

CHAPTER 2 MAJOR PROBLEMS AND ISSUES ON SOLID WASTE MANAGEMENT

2.1 CURRENT PROBLEMS ON SOLID WASTE MANAGEMENT

(1) Lattakia City

A solid waste collection service is provided for the major part of Lattakia city and main streets are kept clean by the Cleansing Department. But solid waste collection in low-income areas located in the suburbs of the city is very poor and unsanitary. About 200 tons of waste, which is equivalent to about 70% of total generated waste, is collected daily, and this is transported to Al-Bassa disposal site. According to results of the citizen awareness survey, 68% of citizens receive collection services, but only 42% are satisfied with the services they receive.

Al-Bassa disposal site is located along the seashore and covers an area of approximately 90 ha. The site is on the coast south of Lattakia City and is visible from the city. Solid waste is dumped without application of any earth covering. Scattering of waste and illegal dumping around the disposal site have widely polluted a large area of surrounding agricultural land.

The site is on the coast south of Lattakia City and visible from the city. Such a large open dumping site is damaging to potential tourism. The old compost plant has been closed because it was seldom operated and produces very bad compost.

The Cleansing Department of Lattakia City possesses 612 personnel who carry out street sweeping, waste collection and collection and disposal of construction waste. Waste collection vehicles and drivers belong to the Vehicle Section. The Compost Plant Section has 32 workers responsible for plant operation and management (operations are currently suspended). 18% of the municipal budget is allocated to these cleansing utility activities.

(2) Jableh City

The Cleansing Department of Jableh city carries out waste collection and street sweeping in the important areas and main roads of the city, and thus the central area is kept in clean condition. However, waste collection services in low-income districts and outlying areas are insufficient and unhygienic. Only 60% of generated waste is collected and the collected waste is dumped in a coastal disposal site. According to the findings of the citizen awareness survey, 60% of citizens receive waste collection services, but only 32% are satisfied.

The disposal site in Jableh City is located on the coast in the south of the city and covers an area of approximately 4 ha. Waste here is open dumped and there is no earth covering at all. Since this site is located close to residential areas, there is an endless stream of complaints from citizens.

(3) Qurdaha City

Qurdaha city has three compactor vehicles and one mechanical sweeper, and waste collection is carried out over almost all of the city (92%). However, the level of citizen satisfaction is just 62%. Collected waste is transported to Al-Bassa for disposal.

(4) Al-Haffeh City

Waste collection is carried out over almost the whole city (88%) by two tractors. However, the level of citizen satisfaction is just 33%. Al-Haffeh city has a regulation for discharging waste before 7:00 AM using plastic bags, but there are no containers. This is one of the reasons for the low level of citizen satisfaction. Solid waste collected in the city is transported to a quarry nearby and open dumped.

(5) Medical Waste

There is a Lattakia Governorate decree on medical waste. Medical waste is transported to the national hospitals in Lattakia for incineration. Accordingly, Lattakia City Cleansing Department collects and transports medical waste in a separate system. However, medical waste is collected and open dumped in the municipal disposal site together with ordinary waste in Jableh because of the shortage of collection equipment.

(6) Construction Waste

Construction waste can be found illegally dumped all over the urban area. In order to maintain the sanitary environment of the city, it is necessary to manage the disposal of construction waste materials.

2.2 MAJOR SOLID WASTE MANAGEMENT ISSUES

Solid waste that is generated as a result of daily life and industrial activities of human beings not only leads to issues on sanitation but also causes environmental pollution. Therefore, in urban areas of concentrated population, it is extremely necessary to remove solid waste immediately, and then treat it appropriately as well as to keep public sanitation and the living environment of urban areas clean by conducting public cleansing services.

In the central parts and on main roads of Lattakia City and the surrounding three cities, waste collection and street sweeping services are more or less satisfactory. In outlying areas, on the other hand, waste collection services are inadequate and this has led to several issues and problems on sanitation and living environment as well as a lot of discontent among citizens. In addition, collected solid waste is open dumped as it is at the final disposal sites without undergoing any intermediate treatment. A compost plant was constructed 20 years ago, however, the plant has not been in operation recently due to bad quality of compost and deterioration of facilities. The final disposal sites are in very poor condition and cause widespread environmental pollution in surrounding areas because they do not carry out earth covering and are subject to spontaneous combustion. In these conditions, waste-pickers collect valuable waste materials and sheep eat food waste. Additionally, due to the advancing deterioration of collection vehicles and equipment, it will become more and more difficult to

maintain collection services even at existing levels. More and more requests from citizens for improving urban environment have increased, and dissatisfaction with and complaints against public services in the area of solid waste management have increased greatly.

Lattakia City and the surrounding three cities assign a lot of staff in solid waste management and allocate approximately 20% of their budgets to this utility, however, as was mentioned above, this is only enough to pay for street sweeping and waste collection in central areas, and the municipalities cannot afford to purchase necessary vehicles and equipment to expand solid waste management and to improve the final disposal sites and renew superannuated equipment. Therefore, it is necessary for Lattakia City and the surrounding three cities to take drastic measures to improve their solid waste management including systems and finances.

It is required in the future to create a society that can reduce consumption of natural resources and the burden on environment as much as possible. In order to attain such a society, the principle of solid waste management has to be based on reducing quantities of solid waste, recycling solid waste as resources as much as possible and treating only non-reusable and recyclable solid waste appropriately. It is necessary for the citizens to keep their city clean first and to not dispose solid waste anywhere illegally in accordance with municipal guidance on solid waste management. In order to get citizens' cooperation, it is important for the municipalities to not only heighten public awareness on environment and solid waste management through as many chances as possible, but also create opportunities for community beautifying and cleaning activities and promote positive citizen participation in such opportunities.

For sound solid waste management, generally, it is pointed out that introduction of the following systems is necessary: 1) to reduce waste generation (generation reduction), 2) to reuse goods and parts that cannot be reduced (reuse), 3) to recycle waste which cannot be reused as resources, which is not reusable (recycling), 4) to generate energy from waste that is not reusable and not recyclable (heat recovery), and 5) to appropriately dispose of waste that is not reusable, not recyclable and not heat recoverable (appropriate disposal)

Accordingly, it is necessary to share the cost of solid waste management based on taking appropriate share of responsibility of the central government, local governments, industries and citizens. The central government and local governments have to formulate a policy on solid waste management and enforce the policy in a planned manner. At the same time, industries have to conduct management of solid waste generated by their industrial activities, and this includes generation reduction, reuse, recycling, heat recovery and suitable disposal. Moreover, it is necessary for the citizens to cooperate with these solid waste management activities by the central government and local governments.

The quantity of solid waste generated per capita in Lattakia City and the surrounding three cities is not large at present. Also, the proportion of kitchen waste is very high in the composition of the waste of those cities. Accordingly, it is appropriate to limit the overall amount of generated waste by introducing a cost bearing system that is based on waste discharge quantities.

