;

- 20% reduction of wastes
- 60% population receiving the service

The outlined policies are as follows;

1. To reduce wastes at origins as much as possible
2. To promote the involvement of general publics and private sectors as partners of waste management
3. To increase the area and quality of waste management service
4. To develop the organizational and legal system
5. To secure the alternative budget

Regarding the above target values, PU seemed that these values are relatively high.

According to the Ministerial Regulation No. 21, PU has implemented pilot projects. The community pilot project was one of them. PU supported the initial cost, raised public awareness for community's cooperation, promoted the community organization and implemented the monitoring in order to establish the independent 3R activity. The contents of this pilot project were home composting, valuable wastes collection by community and so on. In 2008, PU evaluated this pilot project of 2007, in which 44 communities took part. According to this evaluation, 20% of community had serious problems for operation and 30% stopped the activity.

At present (as of January, 2011), PU have continues this pilot projects and would increase the targets in the future.

PU also prepared the guidebook for community-based 3R as follows;

1. General Guidelines for Community Based 3R in Residential Area
2. Guidelines for Planning of Community Based 3R in Residential Area
3. Guidelines for Implementation of Community Based 3R In Residential Area
4. Guidelines for Monitoring and Evaluation of Community Based Integrated Management of 3R Waste in the Residential Area

(2) General Waste Collection and Disposal in Indonesia

1) Primary collection by RT/RW

In city areas, household wastes are collected by the small-scale neighborhood association (Rukun Tetangga: RT) and the large-scale neighborhood association (Rukun Warga: RW) from each house or station by handcarts to the transfer station (Tempat Pembuangan Sementara: TPS). RT/RW is not a legal association, but a voluntary association in order to keep clean and beauty in their area.

2) TPS

TPS is a transfer or collection station of household wastes and road sweeping wastes. The building type of TPS is various, such as platform type and shed with roof. 6 m³ containers are usually set in TPS and several RT/RW shares one TPS.

3) Transportation

City and Regency Government have a responsibility to transport wastes from TPS to the final disposal site by themselves and/or sub-contracted private companies. They usually use arm-roll trucks (mainly 6 m³, 8 m³ and 10 m³), dump trucks (mainly 6 m³, 8 m³ and 10 m³) and pick-up trucks (mainly 2 m³, 6 m³ and 8 m³). It is not popular to use compacter trucks (mainly 6 m³, 8 m³ and 10 m³) at present.

4) Intermediate Treatment

City and Regency Government and/or Provincial Government usually operate composting facility. Construction of composting facility in the area of final disposal sites is promoted because Act No. 18 mentions clearly the improvement the intermediate treatment (processing) as one of the ways to stop End or Pipe approach. However, it is not popular to operate incinerators.

5) Final Disposal

Most of final disposal sites in Indonesia are open dumping sites without leachate treatment system and soil covering, except for some final disposal sites in metropolitan areas. According to Act No. 18, these open dumping sites should be rehabilitated or closed safely.

(3) Statistical Data on Waste Management in Indonesia

It is not periodically implemented by City and Regency Government to record the amount of wastes at each stage (generation, collection and transportation). Only at the final disposal sites in metropolitan areas, transported wastes are measured by truck scales. Therefore, there are not any statistical continuous data on waste management. However, the following 2 data can be used for understanding the situation.

1) Items on Waste Management in Report of Adipura Program (KLH competition program on city environment among local governments)

Adipura Program is started in 1986 based on Environmental Protection Law No. 4, 1982. The

detail is determined by the BAPPEDAL Regulation No. 15, 1982. Evaluation items are management aspect, physical aspect, public health aspect and aspect of park, green area and amenity. Cities, which are evaluated as excellent, can receive the prize money, therefore the participation ratio is mostly 100%. Hearing items related to waste management are very simple, such as organization, waste generation and transportation amounts. The amount of waste is based not on the measuring results, but on the calculation with the unit amount (unit amount of daily generation: 2.5 to 3.0 L/person/day) mentioned in Indonesian National Standard (SNI S04-1993-03).

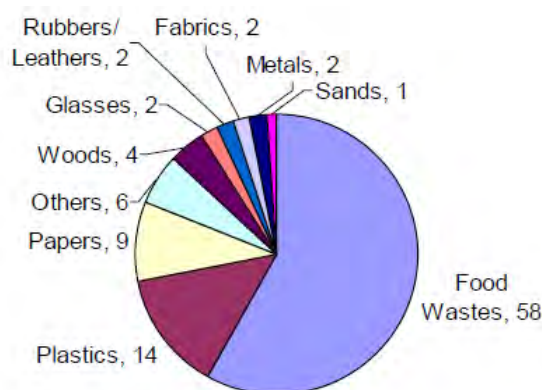
2) KLH Questionnaire Survey on Waste Management in Local Governments in 2007

With the support of JICA advisor for environmental policy, the questionnaire survey was implemented for all local governments to ask the situation of waste management in 2006. The survey result was announced from 2008. The number of target governments was 465, however, the number of respondent governments was 154 (response ratio: 33%, population in respondent governments: 40% of the national population). From the result of this KLH survey, the estimated waste generation amount and the composition are as follows;

Table 3-1 Estimated Waste Generation Amount from KLH Survey

Area	Population (person)	Estimated waste generation amount (Million ton/year)
Sumatera	15,382,173	8.7
Jawa	64,623,161	21.2
Balinusra	4,090,054	1.3
Kalimantan	4,924,449	2.3
Sumapapua	4,916,424	5.0
Total	93,936,261	38.5

Source: Prepared by the Survey Team with KLH survey results of 2007



Source: Prepared by the Survey Team with KLH survey results of 2007

**Figure 3-1 Waste Composition from KLH Survey
(Numbers in the Figure: Percentage (%))**

(4) Policies of West Java Province

To response to Act No. 18, West Java Province enforced Provincial Regulation on Waste Management (No.12, 2010). Each city and regency applied the regulations on hygiene and beauty (K3: Kesehatan Kecantikan Dan Kesehatan) into waste management, however, they should prepare the new regulation specified waste management according to Act No. 18.

Cities and regencies have a responsibility of waste management (construction, operation and management of facility), and provinces have a responsibility and right of regional waste management, which involves several cities and regencies, such as construction, operation and management of regional disposal sites. At present (as of April, 2001), West Java Province has a regional disposal site, Sarimukuti landfill. BPSR has a responsibility of plan, operation and management of Sarimukuti landfill. However, responsibility of collection and transportation is on each city or regency although city or regency uses the regional disposal site. Therefore, City and Regency Governments have targets and policies for waste reduction, 3R promotion, and so on, but West Java Provincial Government does not have any such targets and policies. West Java Provincial Government just has the master plan for construction planning of Legok Nangka landfill (the similar master plan for Nambo landfill is under preparation.). Main policies of target cities and regencies are as follows;

Table 3-2 Main Plan and Strategy on Waste Management of Target Areas

Area	Plan and Strategy
Bandung City	<ul style="list-style-type: none"> • Long-Term Development Plan of Bandung City 2005-2025 • Mid-Term Development Plan of Bandung City 2009-2013 (based on the Regulation of Bandung City No. 9, 2009) • Corporation Plan (Waste Management Guideline) 2007-2011
Cimahi City	<ul style="list-style-type: none"> • 3R Management Study in Cimahi City (2010) • Alternative Methods for Waste Management in Cimahi City (2010) • Operation Standard of Composting in Cimahi City
West Bandung Regency	<ul style="list-style-type: none"> • Mid-Term Regional Development Plan 2008-2013 • Master Plan of Waste Management 2009-2029 • Feasibility Study on Final Disposal 2009 • Social and Economic Study on Final Disposal 2009 • 3R Study Report 2010
Bandung Regency	<ul style="list-style-type: none"> • 20-Year Plan 2008-2028 (Solid Waste Improvement Program) • Master Plan for Final Disposal 2011 • Waste Management Guideline (Regulation No. 21, 2009)
Sumedang Regency	<ul style="list-style-type: none"> • Strategic Plan of Environmental Management Planning Agency 2008—2013 • Mid-Term Regional Development Plan 2009-2013 • Master Plan of Solid Waste 2011
Garut Regency	<ul style="list-style-type: none"> • Regulation No. 9, 1999
Depok City	<ul style="list-style-type: none"> • Master Plan of Waste Management 2008 • Mid-Term Development Plan 2010-2011
Bogor City	<ul style="list-style-type: none"> • Master Plan of Waste Management • Guidelines for Collection, Intermediate Treatment, 3R and Final Disposal
Bogor Regency	<ul style="list-style-type: none"> • Plan, Strategy and Action Plan for Waste Management

Source: Hearing survey results by the Survey team

(5) General Waste Collection and Disposal in West Java Province

General waste collection and disposal in West Java Province is mostly similar to the national one. Only the primary collection in some areas is implemented by City or Regency Government. All target areas handle only MSW (household and household-like wastes). Regarding the industrial wastes, manufacturers transport and dispose by themselves. The waste collection and disposal situation in target areas is shown in Table 3-3. Waste disposal amounts in this Table are estimated with the unit amount of SNI, or calculated by the number of containers or trucks.

(6) Situation of Recycling in West Java Province

Recycling food wastes is mainly implemented public and community facilities, and their capacities are usually small. Valuable wastes (papers, glass, metal, plastic, etc.) are traded among private companies. The starting point of recycling is that scavengers sell the collected valuable wastes to the agents, called "Lapak". Lapak are private company which crush, wash, compress, pack and process such valuable wastes. Lapak usually do not produce recycled materials, but just sell their processed wastes to recycling companies. These recycling companies produce recycled materials and sell them to the market. There are often several Lapak involved between scavengers and recycling companies, Sometimes, Lapak and recycling companies directly buy the valuable wastes from the companies or individuals. Table 3-4 shows the example of recycling in West Java Province.



Table 3-3 Waste Collection and Disposal Situation in Target Areas



	Bandung City	Cimahi City	West Bandung Regency	Bandung Regency	Sumedang Regency	Garut Regency	Depok City	Bogor City	Bogor Regency	
Primary Collection	By RW/RT	By RW/RT	By Regency	By RW/RT	By Regency	By Regency	By City	By RW/RT	By RW/RT	
Secondary Collection	By City	By City	By Regency	By Regency	By Regency	By Regency	By City	By City	By Regency	
Public Recycling and Intermediate Treatment	3 composting sites (Jekekong, Gedebage, Indramayu), 2 crushing sites (Tegallega, Ciroyon)	About 60 community composting sites	None	1 public recycling site and some small-scale community recycle sites	1 composting site (under operation)	-	18 public recycling sites	5 public recycling sites (Indraprasta, Bantar Kemang, Gn Stone, Mulya Harja, Yasmin) and 1 community recycling site (Griya Jasmine)	31 public recycling sites	
Final Disposal	Sarimukti Regional Landfill (possibility to be full by 2011)			Babakan Disposal Site (necessary to improve from open dumping site to sanitary landfill)	Cibeureum Disposal Site (necessary to improve from open dumping site to sanitary landfill) (1.8ha is available among 10ha)	Pasir Bajing Landfill (finished by 70%)	Cipayung Landfill (possibility to be full by 2011)	Galuga Landfill (possibility to be full by 2013)		
Tipping Fee	Household: Rp. 2,000 to 20,000 per month Enterprises: up to their discharged volume, such as hotels: Rp. 15,000 per m ³ (based on the regulation (No. 64, 2002))	Household: about Rp. 5,000 per month	-	Household: Rp. 4,000 to 9,500 per month Enterprises: 35,000/m ³ Markets: Rp. 1,500 to 3,000 per day (based on the regulation (No. 21, 2009))	Household: about Rp. 3,000 per month	Household: about Rp. 1,000 per month	Household: Rp. 3,500 to 17,500 per month	-	-	
Waste Disposal Amount in 2010 (t/year)	323,120	33,964	14,487	51,465	2,408	77,307	120,823	179,142	56,124	
Population (person)	2005	2,270,970	493,698	1,416,441	2,847,493	1,067,361	2,321,070	1,373,860	855,085	3,500,000
	2006	2,296,848	506,250	1,455,624	2,943,504	1,060,109	2,274,973	1,393,568	879,138	3,600,000
	2007	2,339,928	518,985	1,493,238	3,038,038	1,081,290	2,309,773	1,470,002	905,132	3,800,000
	2008	2,520,812	532,114	1,531,072	3,116,056	1,127,255	2,345,108	1,503,677	1,055,734	4,000,000
	2009	2,340,624	547,862	1,548,434	3,148,951	1,127,956	2,380,981	1,536,980	949,066	4,300,000
	2010	2,300,941	580,709	1,581,281	3,181,798	1,154,262	2,401,248	1,639,173	928,443	4,700,000





Note: “-” shows city or regency did not answer.



Source: Hearing survey results by the Survey Team and Center Statistic Bureau of West Java, 2010



Table 3-4 Examples of Recycling Activity in West Java Province

Type	Place	Implementation Agency	Outline
Public Community Recycling Site	Bandung City	Bio-Metha Green Plant	<ul style="list-style-type: none"> • Integrated plant with the methane gas facility, composting facility, and selling handcraft and waste plastics • Supported by the organization, called “Yayasan Saung Kadeudeuh”, the bank (Bank bjb), Solid Waste Enterprise of Bandung City and the university (Universitas Padjadjaran) • Material: household wastes (collection: 3 to 4m3 per day) <p>[Methane Gas Facility]</p> <ul style="list-style-type: none"> • For operation of Methane Gas Facility, source separation (separation at home) was started to separate food wastes and others (about 1,000 households) • Fermentaion period: about 24 days • Produced methane gas: neighboring 3 houses use for power generation and gas <p>[Composting]</p> <ul style="list-style-type: none"> • Composting process: manual process (organic materials were piled up and matured without any additives.) without any turning over • Composting facility: vent pipes were set in a house with roof, but without walls • Fermentation & maturation period: about 3 weeks • Composting products: Rp. 10,000 per one big bag (12kg), and Rp. 2,500 per one small bag (3kg) <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p>Methane Gas Facility</p> </div> <div style="text-align: center;">  <p>Fermentation of Composting</p> </div> </div>

Type	Place	Implementation Agency	Outline
Public Community Recycling Site	Cimahi City	NABILA (independent community organization, called "POKMAS)	<ul style="list-style-type: none"> To recycle waste glass and implement composting Composting is mainly not for making profits, but for public awareness <p>[Recycling waste glass]</p> <ul style="list-style-type: none"> PR is implemented by Cimahi City Material: waste glass from household (free of charge) and from glass manufacture plants (Rp. 250/kg) <p>[Composting]</p> <ul style="list-style-type: none"> Material: direct collection from household (about 900 households) Composting process: manual process (including several times of turning over) without any additives (If the moisture was not enough, only leachate was added.) Composting facility: a house with roof and walls partially Fermentation period: about 9 days Maturation period: about 10 days Composting products: selling at Rp. 1,000/kg Production capacity: 35 packs per month (15kg per 1 pack) Customer: government organization and private companies Leachate: selling as liquid fertilizer at Rp. 45,000/L <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Handcraft of Waste Glass</p> </div> <div style="text-align: center;">  <p>Fermentation of Composting</p> </div> </div>
Public Recycling Site	TPS Indramayu (Bandung City)	Solid Waste Enterprise of Bandung City	<ul style="list-style-type: none"> Function: TPS and composting site Material: household wastes from 15 RWs (30 handcarts per day) Composting products: not for selling, but for delivering neighbors without any charges Composting process: manual process (including several times of turning over) without any additives Composting facility: a house with roof Fermentation and maturation period: about 3 weeks Separated plastics: selling to Lapak (plastic bag: Rp. 750/kg, PET bottle: Rp. 6000/kg)

Type	Place	Implementation Agency	Outline	
			 <p data-bbox="1115 563 1312 590">Containers at TPS</p>	 <p data-bbox="1496 563 1809 590">Fermentation of Composting</p>
Public Recycling Site	Jelekong composting site (Bandung City)	Solid Waste Enterprise of Bandung City	<ul style="list-style-type: none"> • Material: wastes from Ciroyon Market and TPS Tegal Lega because composting plants in these sites (constructed by KLH support) are not operated (6 m³ per day) • Composting process: manual process (including several times of turning over) • Fermentation and maturation period: 3 to 4 weeks • Composting products: for selling (without additives: Rp. 4000/pack (2.5kg), with additives: Rp. 500/kg) or using at public space in Bandung City <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div data-bbox="994 818 1373 1066">  <p data-bbox="1066 1078 1361 1106">Transportation of Materials</p> </div> <div data-bbox="1435 818 1814 1066">  <p data-bbox="1496 1078 1809 1106">Fermentation of Composting</p> </div> </div>	

Type	Place	Implementation Agency	Outline
Private Collection and Recycling Plant	Bekasi City	PT Mittran	<ul style="list-style-type: none"> • Collection of household wastes, separation, composting, selling waste papers, glass and plastics (for material and thermal recycling) and providing lectures of recycling technology and operation • Main revenue: tipping fee by providing the appropriate collection service (revenue from selling products is not main source of revenue) • Collection: collection bin (100L) for 2 or 3 household • Tipping fee: Rp. 50,000 per one collection bin • Composting products: selling as the material for soil conditioner at Rp. 400/kg • Process of soil conditioner production: manual process without any turning over • Facility for soil conditioner production: outside (materials were covered with plastic sheets, but without any vent pipes) • Fermentation & maturation period: about 3 weeks • After fermentation period, soil conditioners were produced by screening. • According to the customers' requests, additives were put in the soil conditioner.
Lapak	Bandung Regency	Mr. Mathondang's PVC plastic recycling center	<ul style="list-style-type: none"> • Collection of PVC pipes and other plastics (bags, PET bottles, etc.) • Material: buying from Lapak (buying price: PET: Rp. 6,500/kg, PP (hard): Rp. 2,500/kg, PP (soft): Rp. 2,000/kg, PVC: Rp. 700/kg, HDPE: Rp. 2,000/kg, LDPE: Rp. 5,000/kg) <p>[PVC pipes]</p> <ul style="list-style-type: none"> • Selling for pipe manufacturer at Rp. 1,600/kg <p>[Other plastics]</p> <ul style="list-style-type: none"> • Selling for recycling plants at after crushing, washing and packing • Production capacity of packing: 15 packs per day (about 1 ton) <div style="display: flex; justify-content: space-around; align-items: center;"> <div data-bbox="994 1002 1435 1241" style="text-align: center;">  <p>Process of washing and crushing</p> </div> <div data-bbox="1435 1002 1877 1241" style="text-align: center;">  <p>Crushed plastics</p> </div> </div>