Because the solid waste of Lattakia City and the surrounding three cities contains a lot of kitchen waste, it is very important to promote recycling of organic waste. Also, it is important to promote recycling of valuable materials such as paper, plastics, metals and glass. In the present circumstances where working opportunities are not sufficiently provided to skilled workers, it is considered realistic to promote waste recycling in cooperation with waste-pickers. Meanwhile, in the long term, it will be necessary to move away from recovery of valuable materials at disposal sites and more towards the separation of such materials at generation sources by means of systematic collection.

As for final treatment, it is necessary to introduce sanitary landfilling. In order to implement this, it is necessary to provide gas removal systems, leachate collection facilities, and landfill equipment including bulldozers and other machinery. Small-scale sanitary landfill sites are not realistic from the viewpoints of management and cost. Therefore, Lattakia City and the surrounding three cities shall jointly construct a large-scale sanitary landfill site in one place. The present dumping site at Al-Bassa is located on the coast, but this will need to be moved because construction of a coastal road is planned here. Thus, construction of a new final disposal site is required and selection of the site for this is a major issue.

It is necessary to have a consensus among persons concerned for the selection of the candidate site for the landfill. In order to get such a consensus, the following principles shall be employed: 1) keep transparency in the procedure, 2) have participation of people concerned in the procedure, 3) fulfill the public responsibility of explanation.

However, it will be difficult for the authorities to obtain such a consensus because citizens living around disposal sites are filled with discontent over the fact that, apart from the case of Damascus, environmental conditions around sites are appalling because solid waste is currently open dumped without undergoing any intermediate treatment, spontaneous combustion occurs at dump sites, and humans and animals scavenge for valuable waste. In order to improve this negative situation, it is essential to eradicate the poor image of final disposal sites by upgrading the present open dumping sites to controlled landfill sites or sanitary landfill sites. It must be considered that the pilot study of improving Al-Bassa disposal site has eradicated the poor image of the site, and has greatly contributed to recovering trust of the public and forming consensus in the selection process for the new disposal site.

CHAPTER 3 POLICY AND TARGET OF THE MASTER PLAN

3.1 BASIC POLICY OF THE MASTER PLAN

The future final disposal site of Lattakia City and the surrounding three cities has been decided as Qasia located some 18 km east of Lattakia. The necessary procedure for the procurement and construction of the site is set to proceed in due course.

A suitable collection system and public cleansing service are required to maintain a comfortable living environment in urban areas. In addition, appropriate treatment systems and environment protection measures have to be employed to prevent environmental pollution around solid waste treatment facilities and final disposal sites. Moreover, it is important, that such facilities and systems be operated and managed in the appropriate manner.

The minimum-cost method is employed to select appropriate technology on solid waste management. While it is necessary to respond to citizens' demands on solid waste treatment services, it is difficult to predict quantitatively the economic and social benefit. Therefore, it is necessary that appropriate alternative plans be selected among several proposed plans taking account of social and financial factors.

In order to sustain the technology systems, sound institutions and organizations must be established. It is necessary to consider participation by the private sector in solid waste management as at the transfer station in Damascus City in order to create efficient systems. As for the leading facilities, the necessity of inter-municipal management and Governorate participation in the solid waste management shall be considered. Therefore, it is also necessary to consider system contents for inter-municipal management and Governorate participation.

Establishment of a stable financial base is required in order to support the operation and maintenance of technology systems. It is essential for the plan to secure financial resources for the operation of future systems. Therefore, it is necessary to introduce the polluter pays principle (PPP) (burden borne by beneficiaries) to finance solid waste management, while service fees must be adjusted so that costs are covered. It is possible to introduce PPP within the present legal framework. In addition, the cost of solid waste management shall be cleared and the financial systems of the municipalities shall be improved to identify the service cost by each cleansing authority.

The residents are not only waste generators but also beneficiaries of the service. It is extremely important to obtain the cooperation of citizens in order to achieve efficient solid waste management. Cleansing department personnel have more opportunities for coming into contact with citizens than other municipal workers. Accordingly, creation of the mutual trust between citizens and the waste workers is essential. Provision of reliable services will encourage cooperation by citizens and lead to the success of sound solid waste management. Especially, cooperation by citizens concerning waste separation at the source is indispensable.

Figure 3.1.1 shows the basic policy in parallel with the master plan for Homs prepared by METAP-EIB study.

Table 3.1.1 Basic Direction

Items	Lattakia and surrounding city	Homs City (METAP Study)
Study Area	Lattakia, Jableh, Al-Haffeh, Qurdaha	Homs city
Final disposal site	Al-bassa (medium term use) Qasia (future disposal site)	Maghlia (26 km from city center)
Transfer station	Jableh, Qurdaha	Al-Bweir
Composting	Composting is recommended together with separate collection of domestic waste	Composting is recommended together with introduction of separate collection for domestic waste
Recycling	Composting Sorting center	Demolition waste Composting Sorting center
Final disposal	Sanitary landfill	Sanitary landfill
Medical waste	Governorate level management	
Alternatives (Scenario)	Alt-1 Sanitary landfill and collection improvement Alt-2 Sanitary landfill, collection improvement and transfer station Alt-3 Sanitary landfill, collection improvement, source separation and recycling (composting and sorting) Alt-4 Sanitary landfill, collection improvement, transfer station source separation and recycling (composting and sorting)	a. Minimum fulfillment b. Promotion of recycling and special block for hazardous waste c. Promotion of recycling and incineration of hazardous waste
Recommended alternative	Alt-4	Promotion of recycling and special landfill block for hazardous waste
Priority project	1. Collection improvement 2. Introduction of separate collection 3. rehabilitation of Al-Bassa disposal site 4. Introduction of Recycling Center (Rehabilitation of Compost Plant and Construction of Sorting Center)	Improvement of collection and transportation Sanitary Landfill Pilot project for others
Organization and institution	New organization for solid waste management to manage major facilities in inter-municipal cooperation	Reform of Cleansing Department
Financial	Impose the “user pays” principle Reform budgeting system for SWM.	Revise service charge to achieve cost recovery
Resident cooperation	Community participation	
Hazardous waste	National level management	
Industrial waste	Small scale industry waste will be collected (excluding hazardous waste)	

3.2 TARGET OF THE MASTER PLAN

In Lattakia, waste collection and street sweeping have been implemented with the goal of sustaining a “clean and beautiful city”. However, due to lack of a clear purpose in the solid waste management, the necessary equipment has become too old for work, collected waste is open dumped at disposal sites, and illegal dumping can be seen all over the place. This situation is a serious issue and citizens understand that drastic improvements need to be made.

To keep the city clean and beautiful, the cleansing service has to be a reasonable system and be accepted by the population. The service cost has to be shared appropriately by the polluters including the citizens since they also generate waste. It is necessary for citizens to understand this and to pay their share of the cost burden.