Type	Place	Implementation Agency	Outline
Private Recycling Plant	Bandung City	Jon Peter's Plant	<ul style="list-style-type: none"> • Material recycling of plastics and metals • Budget for buying materials: Rp. 200 million per day • Buying price: different by color or plastic type (21 price type for plastics and 31 price type for metals) • Material: buying from Lapak • Recycled product: pellets after crushing, washing, drying (about 3 ton per day) <div style="display: flex; justify-content: space-around; align-items: center; margin-top: 10px;"> <div style="text-align: center;">  <p data-bbox="1151 727 1279 754">Stock yard</p> </div> <div style="text-align: center;">  <p data-bbox="1509 727 1800 754">Recycled products (pellet)</p> </div> </div>
Private Recycling Plant	Bogor Regency	geocycle	<ul style="list-style-type: none"> • Business unit of PT Holcim (Third cement company in Indonesia) • Plant is next to the site of Nambo Landfill • Operation: separating, crushing and thermal recycling • Material: woods and plastics from the private company in Cilincing (about 20t/day), Lapak in Depok city (about 20t/day) and so on • Revenue: receiving fee as Rp. 5,000/t • Facility: kiln incinerator (burning temperature: 1,800 °C) • Capacity: about 600 t/day • At present (as of April, 2011), the receiving material is not enough

Source: Hearing survey results by the Survey Team

(7) Priority of this Project

As shown in Table 3-4, the life spans of the regional landfill and the disposal sites in each city and regency are not enough and open dumping sites should be stopped according to Act No. 18. In the future, waste generation will be increased along the population growth. Not only physically, but also financially, cities and regencies have a serious issue that the price of tipping fee is too small and they cannot collect such small amount of fee sufficiently. Therefore, the technically and financially efficient operation of waste management is required. Under such circumstances, it can be said that the priority of this Project is high.

3.3 Evaluation of the Pre-Feasibility Study

The West Java Province conducted Pre-FS (Detail Engineering Design) of Legok Nangka in 2009 and Nambo in 2008 by contracting with a local consultant (PT.MAZA). Being quite important for this F/S, these existing Pre-FS are reviewed in this section.

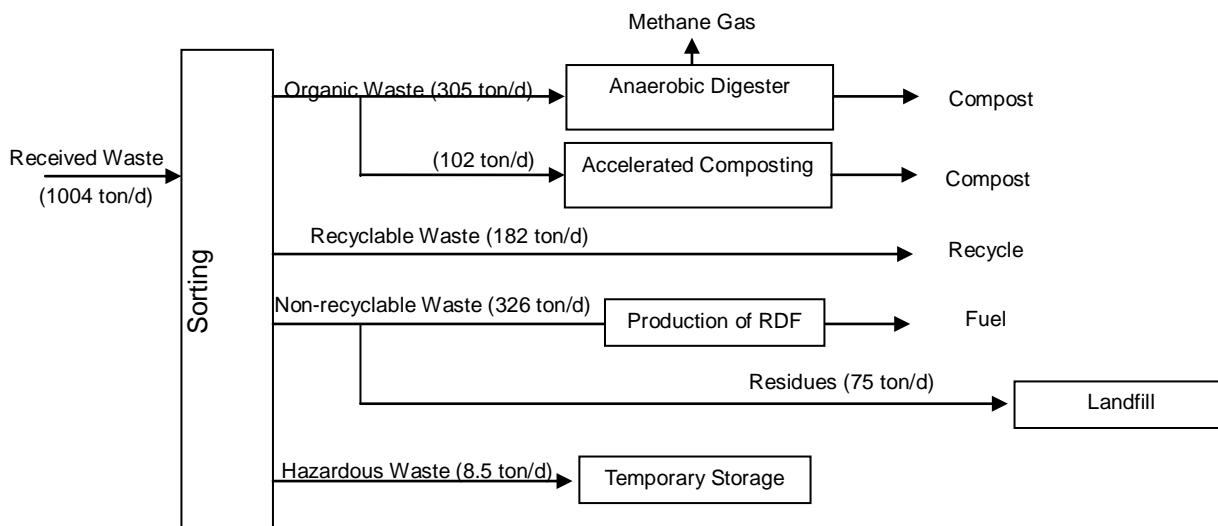
This section mainly evaluates technical plans on waste treatment, final disposal and water treatment, though Pre-FS consists of demand estimation, waste treatment plan, final disposal plan, water treatment and quantity survey. This evaluation takes into account project environment in Indonesia and superiority of Japanese technology, and principles for disposal follow that.

3.3.1 Review of the Treatment Technologies

The characteristics of waste in Legok Nangka assumed in the Pre-FS are shown below in Table 3-5 and Figure 3-2 shows process flow sheet of intermediate waste treatment facilities (Legok Nangka).

Table 3-5 The Pre-FS (Legok Nangka): Characteristics of Waste

Waste Composition	%	Macro	Potential Processing
Organic (Sorted)	40.54%	Organic	raw material compost Anaerobic Landfill Cell
Organic Mix	13.54%	Organic Mix	raw material RDF
Plastics Non-Recyclable	10.88%	Unrecyclable	
Papers Non-Recyclable	7.98%	18.86%	
Plastics Recyclable	7.25%	Materials for	material recycle
Papers Recycle Recyclable	5.32%	Potential	
Metals	1.84%	Recycling	
Textile	2.67%	18.92%	
Glass	1.83%		
Medical Waste	2.97%	Residual	raw material RDF
Other (gravel, dirt, concrete, brick, tile)	4.52%	7.49%	
B3	0.85%		Special Handling



**Figure 3-2 The Pre-FS (Legok Nangka):
Flow Sheet of Intermediate Waste Treatment Facilities**

In the waste flow shown as above Flow sheet, received waste is classified into the following and treated.

Organic Waste	=> Accelerated Composting or Anaerobic Digester => Compost
Recyclable Waste	=> Recycle
Unrecyclable Waste	=> Conversion to RDF => Fuel
Hazardous Waste	=> Temporary Storage

Amount of received waste is about 1,000 tons per day and 75 tons per day of residue is generated. 8.5 ton per day of hazardous waste classified is to be temporarily stored. Others are sent outside as recycle, compost and fuel.

Review has been made to the Pre-FS as stated below.

(1) Hazardous Waste in Received Waste

In the Pre-FS it is assumed that hazardous waste such as medical waste is involved in received waste and that such waste is classified and temporarily stored. However, the Pre-FS remarks only that such waste “to be disposed according to prevailing regulations”.

It's highly unlikely that hazardous waste classified and segregated completely, which might be mixed in organic waste. The organic waste becomes compost through Accelerated Composting System or partially bio-gasified through Anaerobic Digester and recovered with remainder being composted. This means hazardous waste contaminates compost. To utilize compost requires such thorough administration and control as waste to be compost never contaminated with hazardous waste. For instance it is needed to have such idea to collect garbage, especially from fresh food markets, which is never contaminated with hazardous waste, and to compost it to utilize.

(2) Sorting Process

It is very valid and realistic that the waste is sorted to recyclable, non-recyclable and others after screening out whole waste. We will do to follow such like above idea in this feasibility study (F/S).

(3) Anaerobic Digester Method

The Pre-FS mentions that it takes only 180 days for garbage to be in anaerobic fermentation in Anaerobic Digester and then in compost maturation process. But methane gas recovered in the period 180 days is assumed to be a very little and it needs to investigate and to assess sufficiently actual operation data out of such as Denpasar. In Japan, there is no data and such process is not adopted.

Only a portion of garbage (carbon) will be decomposed at the end of 180 days, which leads sufficiently large composting area for compost maturation.

(4) Composting Process

a. Use of Compost Products

The Pre-FS based its study on the condition that compost products would be sold in the market. However, as it is learned that hazardous waste including medical waste is contained in the waste brought at the planned intermediate treatment facility, the hazardous material has to be removed at the facility, which is practically impossible operation. The compost produced under this circumstance may cause health and safety problems, which leads to the judgment that selling the compost in the market is not realistic or practical.

Careful study before the implementation and quality-controlled operation in the implementation stage should be necessary for the following reasons, even after complete segregation and removal of hazardous waste before the facility is guaranteed.

1. It is crucial for the compost producers from a business point of view to maintain compost buyers over the entire operation period. There are some cases where producers failed to have steady buyers.
2. The facility should be operated under professional and controlled manner with special focus on the quality of the compost.

b. Process of Making Compost Products

The Pre-FS proposed the accelerated composting method, but the application of this particular method has not been found in such a large scale operation as the one we plan in Indonesia.

The Pre-FS concluded the fermentation process by this method takes only 7 to 10 days, but the fermentation period consisting of the first phase and second phase, in general, is said to be as short as two months. When such a large change in the processing conditions is found, scientific and robust verification is necessary in consideration of the local conditions, for the composting process strongly depends on the local conditions such as the characteristics of organic waste, moisture rate and temperature.

(5) Selection of RDF Production Process

ASTM (American Society for Testing and Materials) classifies RDF (Refuse Derived Fuel) into 7 classes as shown below.

Table 3-6 Classification of RDF (Refuse Derived Fuel)

Class	Description	Appellative
RDF-1	Wastes used as a fuel in as-discarded form with only bulky wastes removed.	
RDF-2	Wastes processed to coarse particle size with or without ferrous metal separation.	Fluff-RDF
RDF-3	Shredded fuel derived from municipal solid waste (MSW) that has been processed to remove metal, glass, and other inorganic. This material has a particle size such that 95 weight % passes through a 2-in. (50-mm) square mesh screen.	
RDF-4	Combustible waste processed into powder form, 95 weight % passing 10-mesh(1" mesh) screening.	Dust-RDF (Powder RDF)
RDF-5	Combustible waste densified (compressed) into the form of pellets, slugs, cubes or briquettes.	Densified-RDF (Formed Solid RDF)
RDF-6	Combustible waste processed into liquid fuel.	
RDF-7	Combustible waste processed into gaseous fuel.	

Production facility of RDF assumed in the Pre-FS has the process for production of RDF-5 (Form RDF) in the above table, which involves crushing, drying and fabrication. This process is the same one as adopted in Japan in the past. Through the past Japanese operation experience, the followings are pointed out.

- 1) Drying is mandatory as preliminary treatment, when waste contains much water. And drying process demands a lot of fossil fuel. In addition, deodorization treatment for exhaust gas is required and, for the purpose, deodorizer kiln heats up to around 700 degree Celsius, which also consumes fossil fuel. Therefore, expenditure for construction, operation and so on is costlier and greenhouse effect gas emission increases.
- 2) Ignition and fire prevention are important for dryers. Then, oxygen concentration and gas temperature are strictly controlled and administrated. Fires occur in some situations and conditions.
- 3) In order to put waste into compaction process to make RDF, numerous pretreatment and separation systems such as primary crushing, metal detection/removal, aluminum separation, air classification and secondary crushing are required. However, complete elimination of foreign material is impractical. Contamination of foreign materials such as fine metals causes choke/stoppage of compactors and tear/wear in process equipment. And subsequently changes of parts to contact with waste in process and maintenance require considerable amount of expenditure.
- 4) The above appears typically in teeth or blades of crushers, which worn fast due to foreign materials and replacement cost increases largely.
- 5) When converting garbage into RDF, combustible gas generates through fermentation if appropriate drying is not applied, subsequently drying can cause fire and explosion. Addition of calcined lime becomes necessary to prevent decay, which creates chemical cost.
- 6) It should be marked that RDF sometimes contains chlorides.

As conclusion, based on the above, RDF Production Process (RDF-5) supposed in the Pre- FS Report is bearing the potential problem in respect of safety and economy.

As an alternative, RDF production, such as RDF-1 ~ RDF-4 (Fluff/Dust RDF) which does not involve drying and crushing process is ideal. For example it can be considered to use plastics and paper as resource of RDF without drying process.

(6) Waste Sent to Landfill

In the Pre-FS, the waste sent to landfill is assessed to be 75 tons per day (t/d) of residue only. However, as pointed out in the aforementioned paragraphs, it may be under estimation, considering that compost sometimes cannot be utilized due to hazardous materials and only a portion of garbage may be decomposed by Anaerobic Digester Method.

(7) No Consideration on Sanitary Landfill

The West Java Provincial Regulation No.12, 2010 on waste management prohibits open dumping and obligates introduction of waste treatment and sanitary landfill in newly constructed final disposal sites, which has not been considered in the Pre-FS. There is almost no experience of sanitary landfill in Indonesia, so experience of Japan can be used effectively.

(8) Shortage in Engineering Consideration in the Design of the Landfill Site

Groundwater Collecting and Drainage System for the Final Landfill Disposal Site was not considered in the Pre-FS. High level of the ground water will cause swelling of the Sealing Works by the uplift and will damage the sealing wall. To prevent this damage, underground drainage system should be provided.

The drainage shall be collected and discharged to the ground water through penetration system, however, the capacity of ground penetration was not considered well in the pre F/S. To stabilize this fluctuation, a reservoir for drainage control shall be facilitated.

In Japan, in order to reduce the risk of groundwater pollution, the ministerial ordinance for the Sealing Works of the Final Disposal Site in June 1998 was issued. It says "To strengthen water sealing effectiveness, the application of dual combined sealing method, i.e. both seepage control sheets and impermeable soil layer shall be surely adopted". For this project we also offer a combined sealing method to reduce above risk. Furthermore, due to uncertainty of the availability of the impermeable soil and unreliability of the impermeable soil layer method under the high precipitation in Indonesia, it was decided to apply dual seepage control method.

This issue relates to operation of disposal sites and is included in the plan.

3.3.2 Evaluation on Facility Plan of Disposal Site

Facility plan of disposal sites is evaluated as follows.

(1) Consideration on Liner Sheet

Seepage control is an important factor that reduces a risk of contamination of underground water from landfill sites. Pre-FS adopts single-layer liner sheet work.

According to the ministerial order revised in June 1998, seepage control in final disposal sites in Japan should "adopt double-layered seepage control work with liner sheet and impermeable bed and strengthen impervious function such as installation of protection layer".

This plan intends to reduce the above risk and adopt double-layered seepage control work. Application of "double-layered liner sheet structure" is examined, considering availability of impermeable bed and uncertainty of construction work in pluvial climate.

(2) No consideration on Catchment/Drainage Facility of Underground Water

Pre-FS did not consider catchment/drainage facility of underground water. Seepage control work will be damaged by uplift pressure if underground water level is high. This FS considers installation of drainage facility of underground water to avoid the problem.

(3) No consideration on Rain Water Reservoir

Pre-FS plans to control rain water using penetration valve. But the method constrains disposable volume and rain water from both inside and outside of the development area is likely to cause negative impact to downstream areas.

This FS suggests use of rain water reservoir and estimate required capacity of the reservoir referring rainfall profile, though the project area is limited.

3.3.3 Leachate Treatment Facility

Pre-FS defines the following principles regarding seeping water treatment facility.

- Facility should have function to prevent seeping water from deteriorating the environmental and to utilize treated water effectively at the landfill site.
- Facility should be designed to reduce toxic substances in seeping water and diseases caused by them.

Through review of Pre-FS, it is found better that some points on seeping water facility should be improved to meet the principles. The points and reasons are described below.

(1) Concern for Spraying to Green Zone

Treatment water in Legok Nangka is supposed to be sprayed to green zone in the site. If underground water is contaminated by the treatment water, health problems are concerned in downstream villages where residents depend on spring water for daily lives.

(2) Concern for Capacity of Biological Treatment

Performance of biological reactor depends on the number of microorganisms in it. Reactors are not filled with carriers that can incubate microorganisms densely, so those are not suitable for stable treatment of seeping water with high load variation.

(3) Concern for Seasonal Change of Disposal Volume

Volume of seeping water varies by rainfall, and it fluctuates significantly between rainy season and dry season in Indonesia. On the other hand, it takes time to increase the number of microorganisms in biological reactors for treatment of seeping water. Therefore, it is impossible to secure the appropriate number of microorganisms in responding rainfall promptly in principle.

For this reason, this FS suggests place a reservoir before seeping water treatment process. Reservoirs can prevent overload by storing seeping water in rainfall and maintain purification capacity by supplying seeping water to microorganisms in sunny days.

(4) Concern for Discharge of Leachate Water

Seeping water will be too contaminated to treat in anaerobic condition without supply of oxygen, if discharge of it is restricted and rainwater is stored inside landfill sites. Pre-FS did not recognize this problem.

3.3.4 Summary of Pre-FS Evaluation and Basic Principles of Waste Disposal Plan

Based on evaluation of Pre-FS, waste disposal method and plan are summarized as the table below. Detailed disposal method is examined in Chapter 5 and later.

Table 3-7 Summary of Pre-FS Evaluation and Basic Principles of This FS

Process/Viewpoint	Evaluation of Pre-FS	Principles of This FS
Sorting Process	The process is suitable to the local circumstances and highly feasible.	The process in Pre-FS is followed.
Handling of Hazardous Waste	Hazardous waste is possible to be mixed in compost.	Thorough management is necessary so that hazardous waste is not mixed.
Anaerobic Digester Process	It is adopted, but its efficiency is low as a process in disposal sites with limited area.	Other methods such as “Wet Type Medium Temperature Ferment Treatment” are suggested.
Treatment of organic waste and safety/ usability of compost	There is high risk in selling after compost production at current condition.	A part of products is used as cover soil at the disposal site after stable treatment as used for compost production.
Problem in RDF Production Process	RDF-5 has problems in terms of safety and economic efficiency.	RDF-5 production plant is not adopted.
Amount of Waste to Final Disposal Site	Disposal volume is under- estimated.	Volume of waste to final disposal sites is estimated as precise as possible.
Sanitary Landfill	It has not considered yet, and there is almost no experience in Indonesia.	Experience in Japan is effective. It is included in operational issues of disposal sites.
Liner Sheet	Single-layered liner sheet is adopted.	Seepage control work is doubled, and “double-layered liner sheet structure” is considered for application.
Catchment/Drainage Facility of Underground Water	Not considered	Installation is considered to avoid damage to seepage work.
Rain Water Reservoir	Not considered	Rain water reservoir is adopted, for it is likely that rain water from development area will cause negative impacts to downstream areas.
Spraying Seeping Water to Green Zone	Health problems of residents are concerned, if underground water is contaminated by seeping water.	Reservoir is suggested to be placed before seeping water treatment process.
Biological Treatment	It is not suitable to stably treat seeping water whose load variance is wide.	
Seasonal Variation of Disposal Volume	It is not considered despite a big variation.	
Discharge of Seeping Water	It is not evaluated, and there is almost no experience in Indonesia.	Experience in Japan is effective. It is included in the implementation plan as a consideration item.