There are various opinions on how to build rational solid waste management systems. Common understanding more or less exists concerning the need to aim for a society that generates as small an environmental load as possible. For this reason, it is necessary to minimize waste discharge quantities and advance reuse and recycling. However, because the benefits of these activities are widely dispersed, recovery within the framework of solid waste management alone is difficult and costs increase as a result. Even so, it is necessary to build the system while aiming to achieve a society that has low environmental load. Moreover, stable sources of finance must be secured for solid waste management. Only when sound finances are secured does it become possible to build a system that is favorably viewed by citizens and maintain a clean and beautiful urban environment.

The objective of solid waste management is to limit generation of solid waste, remove generated solid waste from the urban area in an efficient and economic manner, promote recycling, mitigate environmental load, carry out sanitary treatment and disposal, and as a result preserve the urban living environment. With this objective in mind, the Master Plan aims to build a sustainable and appropriate solid waste management system.

- a. Target year 2010
- b. Master Plan Targets

Establishment of a sustainable and appropriate solid waste management system:

- Provision of waste collection services in urban areas
- Construction and procurement of necessary facilities and equipment
- Promotion of recycling
- Introduction of sanitary landfilling
- Establishment of an inter-municipal treatment and disposal system
- Rehabilitation of existing disposal sites
- Construction of financial base

CHAPTER 4 SOCIO-ECONOMIC FRAMEWORK OF THE MASTER PLAN

4.1 POPULATION PROJECTIONS

Population projection is one of major socioeconomic indices for formulation of plans, and the projection for year 2010, which is target year of the master plan on this study, was examined taking into consideration of Census¹ information and Civil Records². In addition to this, tourist flows in subject areas were also explained as seasonal migration to those areas.

(1) Conditions of the Projection

1) Base Information

There are two kinds of available information on population in the Study area. One is Census and the other one is Civil Records. Last Census was carried out in 1994 and it is expected to carry out next Census soon. The Census subjects to residents in certain area such as administrative boundary including citizens and non-citizens. While the Civil Records is taking in account of Citizens only. Those two were considered as base information in order to estimate future population.

2) Growth Rate

The Central Bureau of Statistics (CBS) has estimated future population from year 1995 to 2005 based on the last Census carried out in 1994. According to estimation results, the annual average growth rate was 2.24% on the period and the annual growth rate in each year seems to be flat, which is 2.25-2.3%. Only year 1994-1995 has different growth rate, which is 1.89%. In addition, there is same growth rate applied for other municipalities as well as that of Lattakia Municipality.

Moreover according to the annual Civil Records obtained from Civil Affair Department of Lattakia Governorate, the average population growth rate of 1980s and 1990s were 3.62% and 2.51% respectively. In reference to the last Census, annual average growth rate of year 1994-2000 was 2.69%. In this regard, population growth rate is decreasing recently.

3) Conditions of the Projection

Taking in consideration of population numbers by the Census results in 1994 and the recent actual growth rate from Civil Records, which are year 1994-2000, an annual average growth rate, 2.69%, was applied for these projections throughout the year 2010. It is assumed that this rate is maximum growth rate for the first decade of this century.

¹ The Central Bureau of Statistics is a governmental organization, which has an authority to carry out Census. The Census subjects for residents in certain administrative border including citizens and non-citizens.

² Civil Affair Department of Ministry of Interior has an authority to register citizens.

(2) The Projection Results

The population of Lattakia and three surrounding cities was estimated based on the census of 1994 and population growth rate of 2.7% issued by the Syrian Department of Statistics. According to this, population in 2001 is estimated as 541,000 and population in 2010 is estimated as 687,000, which represents a 27% increase over 10 years.

Table 4.1.1 Population Forecast

City/Year	(Unit: Persons)		
	2001	2005	2010
Lattakia	375,435	428,721	476,747
Jableh	92,729	105,890	117,752
Al-Haffeh	23,516	26,854	29,862
Qurdaha	49,291	56,287	62,593
Total	540,971	617,752	686,954

(3) Tourism Migration

Lattakia municipal area is one of the most prestigious tourism areas in Syria and most of the tourism facilities in Lattakia Governorate are concentrated in Latakia Municipality such as accommodations, restaurants, summerhouse, rent apartments, etc. In order to estimate a number of tourist and tourism facilities for the estimation of waste generation amount, annual number of tourist and number of tourism facilities by types are considered.

1) Tourism Flow

The total number of tourist in Lattakia Governorate is approximately 200,000 annually which is 12% of total tourists, approximately 1,640,000, in Syria as of 1999. The death of the former President in 2000 is partly responsible for the decline. The effect of other factors on tourism's declines is unknown.

In addition, there are various kinds of tourism resource in this governorate so that tourism development and promotion will have an effect on tourist number in future.

Table 4.1.2 Tourism Flow in Lattakia Governorate and Syria, 1999

	Lattakia Governorate					All Syria			
	Syrian	Arab	Foreign	Total	Share	Syrian	Arab	Foreign	Total
January	5,820	596	1,008	7,424	8%	50,714	20,032	21,831	92,577
February	3,921	506	1,427	5,854	5%	48,397	19,726	46,893	115,016
March	10,659	1,758	3,257	15,674	10%	60,710	30,874	68,096	159,680
April	7,797	1,361	7,234	16,392	12%	60,612	31,332	43,678	135,622
May	6,709	1,111	4,981	12,801	10%	60,173	30,667	42,524	133,364
June	9,688	2,767	2,109	14,564	11%	57,505	38,390	39,095	134,990
July	22,019	9,773	2,455	34,247	22%	75,858	46,459	31,592	153,909
August	23,808	6,215	2,715	32,738	16%	87,390	58,619	57,223	203,232
September	22,874	5,482	3,524	31,880	16%	79,229	47,804	70,298	197,331
October	9,989	1,530	6,739	18,258	14%	56,413	34,391	44,118	134,922
November	4,830	955	2,708	8,493	8%	50,262	34,444	22,854	107,560
December	2,559	369	621	3,549	5%	40,181	19,975	15,293	75,449
Total	130,673	32,423	38,778	201,874	12%	727,444	412,713	503,495	1,643,652

Source: Statistical Abstract 2000

According to tourism statistics done by Directorate of Tourism in Lattakia, approximately 98% of the total tourist in Lattakia Governorate are concentrated in the Lattakia Municipality. The remaining 2% are scattered over other territories of the Lattakia Governorate. Therefore the greater concern is for tourist number in the Lattakia Municipality.

2) Seasonal Frequency of Tourist Number

Tourists visit throughout the year but greater number of tourists is July, August, and September as defined as tourism high season. January to June and October are defined as medium season, and remaining will be defined as low season. In the high season, more than 30,000 tourists a month visit in the Lattakia Municipal area.