3.4 Development Strategy

Based on evaluation of Pre-FS and results of field surveys, this section suggests the development strategy of the PPP project as the Joint Venture from the viewpoints of technology and finance/management. This study suggests implementation by PPP reflecting request from the Indonesian Government, and structures the project plan considering Japanese technology for improvement of social/environmental condition and financial condition of the Indonesian Government.

3.4.1 Overview

Waste disposal service is essential public service for residents. Therefore, governmental agencies are responsible for providing the service by construction and operation of facilities in many developing countries. As its background, (1) waste disposal service requires a large amount of initial investment for constructing infrastructure, but it is difficult to get stable revenue through steadily receiving service charge from users. And, (2) it is also necessary to facilitate formulation of circulatory society and citizens' participation to waste sorting and 3R activities along with service provision, which is an important role of the public administration. Furthermore, (3) operator takes an important role in mitigating external environmental impacts (bad smell, water contamination, etc.) caused with waste disposal, and it needs adequate skills, knowledge and experiences. For these reasons, the service has been provided mainly by public side.

Considering characteristics of waste disposal site project, it is very risky and difficult that private operator implements such project alone. Meanwhile, public sector needs to spend a big investment as 100 million dollars and costs for operation and maintenance after construction. So, it is also difficult and inefficient for public sector to implement all portion of the project. For this reason, this study suggests to introduce PPP scheme for the project.

The introduction of the PPP scheme will: (1) significantly decrease the initial investment financial burden on the Government of Indonesia (through ODA financing). And, optimization of construction cost and efficient operation can be expected through utilization of technology and management know-how of private sector. In addition, (2) through the application of private sector technology and management know-how, construction costs will be optimized and efficient management will be implemented. Regional waste management activities (such as waste separation and conducting educational activities for 3R) which are difficult for the private sector can be conducted by the public sector through ODA assistance. (3) Furthermore, a traditional scheme where only the management of the facility is delegated to the private sector, the private sector must operate the facility constructed upon public sector specifications. However, the PFI scheme proposed in this study will commission the private sector to design and construct the facility (intermediate treatment facilities) allowing for efficient waste treatment with less environmental impact based on the utilization of private sector knowledge and experience.

Such service-purchase type PFI approach has been successfully applied to waste disposal projects in Japan as well. For example, waste disposal sites are eventually operated in Rubeshibe (since 2001) and Wakkanai (since 2004) in Hokkaido². There are many examples of service-purchase type PFI approach in Japan and these can be improved and applied to Indonesia, though Indonesia does not have experience of PFI to waste disposal projects.

² A number of Indonesian governmental officers are interested in the approach, when the Japan PFI Institute, a member of this Joint Venture, introduced the example in a presentation in Indonesia last year.

3.4.2 Summary of Conditions for Success of the Project

Figure 3-3 illustrates conditions to be considered for realization of the project and the relationship among them.

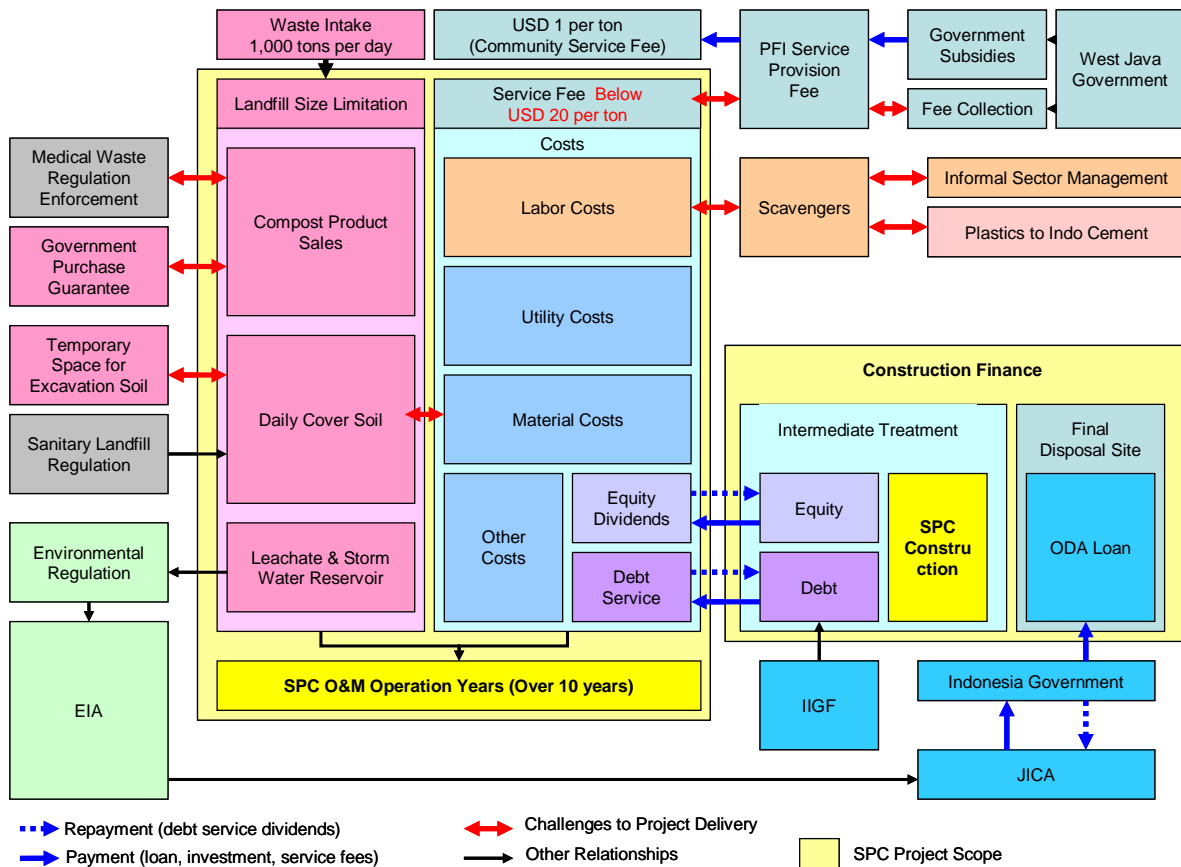


Figure 3-3 Conditions for Success of the Project and Relationship

Figure 3-3 consists of domain A as project scope, domain B as construction finance and the surrounding external conditions.

First, project scope (domain A) in left of the middle represents conditions to accept waste 1,000 ton/day. The biggest constraints are landfill size and revenue. It is necessary to secure adequate area for treatment zone to produce sellable compost, landfill zone to do sanitary land fill and accommodate waste more than 10 years, and reservoir to prevent water contamination and flood for reasonable price within the limited site area. And, it is also important to balance costs for compost production and operation of landfill sites such as labor cost, utility costs, material costs, SPC equity dividends and debt service in the limited revenue.

Secondly, construction finance (domain B) in lower-right of the middle relates to equity dividends and debt in the project scope. Financing plan is necessary to guarantee sustainable operation of SPC with keeping ideal balance between SPC budget and Yen loan.

The Study Team suggested the business plan to satisfy various stakeholders of this project through examination of dozens of combination of project scope and financing plan.

Major external conditions include issues concerning 1) quality of waste and environment, 2) revenue, 3) labor costs, and 4) financing. The left column of domain A shows the issues on

quality of waste and environment such as relevant regulations and guarantee by the Government as requisite conditions for success of the project. This FS does not cover issues on financial capacity of the West Java Provincial Government for expensing service fees and employment of scavengers (making significant social impacts). However, there are also necessary conditions for the project and should be coordinated with the West Java Provincial Government continuously. Financing conditions are shown below domain B. Financing from commercial sources requires guarantee by the Indonesian Government and project formation by Yen loan and which necessitates adherence of environmental regulations. Besides of the listed major conditions, detailed conditions are also examined.

Particular development strategies by conditions, and final proposals for this projects are summarized in the table below. The table also summarizes specific conditions of Legok Nangka and Nambo.

Table 3-8 Conditions, Development Strategies, and Final Proposals of the PPP Project

Items	Conditions and Strategies	Final Proposals
1. Construction finance	<ul style="list-style-type: none"> • Project by PPP is suggested reflecting request from the Indonesian Government. • This project as a whole has low financial profitability and it is difficult to cover all amount of the budget only by private sector. Therefore, it is suggested that the public sector should cover construction of final disposal sites as a lower profit part of the initial investment (financing by Yen loan) and service-purchase type PFI scheme should be applied to the complex waste treatment as a profitable part. • Appropriate balance between public portion (Yen loan) and private portion (private financing by SPC) should be maintained in implementation of PPP projects. 	<ul style="list-style-type: none"> • Proposed as shown in the left column • The life (capacity) of the landfill site and capacity of the leachate treatment facilities are attributed to the balance for public portion and private portion. If the balance were fixed, the capacity becomes smaller. Therefore, consideration of the balance was not prioritized. • Details were explained in the Chapter 12.
2. Revenue	<ul style="list-style-type: none"> • Service-purchase type PFI scheme is suggested for operation of complex waste treatment plants and final disposal sites, and the West Java Provincial Government will pay PFI service provision fees to the private SPC as an operator. • PFI service fees paid by the West Java Provincial Government will be 12 USD per ton of receiving waste following suggestion from the Provincial Government. 1 USD of the fee is allocated as community service fee. • The West Java Provincial Government is responsible for collection of service fee from households and expenses subsidy to fill the gap between collected fees and PFI service fees to SPC. 	<ul style="list-style-type: none"> • The study team explained values of the engineering specifications for applying technologies of Japan, with comparison of specifications of existing landfill sites in Indonesia. The target service fee will be less than 20 USD per ton. • The study team reviewed the proposed specification, technologies and O&M methods in the Interim report, and re-designated. The initial cost and operation cost were also revised. The details for design, specification, and cost revision were summarized in Chapter 5 and 6.
3. Constraint on site area	<ul style="list-style-type: none"> • Efficient utilization of site area in Legok Nangka is a key issue considering the limited area for facilities and gradient of the acquired 74.6Ha land. • Constraint on site area in Nambo is less serious than in Legok Nangka. 85Ha of land will be acquired through swapping procedure between the National Forest Company under the Ministry of Forest and the West Java Provincial Government, though 15 Ha has been acquired so far. 	<ul style="list-style-type: none"> • Justified the amount of the delivered wastes to the landfill by applying handing over of the compost products to WJPG, and reconcile the size of landfill with the site • Details for site layout are shown in Chapter 5 and 6.

Items	Conditions and Strategies	Final Proposals
4. Volume of receiving waste	<ul style="list-style-type: none"> Daily receiving volume will be 1,000 ton in both Legok Nangka and Nambo, considering the current volume and quality of waste, and demand estimation. 	<ul style="list-style-type: none"> Designed as shown in the left column. Confirmed the adequate demand for the site. Details are shown in Chapter 4.
5. Compost products	<ul style="list-style-type: none"> Recycling of waste is expected as compost products (soil conditioner and fertilizer) to be used agricultural lands around Legok Nangka. However, it is noted that commercialization of composts is difficult in the current situation without eliminating harmful substances such as medical waste. Regulation to control medical waste should be introduced. Market of compost products is not established and it is concerned that there is no buyer of the products. System should be designed such as governmental purchasing guarantee. Sufficient time and land are needed to process compost of marketable quality. Compost production area will be compensated by areas for other facilities in the limited area. However, realization of compost products prolongs the life of landfill sites by reducing waste volume carried in. Therefore, this study also considers a scenario to truck over compost products. 	<ul style="list-style-type: none"> WJPG and the study team agreed that the Compost products will be handed over to the WJPG. Details are shown in Chapter 11. A capacity building project for 3R expansion was proposed to strengthen implementation the hazardous or medical wastes regulation. Details are shown in Chapter 11. WJPG and the study team agreed that the quality and process of the Compost products to reduce the size of compost to reconcile with the site area. Details are shown in Chapter 5 and 6.
6. High calorie waste	<ul style="list-style-type: none"> MOU between the West Java Provincial Government and a cement factory around Nambo conditions “product generated in the process of waste treatment” on using the access road. This study considers scenario that the landfill site shall not accept high calorie waste in 1,000 ton of waste carried into the site per day. 	<ul style="list-style-type: none"> WJPG and PT Indocement has not finalized their discussion, therefore, the waste with high calories shall be sold to the recycle market, and the sales was accounted as revenue of the SPC. Details are shown in the Chapter 11.
7. Scavenger	<ul style="list-style-type: none"> There exist scavengers (waste pickers) collecting high calorie waste for their lives at final disposal sites and relay points. Social consideration for scavengers is emphasized in Indonesia. This study regards consideration for scavengers as a sensitive issue in respect that their livelihoods might be affected by transferring high calorie waste to the cement factory. Considering these points, this study considers employment of scavengers in waste sorting facilities. This study does not focus on informal sector management of waste including the scavenger issue, and suggests consideration of the issue in a technical cooperation project. 	<ul style="list-style-type: none"> The study team proposed WJPG to enhance employment of the Scavenger. On the other hand, some of local residents were against to the employment of scavengers; therefore the study team proposed a prioritized employment scheme to the residents. The proposed 3R capacity building project includes the scope for informal sector management. Details are shown in Chapter 11.
8. Environmental standard	<ul style="list-style-type: none"> It is an important issue whether this project complies with the environmental standards of the Indonesian and West Java Provincial Governments as a condition of category A Yen loan project. In particular, this study examines the effluent standard of treated seeping water and requirement of rain water (flood) reservoirs. However, these factors greatly affect usage of the limited land (especially in Legok Nangka) and project costs, so careful consideration is needed. 	<ul style="list-style-type: none"> The study team carefully coordinated and studied the necessary qualification for the discharging treated water. The study team proposed to discharge the treated water to rivers with adequate amount of flow. (see Chapter 7) The revision of the FDS size resulted to provide necessary size of area for the leachete treatment facility.

Items	Conditions and Strategies	Final Proposals
9. Project duration	<ul style="list-style-type: none"> The project duration shall be around 15 years with satisfying items 1-8 above. 	<ul style="list-style-type: none"> The project life comes 14.2 years for the LN site, and 16.7 years for the Nambo site.
10. Governmental guarantee for private investment	<ul style="list-style-type: none"> Considering items 1-9 above, private investors will regard this project risky and difficult even as a PPP project without a certain kind of governmental guarantee. Accordingly, this study suggests to provision of necessary governmental guarantees to reduce external risks for private investors. Risk analysis will be shown in DFR. 	<ul style="list-style-type: none"> Considered governmental guarantee services by IIGF, and checked its accessibility. Details are shown in Chapter 12 Conducted risk analysis, which is shown in Chapter 10.
11. Maintenance and financial plan	<ul style="list-style-type: none"> Financial plan is formulated through estimation of development costs required for the facility plan and maintenance costs. Requirements in Japan are applied to estimation of facilities using technology which is uncommon in Indonesia. 	<ul style="list-style-type: none"> Proposed as shown in the left column Revised maintenance specification if such requirement in Japan cause serious over payment; and prepared adequate O&M scheme. Details are shown in Chapter 12
12. Combination of other assistances	<ul style="list-style-type: none"> External conditions and considerations are addressed by combination of multi-layered assistance menus of JICA including development study, technical cooperation project, grassroots grant, etc. 	<ul style="list-style-type: none"> Proposed capacity building projects to enhance 3R, hazardous waste control, etc, which are related to this PPP project.

3.5 Strategy for Business Opportunity Development

3.5.1 Advantage in the Proposed Technologies

The corporate members of this study are leaders in the field of waste treatment technologies, have superior reputation, and have a track record.

As aforementioned, the waste management sector in Indonesia has bottlenecks in terms of i) adequate waste treatment and disposal technologies, and ii) sustainable environmental protection, such issues were raised as medium-term National Development Plan. The Japanese technology in this sector, the waste treatment process according to the intermediate processing (composting, gasification, and utilization as an energy source) has reached the leading level in the world.

As for the landfill construction and operation, the members has knowledge and experience in the proper storage of waste, qualified compost production, design and materials to sanitize waste (semi-aerobic landfill system known as “Fukuoka Method”, qualified waterproof sheet, interruption diagnostic system).

Combination of both technologies for the intermediate processing landfill can mitigate the environmental impact in and around the disposal site, it is possible to maintain sustainable environmental protection.

3.5.2 Advantage in Japan ODA Loan Scheme

This study will integrate the official Yen loan (public) and private companies’ investment, and promote the technology to the emerging market in developing countries. On preparing the implementation plan and the procurement plan, measures should be proposed and materialized to encourage investment and participation of private companies. Specifically,

i) Proposing a procurement package integrating “Construction and O&M”, which are significant characteristics of the PPP project

- ii) Utilize the Yen-loan procurement guideline, which can enhance participation of companies from Japan.

Details are explained and illustrated in Chapter 12.

After the integration of JICA and JBIC in 2009, JICA can materialize Yen-loan projects with multi-layered assistance, including TA and grass-root assistances, which is unique among bi-lateral development partner agencies. To enhance this JICA advantage in this project, the study team proposed in the chapter 11, and considered the following;

- i) Tender assistance (tender document preparation) can be covered
- ii) JICA technical cooperation project can be applied to supportive components, including 3R Promotion in West Java Province, Capacity building for waste management sectors in the West Java Government, informal sector management including issues of Scavengers, etc,

It should be noted that multi-layered approaches were applied in this study. First, the study team provided opportunities of technology transfer to the participants of JICA training course for “Capacity building courses for local governments administration staffs in Indonesia”, invited and held in JICA Tokyo Center in February 2011. The study team made a presentation for waste management experiences in Japan and its advantage in technology and operation.