Table 4.1.3 Number of Tourist per night in Lattakia City

	Y1995	Y1996	Y1997	Y1998	Y1999	Y2000
January	8,236	5,386	5,199	5,141	7,320	5,889
February	4,477	6,603	6,758	7,546	5,784	5,378
March	11,471	10,163	10,131	7,304	13,200	12,642
April	11,486	16,695	15,701	18,709	16,158	13,868
May	12,573	11,359	11,937	10,858	12,676	12,011
June	9,612	9,883	10,601	9,364	14,298	11,416
July	12,469	15,846	16,654	34,119	32,030	24,733
August	26,627	25,992	26,896	45,287	33,085	34,517
September	15,044	14,642	20,690	33,468	31,486	32,908
October	13,974	14,125	14,524	16,233	18,149	16,720
November	7,853	7,441	7,081	9,536	8,428	7,654
December	7,077	6,441	7,304	6,943	3,499	3,663
Total	142,894	146,572	155,473	206,506	198,112	183,399
Growth		2.6%	6.1%	32.8%	-4.1%	-7.4%

Source: Tourism Directorate of Lattakia, Ministry of Tourism

3) Tourism Facilities

There is limited information so far. So it is assumed that 98% of tourism facilities in the Governorate are located in Lattakia Municipality based on tourist flow information in Lattakia Governorate classified by municipalities. The number of tourism facilities is shown in the following table and more than 6,200 beds are located in Lattakia Municipality area.

Table 4.1.4 Number of Hotels Classified by Category & Their Capacity in Lattakia Governorate, Year 2000

	5 star	4 Star	3 Star	2 Star	1 Star	Hostel	Apartments	Total	Lattakia Municipality
No. of hotels	2	1	8	10	19	8	10	58	57
No. of rooms	1,369	120	391	306	319	109	59	2,673	2,620
No. of beds	3,592	240	774	661	702	257	178	6,404	6,276

Source: Directorate of Tourism, Lattakia, Ministry of Tourism, 2000 and estimation by JICA Study Team

Besides hotel facilities there are other kinds of accommodations such as camping sites, beach cabins and rent villas shown in the following table. The total capacity (bed) is

approximately 30,000 beds in the Lattakia Municipality area. In addition, there are approximately 18,000 restaurant and coffee shop seats in the Lattakia Municipality area.

Table 4.1.5 Tourist Accommodation and Restaurants in Lattakia Governorate

	Lattakia Governorate		Lattakia Municipality	
	Number	Capacity	Number	Capacity
Camping site	497	2,000	487	1,960
Beach Cabin	4,000	24,000	3,920	23,520
Rent Villa	1,500	5,000	1,470	4,900
Total	5,997	31,000	5,877	30,380
Restaurant	170	17,400	167	17,052
Coffee Shop	44	1,540	43	1,509
Total	214	18,940	210	18,561

Source: Directorate of Tourism, Lattakia, Ministry of Tourism, 2000 and estimation by JICA Study Team

4.2 ECONOMIC FORECAST

(1) The National Economy

The performance of the Syrian economy falls into two periods. The first period was from 1977 to 1987. During this period the economy was mainly socialist with active private sector participation in parts of the handicrafts industry, food processing industries, and agriculture. The country had close economic ties with the former Soviet Union, the Eastern block and the Arab countries.

The second period (from 1988 to the present) began as the former Soviet Union, Syria's main trading partner, weakened and soon after collapsed. With the eruption of the Gulf war, Syria took a stand with the alliance led by Saudi Arabia and the Western World to liberate Kuwait, bringing it into contact with the Western world. Thereafter peace negotiations with neighboring Israel took center stage and the threat of war diminished. Under these conditions the Western world, including Japan, took an active role in international cooperation with Syria.

The most significant action taken during this second period was the strategy Syria adopted for strengthening its private sector participation in the country's economy. Investment Law no. 10 was adopted in 1991. Within one year of promulgating this law the shares of the private sector in imports, exports (excluding crude oil), and fixed capital investments, overtook those of the public sector.

(2) Lattakia Governorate

Lattakia is the major Syrian seaport for non-petroleum products, and hence its economic prosperity is closely tied to the development of international trade. The following table illustrates the importance of trade and related transport, communication and finance activities in Lattakia.

Lattakia is also a major tourism area especially for seaside resort holidays. Currently most visitors are domestic but the potential exists to increase the number of visits by foreigners for resort holidays. This could supplement the already substantial number of foreigners visiting the historic sites of Syria. Unfortunately the importance of tourism is not fully reflected in classifications used in the following statistics.

Table 4.2.1 GRDP Estimation (1998)

(Unit: Million SP)

	Agriculture	Mining & manufacturing	Construction	Wholesale & retail trade	Transport & communication	Finance & insurance	Social & personal services	Government services	Total
Damascus city	12,182	36,803	9,152	43,005	24,002	11,990	4,815	18,853	160,801
Aleppo	40,915	21,244	5,294	50,595	17,246	6,401	2,617	10,245	154,557
Homs	11,340	10,219	2,537	6,811	7,291	2,247	965	3,779	45,188
Hama	32,372	8,721	2,163	7,978	4,653	1,130	590	2,309	59,916
Lattakia	6,781	5,993	1,493	7,719	5,734	1,739	965	3,779	34,203
%	19.8	17.5	4.4	22.6	16.8	5.1	2.8	11.0	100
Deir el-Zor	24,518	3,880	967	2,270	2,206	440	590	2,309	37,180
Idlib	27,315	6,877	1,714	6,811	4,312	717	697	2,729	51,171
Hassaka	25,169	6,569	1,637	2,854	3,827	893	944	3,695	45,589
Raqqa	13,562	4,495	1,110	1,103	2,167	494	354	1,386	24,670

	Agriculture	Mining & manufacturing	Construction	Wholesale & retail trade	Transport & communication	Finance & insurance	Social & personal services	Government services	Total
Sweida	4,406	1,959	479	1,038	1,250	555	225	882	10,793
Daraa	7,126	2,651	651	1,751	3,291	568	654	2,561	19,253
Tartous	12,681	4,418	1,101	4,281	5,008	1,144	622	2,435	31,689
Quneitra	805	384	86	195	303	61	11	42	1,886
Total%	219,170	114,212	28,383	136,411	81,289	28,379	14,048	55,004	676,896
%	32.3	16.9	4.2	20.2	12.0	4.2	2.1	8.1	100

Source: Central Bureau of Statistics and Study Team Estimates

While agriculture within the Lattakia Governorate is proportionally less important than in many other regions, Lattakia is still an important service center for agriculture in surrounding regions.

(3) Growth predictions

The two major drivers of growth in Lattakia are likely to be trade and tourism. Growth in both of these sectors will depend primarily on national rather than regional policies. If the economy is successfully opened to the outside world, then foreign trade will grow much faster than the economy overall, and this in turn will result in faster growth in Lattakia than in the country overall. A growth in foreign tourism in Lattakia will also most likely be driven by a shift in the image of Syria promoted in the international tourism market.