Secondly, during the study period, the study team provided opportunities of technology transfer to the counterpart organization (KIMRUM).

4. Waste Generation Forecast and Material Balance Analysis

4.1 Waste Generation Forecast

The amount of transported waste (waste amount at the enter of the landfill site) is estimated with the result of existing FS, data of BPS and hearing results of BPSR and each city and regency. After the completion of waste quantity and quality analysis, this estimation will be revised.

(1) Methodology

The amount of transported waste was estimated with the data shown in Table 4-1. Target areas for Legok Nangka Landfill are 6 areas; Bandung City, Cimahi City, West Bandung Regency, Bandung Regency, Sumedang Regency and Garut Regency. Target areas for Nambo Landfill are 3 areas; Bogor Regency, Bogor City and Depok City. At first, total population and the unit amount of transported waste (the amount of transported waste per person per day) in each area were calculated by the trend estimation method. The amount of transported waste in each area was estimated with these calculated population and the unit amount of transported waste. This estimation method is the most popular method in Japan. Among the statistic data of the amount of transported wastes by 2010 provided by the Provincial, City and Regency Government, some volume values were calculated with the specific gravity 0.3 t/m^3 , which is calculated by the result of waste quantity and quality analysis. Only the statistic data from West Bandung Regency, Bandung Regency and Sumedang Regency were not enough for estimation, so the unit amount of transported waste of Garut Regency was applied for these areas.

Table 4-1 Data for Estimation and Method

	Item		Data and Estimation Method
Statistical Data	(1)	Total population	Data from the hearing survey and statistics from Center Statistic Beaureau of West Java, 2010
	(2)	Population for service	Data from the hearing survey and the existing FS
	(3)	Amount of transported waste (waste for the disposal site)	Data from the hearing survey
	(4)	Unit amount of transported waste (per person per day)	(3)/(2)
Estimation Data	(5)	Estimation of total population	Trend estimation with (1)
	(6)	Estimation of population for service	(5)×(2)/(1)
	(7)	Estimation of unit amount of transported waste (per person per day)	Trend estimation with (4)
	(8)	Estimation amount of transported waste (waste for the disposal site)	(6)×(7)
	(9)	Estimation of total amount of transported waste	$\Sigma(8)$

(2) Estimation Results

From the hearing survey with BPSR and target areas, the total amount of transported waste from 6 target areas in 2010 was 1,377 t/day. The estimated daily amount transported to Legok Nangka Landill is shown in the following Figure. The amount will be 1,778 t/day by 2030. In the existing FS report, the amount (excluding the estimated recycled amount) in 2030 was estimated as 1,837 t/day excluding the waste from Cimahi City.

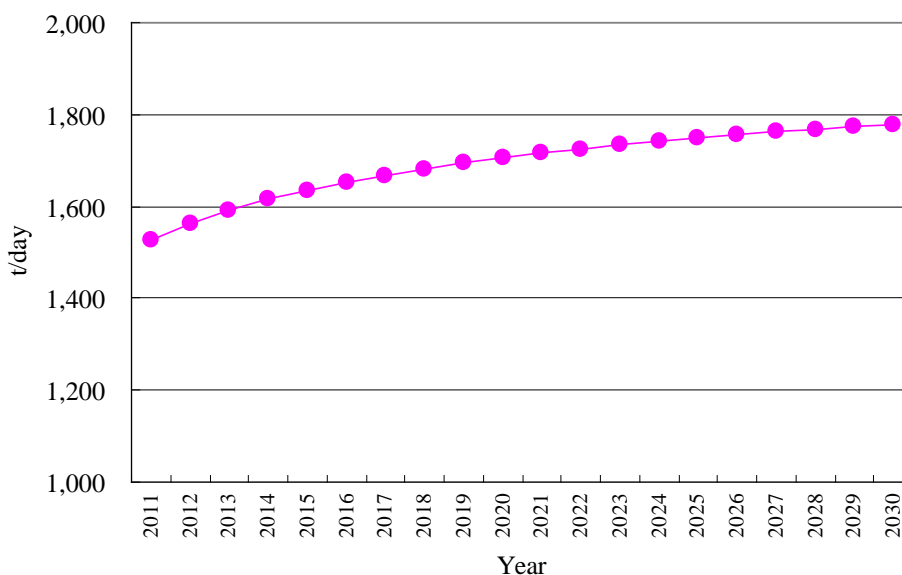


Figure 4-1 Estimated Daily Amount Transported to Legok Nangka Landfill (Sum of 6 Target Areas)

From the hearing survey with BPSR and target areas, the total amount of transported waste from 3 target areas in 2010 was 976 t/day. The estimated daily amount transported to Nambo Landfill is shown in the following Figure. The amount will be 1,175t/day by 2030. In the existing FS report, the amount in 2030 was estimated as 3,893 t/day.

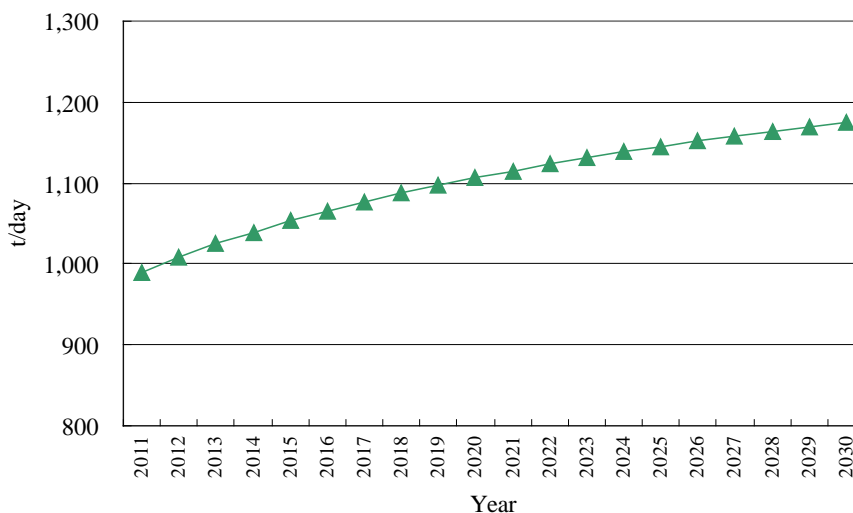


Figure 4-2 Estimated Daily Amount Transported to Nambo Landfill (Sum of 3 Target Areas)

(3) Fluctuation Possibility

The amount of transported waste can be easily changed by the population, economic growth, introduction of 3R and other waste policies, and change or renewal of waste management policies (collection, transportation and disposal) by Provincial, City and Regency Governments. As a result of discussion with related organizations and analysis of data, there are not any

policies which are realized in the near future and will affect the estimation¹. Therefore, the expected amount of the waste in the region is adequate to the planned capacity of the FDS.²

4.2 Waste Quality and Material Balance

(1) Survey Purpose

In order to design and construct the intermediate treatment facility, it is necessary to design the system based on the actual local waste qualities and properties. In order to base the design criteria of the project based on up-to-date information on waste composition, a waste sampling survey was sub-contracted to the Laboratory of Solid and Hazardous Wastes, Civil and Environmental Engineering of the Institute Technology Bandung (ITB).

Data samples were collected randomly, and due to the fact that the data is based on only a few samples, outliers may cause irregularities in the waste composition analysis. However, the analysis data shows waste composition ratio of the whole target region. Furthermore, the Pre-Feasibility report develops its facilities design concepts based on a waste composition analysis which utilizes secondary data from the master plan and other researches.

(2) Waste Composition Analysis TOR

The survey was conducted based on the below mentioned Terms of Reference (TOR).

TOR 1: Analysis and summary of the existing data of waste characteristics related to Legok Nangka FDS and Nambo FDS

TOR 2: Identification of sources and areas of waste generation (i.e. domestic, market, commercial facilities, industrial waste) for Legok Nangka FDS and Nambo FDS (Sarimukti for Legok Nangka; at Gluga (Bogor), and at Cipayung (Depok) for Nambo), furthermore confirm whether wastes other than urban wastes are included)

TOR 3: Conduct waste sampling at the above mentioned existing disposal sites

TOR 4: Analysis of waste density (weight per quantity of waste) for Legok Nangka FDS and Nambo FDS based on the above mentioned samples

TOR 5: Analysis of physical composition of waste for Legok Nangka FDS and Nambo FDS. Group wastes based on macro waste composition of the target region (organic, recycle, non-recycle, etc) and calculate the waste composition density of each group

TOR 6: Analysis of flammability/fermentation of waste for Legok Nangka FDS and Nambo FDS

TOR 7: Analysis of harmful contents of waste for Legok Nangka FDS and Nambo FDS

¹ The Waste Management Policy and Strategy by PU (2006), explained in Chapter 3, proposed to reduce the waste up to 20% in Indonesia by 2010, however, the Ministry of Public Works (PU) reviewed its low achievement and evaluated the target was too high. ITB proposed a scenario including 20% reduction of waste by 2030 for this fluctuation possibility, however, its possibility of implementation is still unclear. The SPC needs to monitor the demand in future, however, it can be estimated that the necessary amount of waste to the project sites would not fail short to the provided capacity if the ITB scenario were implemented because i) the waste management could be implemented gradually by 2030, and the expected amount in 2030 under full scale scenario will not give major impact.

² The expected waste amount per day for this project is designated as 1000 t/d for both FDS, which the WJPG agreed to this amount. The WJPG will utilize the existing FDS sites with proper improvement (see Table 3-3) for exceeding amount.

(3) Survey Structure

The waste sampling survey will be conducted by ITB, however the study team will determine the particular survey items, confirm the survey conditions and deliverables in order to maintain quality control.

(4) Survey TOR

1. TOR1

(Survey Purpose)

Waste composition may differ based on region, seasonal changes, and changes in living conditions, hence is difficult to draw a conclusion from sample surveys conducted in a short period of time. Therefore, it is important to confirm the validity of the sample surveys through the collection and analysis of collected existing data.

(Survey Overview)

Collect and analyze comparable relevant information on waste composition by reviewing existing literature including the existing master plan, the feasibility studies for Legok Nangka and Nambo, as well as other studies conducted by ITB.

2. TOR2

(Survey Purpose)

The project proposes to collect waste from the target six cities and regencies for Legok Nangka, and three cities and regencies for Nambo; however as the target waste collection area covers a vast region, furthermore, as the waste reception management structure is unclear, it is essential to identify the waste source (household, market, commercial, industry) and confirm whether industrial wastes as well as wastes other than urban wastes will be included.

(Survey Overview)

Confirm the waste transport vehicles (entrance time, number plate, type of vehicle, possible load volume) at the identified existing final disposal sites, and obtain information on the source (region and waste source).

3. TOR3

(Survey Purpose)

Collect a random sample of wastes at the above mentioned final disposal sites which will be used for the analysis described in TOR 4, 5, and 6.

(Survey Overview)

Collect an appropriate amount of waste from randomly chosen incoming waste vehicles at the final disposal sites mentioned above. First, differentiate the collected waste samples into groups using a 50 mm screen and conduct measurements for each group. For wastes differentiation under 50 mm conduct the same procedure using a 10 mm screen in order to group and measure the wastes. Finally measure the wastes under 10 mm.

4. TOR4

(Survey Purpose)

Clarify the weight per volume (density) of the intake waste in order to allow for the review the size capacity of the intermediate treatment facility and final disposal site.

(Survey Overview)

Collect an appropriate amount of waste from randomly chosen incoming waste vehicles at the final disposal sites mentioned above and measure the density.

5. TOR5

(Survey Purpose)

When developing the design criteria of the intermediate treatment facility, it is essential to design concept based on the actual waste qualities of the target region. Currently, there is a system to collect organic wastes prior to waste transport into the final disposal sites, resulting in a difference between the wastes at waste source and waste transported to the final disposal sites. Thus, it is important to conduct a waste composition analysis of the wastes transported into the final disposal sites.

(Survey Overview)

Collect an appropriate amount of waste from randomly chosen incoming waste vehicles at the final disposal sites mentioned above and waste type (organic, grass/leaves, plastic, metal, rubber, and clothing/textile). Ultimately, classify the wastes into categories based on waste composition.

6. TOR6

(Survey Purpose)

A flammability and fermentation analysis will be conducted.

(Survey Overview)

A laboratory analysis for flammability and fermentation (i.e. moisture content, volatile content (VS), ash content, calorific value, elemental composition of combustible contents (C, H, O, N, S, Cl)) will be conducted for the collected samples.

7. TOR7

(Survey Purpose)

In order to consider the possibility of waste-reuse for compost, it is important to assess the hazardous properties of the wastes. Identify the hazardous properties of the intake waste based on the results from the waste composition analysis.

(Survey Overview)

Based on the grouping of the samples collected in TOR 5, identify wastes inclusive of hazardous materials such as batteries and light bulbs through visual inspection. Compare the ratio by weight of hazardous wastes to entire wastes in order to identify the potential of hazardous waste intake.

(5) Waste Composition Analysis Results

Legok Nangka

Physical characteristics

Physical characteristics of waste are indicated in Table 4-2.

The sampling was conducted taking House hold Waste (3 sample) and Market Waste (2 samples). The data has been weighted averaged.

The hazardous wastes are supposed not to be received into this facility. However Table 4-2 includes hazardous wastes based on the data from ITB. If perchance the hazardous wastes are received, they will be separated, stored temporarily and then brought out and processed in an external organization.

Table 4-2 Physical characteristics of waste (Legok Nangka)

Classification	Composition	Rate (%)
Organic	Organic + Leaves/Garden	47.2
	Residues (supposed to be organic)	9.7
Plastic	Recyclable plastic	12.1
	Non recyclable plastic	5.9
Paper	Paper	10.6
Metal	Metal	0.2
Hazardous Wastes	Hazardous Waste	0.1
Others	Mineral	0.9
	Textile	7.4
	Rubber	0.5
	Disposal Nappies	5.0
	Composites	0.0
	Others	0.5
Total		100

Chemical Characteristics

Chemical characteristics of waste are indicated hereunder as Table 4-3.

Table 4-3 Chemical Characteristics of Wastes (Legok Nangka)

Items	Moisture Content (%)	Ash content (%)	Ultimate Analysis						High Calorific Value (cal/gr) db
			C (%)	H (%)	N (%)	O %	S %	Cl %	
Kitchen refuse	72.0	2.3	29.1	10.5	1.8	54.6	1.2	0.6	3,708
Leaves/Garden	69.9	4.7	26.9	9.5	1.8	56.6	0.2	0.2	3,879
Papers	53.6	5.1	33.8	3.1	1.9	55.5	0.2	0.4	3,988
Plastics	30.7	9.8	45.5	4.0	1.9	38.2	0.2	0.4	8,205
Rubbers	10.0	26.3	55.0	2.0	2.1	13.9	0.6	0.2	5,513
Textiles	42.5	4.4	44.7	4.4	2.0	43.4	0.8	0.3	5,560
Others	14.8	4.5	42.4	3.6	2.0	44.7	0.9	0.8	4,970

Source of the Waste

Source of waste are indicated hereunder as Table 4-4.

Table 4-4 Source of Wastes (Legok Nangka)

Source	Volume (m ³)/Day	% of Total
Household	944	40.6
Temporary Disposal Site	642	27.6
Hotel	0	0.0
Office	39	1.7
Hospital	10	0.4
Market	286	12.3
School	0	0.0
Shop	34	1.4
Car/Bus Station	5	0.2
Street	367	15.8
TOTAL	2,325	100.0

Nambo

Physical characteristics

Physical characteristics of waste are indicated in Table 4-5.

The sampling was conducted taking House hold Waste (3 sample) and Market Waste (2 samples). The data has been weighted averaged.

The hazardous wastes are supposed not to be received into this facility. However Table 4-5 includes hazardous wastes based on the data from ITB. If perchance the hazardous wastes are received, they will be separated, stored temporarily and then brought out and processed in an external organization.

Table 4-5 Physical Characteristics of Waste (Nambo)

Classification	Composition	Rate (%)
Organic	Organic + Leaves/Garden	51.6
	Residues (supposed to be organic)	8.7
Plastic	Recyclable plastic	12.3
	Non recyclable plastic over 50mm	4.4
Paper	Paper	9.8
Metal	Metal	0.2
Hazardous Wastes	Hazardous Waste	0.1
Others	Mineral	1.2
	Textile	3.8
	Rubber	0.5
	Disposal Nappies	6.6
	Composites	0.0
	Others	0.6
Total		100

Chemical Characteristics

Chemical characteristics of waste are indicated hereunder as Table 4-6.

Table 4-6 Chemical Characteristics of Wastes (Nambo)

Items	Moisture Content (%)	Ash content (%)	Ultimate Analysis						High Calorific Value (cal/gr) db
			C (%)	H (%)	N (%)	O %	S %	Cl %	
Kitchen refuse	70.9	6.9	31.6	9.6	1.7	49.0	0.6	0.6	3,674
Leaves/Garden	66.3	7.5	31.3	7.9	1.7	50.7	0.3	0.4	3,667
Papers	56.4	12.3	25.7	3.8	1.8	55.4	0.3	0.6	4,328
Plastics	40.6	8.5	39.7	1.6	1.9	47.3	0.3	0.6	7,044
Rubbers	16.1	20.8	49.7	2.3	2.0	22.2	0.4	0.3	5,418
Textiles	54.2	5.8	33.4	3.1	1.9	55.3	0.4	0.2	5,133
Others	37.4	15.5	35.4	1.7	1.9	41.9	0.6	0.3	4,641

Source of the Waste

Source of waste are indicated hereunder as Table 4-7.

Table 4-7 Source of Wastes (Nambo)

Source	Volume (m ³)/Day	% of Total
Household	454	35.9
Temporary Disposal Site	213	16.9
Hotel	11	0.9
Office	30	2.3
Hospital	11	0.9
Market	184	14.6
School	29	2.3
Shop	68	5.4
Car/Bus Station	12	1.0
Street	254	20.1
TOTAL	1,266	100.0