While there are some signs that the Syrian economy is opening up, these have yet to be reflected in the trade accounts. Hence for the time being prudence requires that projections for growth in Lattakia simply match those for the national economy. For national projections, we refer to World Bank estimates of 2% p.a for the medium term as shown in the following tables.

In the short term however Lattakia has to overcome a particularly serious downturn in the construction industry. Over the past few years there has been a major building boom throughout Syria. This followed a period of rapid growth in the late '90's when many people tried to protect their liquid assets by plowing them into real estate. This trend has been particularly pronounced in Lattakia, where a significant number of new buildings were constructed particularly for vacation accommodation in the Lattakia region. It will take some time for this glut to clear.

Table 4.2.2 shows the prediction of GRDP in Lattakia, Jableh, Al-Haffeh, and Qurdaha. The growth ratio of GRDP (2.0%) is less than that of population (2.69%), therefore, GRDP per person will be reduced gradually.

Table 4.2.2 GRDP Prediction

	(Unit: Million SP)		
	2001	2005	2010
Lattakia	15,166	16,417	18,125
Jableh	3,746	4,055	4,477
AL-Haffeh	950	1,028	1,135
Qurdaha	1,991	2,155	2,380
Total	21,853	23,655	26,117

Note: Estimated based on GDP ratio of Lattakia Governorate in 1998.

Municipality budget of Lattakia, Jableh, Al-Haffeh, and Qurdaha, predicted based on the growth rate of GRDP, is shown in Table 4.2.2. In 2010, total budget of four cities will be 786.3 million Syrian Pond.

Table 4.2.3 Prediction of Municipality Budget

(Unit: Million SP)

	2001	2005	2010
Lattakia	605.0	654.9	723.0
Jableh	45.7	49.5	54.6
AL-Haffeh	2.4 *	2.5	2.8
Qurdaha	4.9 **	5.2	5.9
Total	658.0	712.1	786.3

Note *1): Estimated based on the budget in Qurdaha (SP1,100/person).

*2): Budget in 2000.

Syrian Arab Republic at a glance

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POVERTY and SOCIAL

1999

	Syrian Arab Republic	M. East & North Africa	Lower-middle-income
Population, mid-year (millions)	15.7	291	2,094
GNP per capita (Atlas method, US\$)	1,010	2,060	1,200
GNP (Atlas method, US\$ billions)	16.0	599	2,513

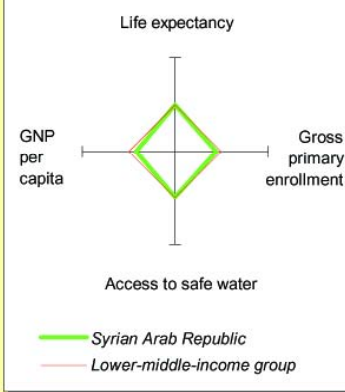
Average annual growth, 1993-99

	Syrian Arab Republic	M. East & North Africa	Lower-middle-income
Population (%)	2.7	2.1	1.1
Labor force (%)	3.8	3.0	1.2

Most recent estimate (latest year available, 1993-99)

	Syrian Arab Republic	M. East & North Africa	Lower-middle-income
Poverty (% of population below national poverty line)	..	..	..
Urban population (% of total population)	54	58	43
Life expectancy at birth (years)	69	68	69
Infant mortality (per 1,000 live births)	28	45	33
Child malnutrition (% of children under 5)	13	15	15
Access to improved water source (% of population)	85	71	86
Illiteracy (% of population age 15+)	26	36	16
Gross primary enrollment (% of school-age population)	101	95	114
Male	106	102	114
Female	96	88	116

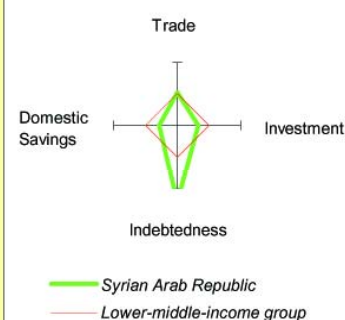
Development diamond*



KEY ECONOMIC RATIOS and LONG-TERM TRENDS

	1979	1989	1998	1999
GDP (US\$ billions)	9.9	9.9	17.1	16.5
Gross domestic investment/GDP	26.2	15.9	21.0	17.6
Exports of goods and services/GDP	19.1	24.2	31.1	31.2
Gross domestic savings/GDP	9.3	11.1	20.6	17.2
Gross national savings/GDP	9.7	3.8	20.1	16.3
Current account balance/GDP	-7.4	10.1	0.3	3.0
Interest payments/GDP	0.7	0.6	0.5	0.5
Total debt/GDP	23.6	176.5	131.1	137.5
Total debt service/exports	9.2	21.3	2.5	3.4
Present value of debt/GDP	..	..	121.9	..
Present value of debt/exports	..	..	290.8	..

Economic ratios*

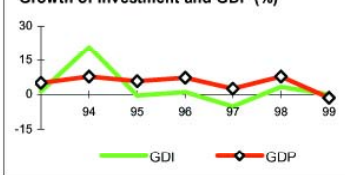


	1979-89	1989-99	1998	1999	1999-03
(average annual growth)					
GDP	2.1	6.3	7.8	-1.5	2.0
GNP per capita	-1.8	2.9	4.4	-4.9	-1.4
Exports of goods and services	5.0	10.8	10.9	-1.2	1.9

STRUCTURE of the ECONOMY

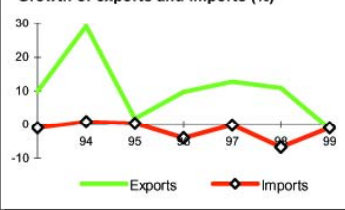
	1979	1989	1998	1999
(% of GDP)				
Agriculture	..	23.7	32.4	30.4
Industry	..	23.7	16.9	17.3
Manufacturing	..	..	5.5	5.6
Services	..	52.6	50.7	52.3
Private consumption	69.1	72.9	67.8	70.7
General government consumption	21.6	16.0	11.6	12.1
Imports of goods and services	36.0	29.1	31.5	31.6

Growth of investment and GDP (%)



	1979-89	1989-99	1998	1999
(average annual growth)				
Agriculture	0.8	14.1	22.2	-7.5
Industry	5.3	0.1	2.4	1.0
Manufacturing	..	5.6	2.0	2.0
Services	1.3	5.7	0.6	2.2
Private consumption	3.0	4.2	6.5	-2.5
General government consumption	-2.9	0.3	2.2	1.2
Gross domestic investment	-3.4	6.6	3.3	0.0
Imports of goods and services	-1.6	0.4	-6.6	-1.0
Gross national product	1.5	6.1	7.8	-1.9

Growth of exports and imports (%)



Note: 1999 data are preliminary estimates.

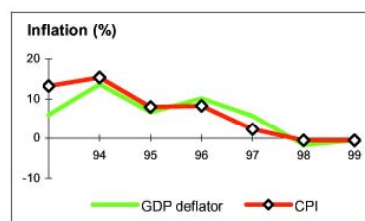
* The diamonds show four key indicators in the country (in bold) compared with its income-group average. If data are missing, the diamond will be incomplete.

Source: World Bank

Syrian Arab Republic

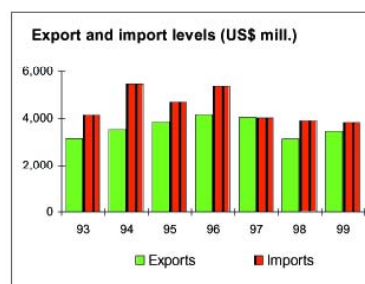
PRICES and GOVERNMENT FINANCE

	1979	1989	1998	1999
Domestic prices				
(% change)				
Consumer prices	4.6	11.4	-0.5	-0.5
Implicit GDP deflator	16.1	23.3	-1.6	-0.5
Government finance				
(% of GDP, includes current grants)				
Current revenue	..	..	26.2	26.2
Current budget balance	..	8.2	8.5	8.5
Overall surplus/deficit	-15.6	-0.2	-4.4	-4.4



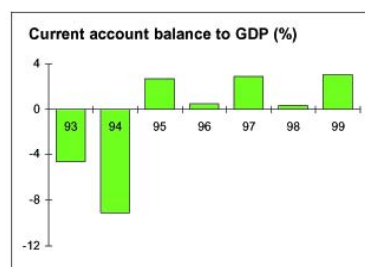
TRADE

	1979	1989	1998	1999
(US\$ millions)				
Total exports (fob)	1,648	2,990	3,135	3,464
Crude petroleum	1,179	1,182	1,342	1,907
Cotton	..	..	366	..
Manufactures	..	..	..	..
Total imports (cif)	3,055	2,080	3,895	3,832
Food	..	..	442	522
Fuel and energy	836	165	..	..
Capital goods	..	..	2,053	2,105
Export price index (1995=100)	10	53	64	78
Import price index (1995=100)	8	47	92	91
Terms of trade (1995=100)	118	113	70	85



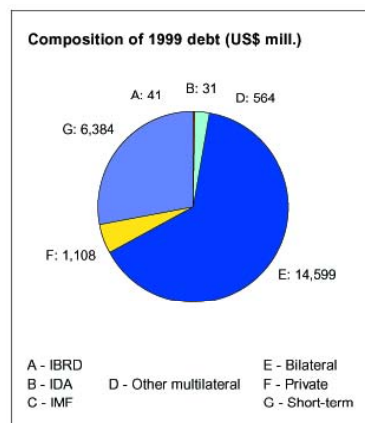
BALANCE of PAYMENTS

	1979	1989	1998	1999
(US\$ millions)				
Exports of goods and services	2,024	3,906	4,930	5,385
Imports of goods and services	3,645	2,613	4,788	4,736
Resource balance	-1,621	1,293	142	649
Net income	890	-293	-606	-644
Net current transfers	0	0	523	496
Current account balance	-731	1,000	59	501
Financing items (net)	930	72	-34	-351
Changes in net reserves	-199	-1,072	-25	-150
Memo:				
Reserves including gold (US\$ millions)	..	..	2,079	1,929
Conversion rate (DEC, local/US\$)	3.9	21.2	45.3	46.0



EXTERNAL DEBT and RESOURCE FLOWS

	1979	1989	1998	1999
(US\$ millions)				
Total debt outstanding and disbursed	2,340	17,389	22,435	22,727
IBRD	158	434	67	41
IDA	41	46	32	31
Total debt service	271	927	176	247
IBRD	15	0	71	77
IDA	0	0	2	2
Composition of net resource flows				
Official grants	1,634	25	95	..
Official creditors	275	643	-28	-114
Private creditors	-24	-10	-4	-6
Foreign direct investment	0	74	80	125
Portfolio equity	0	0	0	0
World Bank program				
Commitments	30	0	0	0
Disbursements	58	0	0	0
Principal repayments	2	0	23	23
Net flows	57	0	-23	-23
Interest payments	13	0	50	56
Net transfers	43	0	-73	-79



World Bank

8/25/00

Source: World Bank

4.3 INSTITUTIONAL AND LEGAL FRAMEWORK

4.3.1 Institution Arrangement on the Governorate Level

Based on the Local Administration Law of October 10, 1974, the responsibility of solid waste management is imposed to each municipality. Lattakia, Jableh, Al-Haffeh, and Qurdaha have its own cleansing department or section in the municipality organization.

Taking into account the budget allocation of the local government, it can be said that it has some difficulty for the procurement of equipment and the construction of SWM related facilities, especially for small cities. Meanwhile, it is necessary to introduce one sanitary landfill site in Qasia as an inter-municipal disposal in the study area, which may require the long distance transport of the waste from Jableh and Qurdaha city.

Based on the above understandings, institutional arrangement on the Governorate level shall be considered in the master plan.

4.3.2 Improvement of Tariff System

Syria has already introduced the tariff system related to solid waste management. It is informed that the fee collection from the commercial entities is good, however, from the household viewpoint, is insufficient. As shown in Table 1.2.32 (section 1.2.8 of this report), SWM related income in the study area is only 31.3% of the expenditure.

Based on this understanding, in accordance with the beneficiaries pay principal, present tariff system in the study area shall be verified and improved in the master plan, from the aspect of fee level re-arrangement, collection ratio improvement, etc. At the same time, reduction of subsidy from the Central Government will be examined, in order to introduce an independent management of SWM by the local government.

4.3.3 Hazardous Waste Management

Treatment of the hazardous waste is one of the key issues in the study area. In general, it is required to execute the special treatment based on its own waste characteristics. From this point of view, practically, it can be said that the management of hazardous waste by the Municipality and/or Governorate level is difficult. Therefore, hazardous waste shall be managed on the National level.

4.3.4 Basic Law

- **The Local Administration Law (the LAL) of October 10, 1974**

The LAL shall be stringently kept and obeyed for the alteration and the amelioration of the SWM scheme in Lattakia City and the 3 surrounding Cities on the M/P in 2010.

- **Environmental Protection Law (the EPL)**

The EPL was drafted but is not approved yet by cabinet to date, 2001. Once the EPL is approved, the M/P for the said 4 Cities in 2010 shall abide by the EPL and the alteration and/or improvement of the SWM scheme.

Other basic laws including the Financial Law of 1994 relating to the SWM shall be respected for the M/P on the SWM in 2010.

4.3.5 Decree, Order, Regulation, etc.

It is indispensable for the SWM to be obedient to the decrees, their amendments approved by President and/or Governor, the orders, regulations and their amendments approved by Governor and/or City Council.

New Decrees shall be promulgated for the establishment of the New SWM Institution under the direction of the Executive Office for Town Facilities as well as Lattakia Mayor under Lattakia Governorate Council (headed by Governor).

4.3.6 Standard, Guideline etc.

Standards and Guidelines shall hardly be regarded in light of the status quo as legitimately compulsory regulations but be as much as possible obeyed for implementation of matters.

- **The SASMO standard**

The Standard No. 2014 (Approval Decision No. 244) of August 31, 1998 was published by the Syrian Arab Organization for Standardization and Metrology (the SASMO), inter alia, the Organic Materials Department of the Chemical Standards Directorate (10 personnel) under the Ministry of Industry.

Current Environmental Law has excluded the EIA aspects. Nevertheless the EIA has been carried out referring to the EU or International Organization's system since realization of environmental importance arisen in Syria.

CHAPTER 5 PLANNING CONDITIONS

5.1 SOLID WASTE AMOUNT AND QUALITY

5.1.1 Solid Waste Amount

(1) Unit Generation Rate

The solid waste amount surveys at source were conducted once during winter and once during summer in both Lattakia and Jableh. Unit generation rate obtained by the survey are shown in Table 5.1.1.

Table 5.1.1 Unit Generation Rate

Waste Type	Lattakia		Jableh		Average
	Winter	Summer	Winter	Summer	
Domestic waste					
- High Income	0.56	0.78	0.62	0.93	0.69 kg/day/capita
- Middle Income	0.56	0.63	0.52	0.55	0.59 kg/day/capita
- Low Income	0.38	0.43	0.38	0.51	0.41 kg/day/capita
Commercial waste ^{*)}	0.17 kg/day/capita				
Total average	0.71 kg/day/capita				

Note: ^{*)} Commercial waste contains shop, private office, restaurant, hotel, public office, school, market, road and park waste.

Source: JICA Study Team

In the master plan, the average generation rates for both seasons will be used as the basic parameter for understanding present waste amount and forecast.

(2) Present Waste Amount

In order to prepare the master plan, the present waste amount is estimated as shown in Table 5.1.2, based on the present population described in section XXX, unit generation rate shown in Table 5.1.1 and statistical data of commercial entities provided by the Syrian side.

The ratio of municipal waste amount generated in the study area is: 73% in Lattakia, 16% in Jableh, 4% in Al-Haffeh and 7% in Qurdaha.

Table 5.1.2 Waste Amount Generated in 2001

Waste Type	Waste Amount Generated (ton/day)				
	Lattakia	Jableh	Al-Haffeh	Qurdaha	Total
Domestic waste					
- High income	39	10	2	5	56
- Middle income	110	27	7	14	158
- Low income	54	13	3	7	78
Sub-total	203	50	12	26	292
Commercial waste	66	9	2	2	78
Road & Garden waste	11	3	1	1	15
Total (Municipal waste)	280	62	15	29	385
Seasonal waste in summer ^{*)}	40	5	1	2	48
Medical waste	3.9 ton/day (of which 1.4 ton/day is infectious waste)				
Small-scale industrial waste	10 ton/day				

Note: ^{*)} Seasonal waste in summer will be generated in July, August and September.

Source: JICA Study Team

(3) Waste Amount Forecast

The expected tendency of the unit generation rate may increase with an increase in wealth and a change of lifestyle. In Japan, the annual growth of unit waste generation rates in the 1980's ranged between 2 and 3%. In Lattakia and surrounding three cities, taking into account the prospects for moderate economic growth, more modest annual growth rate of 1% has been adopted to forecast future solid waste amount for each type of waste.

Table 5.1.3 Waste Unit Generation Rate Forecast

Waste Type	Unit	2001	2006	2010
Domestic waste				
- High income	kg/day/cap	0.69	0.73	0.76
- Middle income	kg/day/cap	0.59	0.62	0.64
- Low income	kg/day/cap	0.41	0.43	0.45
Commercial waste ^{*)}	kg/day/cap	0.17	0.18	0.19
Seasonal waste in summer	ton/day	48	50	52
Medical waste	kg/day/bed	3.0	3.2	3.3
Small-scale industrial waste	ton/day	10.0	10.5	10.9

Note: ^{*)} Commercial waste includes road & garden waste

Source: JICA Study Team

Taking into consideration the population growth forecast as outlined in section XXX of this report and the forecast unit generation rate shown in Table 5.1.3, the waste amount generated by each waste type and by each city are shown in Table 5.1.4 and Table 5.1.5, respectively. The master plan with the target year of 2010 has been prepared based on these figures.

Table 5.1.4 Waste Amount Forecast

Waste Type	Unit	2001	2006	2010
Domestic waste				
- High income	ton/year	20,466	24,555	28,434
- Middle income	ton/year	57,755	69,335	80,236
- Low income	ton/year	28,542	34,250	39,667
Commercial waste	ton/year	28,386	29,846	31,057
Road & Park waste	ton/year	5,559	5,869	6,108
Sub-Total	ton/year	140,708	163,855	185,502
Seasonal waste in summer ^{*)}	ton/year	4,320	4,500	4,680
Medical waste	ton/year	1,424	1,497	1,570
Small-scale industrial waste	ton/year	3,607	3,791	3,945
G. Total	ton/year	150,059	173,643	195,697

Note: Each figures includes the waste amount in Lattakia, Jableh, Al-Haffeh and Qurdaha.

^{*)} Seasonal waste in summer will be generated in July, August and September.

Source: JICA Study Team

Table 5.1.5 Waste Generation Amount in 2010

(Unit: ton/day)

City/ Waste type	Domestic waste	Commercial waste	Road & Part waste	Total
Lattakia	282.0	71.9	11.6	365.5
Jableh	69.7	9.7	3.5	82.9
Al Haffeh	17.7	1.9	0.8	20.3
Qurdaha	37.0	1.6	0.9	39.5
Total	406.4	85.1	16.7	508.2

Note : Beside that, seasonal waste in summer (47 ton/day), medical waste (4 ton/day), and small scale industry (10ton/day) are generated.

5.1.2 Solid Waste Quality

The solid waste composition surveys at source were conducted by the JICA Study Team in both winter and summer season. The results of the survey of waste composition in wet base and waste quality including moisture, ash, non-organic content and C/N ratio are summarized in the Table 5.1.5 and Table 5.1.6, respectively.

Table 5.1.6 Waste Composition (Wet Base)

Waste composition	Domestic Waste			Commercial Waste ^{*)}		
	Winter	Summer	Average	Winter	Summer	Average
Food, Vegetable	70.4	74.9	72.7	57.0	52.6	54.8
Paper	10.1	8.4	9.2	20.4	22.4	21.4
Plastic	8.1	8.7	8.4	9.1	13.2	11.2
Rubber & Leather	0.5	0.3	0.4	0.2	0.1	0.2
Wood	0.4	0.2	0.3	1.4	1.2	1.3
Textile	2.4	2.0	2.2	0.8	0.4	0.6
Metal	1.7	1.3	1.5	1.8	1.7	1.7
Glass	1.6	0.8	1.2	3.3	0.9	2.1
Ceramic	0.4	0.2	0.3	0.0	0.1	0.0
Stone & Sand	1.3	1.4	1.4	2.6	3.2	2.9
Others (>5mm)	0.8	1.6	1.2	3.2	4.2	3.7
Others (<5mm)	2.4	0.1	1.2	0.2	0.0	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
Bulk density (kg/l)	0.19	0.21	0.20	0.13	0.13	0.13

Note: ^{*)} Composition of commercial waste contains shop, private office, restaurant, hotel, public office, school, market, road and park waste.

Source: JICA Study Team

Table 5.1.7 Waste Quality

Waste Type	Moisture Content		Ash Content		Un-Organic Content		C/N Ratio	
	Average	Diversion	Average	Diversion	Average	Diversion	Average	Diversion
Domestic waste	67.3	7.3	11.2	6.2	21.5	5.5	63.6	28.1
Commercial waste	62.6	22.2	14.1	11.7	23.4	13.1	72.9	23.6
Market waste	85.4	1.9	5.2	2.5	9.5	0.6	53.0	8.5
Office waste	34.5	20.5	13.0	11.7	52.5	9.8	75.5	27.6

Source: JICA Study Team

Based on the source separation practice carried out in the pilot study on public awareness campaign, waste composition of organic and non-organic waste separated at source is shown in Table 5.1.7. 78% of source separated waste was organic waste, while, 22% was non-organic waste.

Table 5.1.8 Composition of Source Separated Waste

Composition	Organic Waste (%)	Non-organic Waste (%)
Food, Vegetable	83.6	32.9
Paper	5.8	20.6
Plastic	5.4	19.1
Textile	1.4	4.5
Metal	1.0	3.4
Glass	0.8	2.7
Others	2.0	16.8
Total	100.0	100.0

Source: JICA Study Team

5.2 MINIMUM SERVICE LEVEL

Punctual removal of solid waste from urban area is indispensable to keep the city clean and beautiful, to maintain public health and to prevent the spread of communicable disease. The collected waste shall be disposed in the proper way. Dumped waste shall be at least compressed and covered by soil to avoid which is unsightly, and also to reduce bad odors and the environmental impact on the surrounding area. No body can accept open dumping of any waste including construction debris. Reconstruction of recycling system shall be considered to promote recycling and to reduce waste amount. Minimum service level for solid waste management will be summarized as shown in Table 5.2.1.

Table 5.2.1 Minimum Service Levels

	Lattakia City	Jableh, Al-Haffeh and Qurdaha City
1. Waste collection		
Domestic waste (Central and commercial area)	Daily collection for container system 3 times a week for other system Separate collection for organic and in-organic waste shall be introduced	Daily collection for container system 3 times a week for other system Separate collection for organic and in-organic waste shall be introduced
Domestic waste (Peripheral & low income area)	Daily collection for container system 3 times a week for other system Separate collection for organic and in-organic waste shall be introduced	Daily collection for container system 3 times a week for other system Separate collection for organic and in-organic waste shall be introduced
Reusable material	To be collected separately	To be collected separately
Commercial waste	Daily collection for container system in central area and 3 times a week for other areas	Daily collection for container system in central area and 3 times a week for other areas
Small-scale industry waste	Same as domestic waste excluding hazardous waste	Same as domestic waste excluding hazardous waste
2. Transportation	----	Transfer stations shall be considered in Jableh and Qurdaha
3. Waste reduction and resource recovery	Separate collection and recycling of reusable material	Separate collection and recycling of reusable material
4. Waste treatment and disposal	Sanitary landfill Composting of organic portion of the waste	Sanitary landfill Composting of organic portion of the waste
5. Medical waste	Independent collection and treatment of infectious waste	Independent collection and treatment of infectious waste
6. Street sweeping	Daily sweeping in city center, once a week sweeping in peripheral areas	Daily sweeping in city center, once a week sweeping in peripheral areas
7. Illegal dump sites	Rehabilitation of Al-Bassa disposal site and illegal dump site	Rehabilitation of illegal dump site
8. Service charges	Introduction of “polluter pays” principal.	Introduction of “polluter pays” principal
9. Industrial waste	Generators responsibility (Medium and Large)	Generators responsibility (Medium and Large)
10. Hazardous waste	National level management	National level management

5.3 WASTE DISPOSAL SITES

Waste is currently disposed of at Al-Bassa disposal site, however, construction of a new site is required for the following reasons:

- Part of the sandy coastline is used by the site, which can even be seen from Latakia inner city. There have been numerous complaints about the environmental pollution that takes place here.
- Ground consists of permeable sandy layers and groundwater is already polluted. It is necessary to prevent further pollution in future.
- There are plans to develop the sandy beach here as a tourist spot and to construct a coastal road in the area.

For the above reasons, a site selection committee was set up and, in its third meeting on August 16, 2001, it decided to adopt Qasia as the location for the new disposal site. Since it is thought that the final acquisition of site land will take more time, waste shall continue to be disposed at Al-Bassa for the immediate future, and sanitary landfilling shall be commenced at the new site in Qasia from 2010.

CHAPTER 6 TECHNICAL ALTERNATIVES AND SELECTION OF OPTIMUM ALTERNATIVE

6.1 TECHNICAL ALTERNATIVES FORMULATED

Since bulldozers and other heavy machinery are required to carry out sanitary landfilling, costs work out to be too high in small disposal sites. Accordingly, one disposal site shall be constructed for Lattakia in 2010 at Qasia. In view of this, the following alternatives are proposed upon giving consideration to efficient transport and promotion of recycling.

- Alternative I Sanitary landfill and direct transport
- Alternative II Sanitary landfill and transfer transport
- Alternative III Separate collection, sanitary landfill, organic waste composting/ sorting center, and direct transport
- Alternative IV Separate collection, sanitary landfill, organic waste composting/ sorting center, and transfer transport

There will be only one sanitary landfill site in Lattakia Governorate because heavy equipment shall be provided for daily operation, which is costly for small-scale disposal sites. Lattakia, Jableh, Qurdaha and Al-Haffeh city shall transport their waste to this sanitary landfill site in Qasia. But Jableh and Al-Haffeh city are facing shortage of collection equipment and have no capability to transport solid waste to distant landfill site if no equipment is provided. Therefore, new collection vehicle shall be provided in the alternative I and III or a new transportation agency and system shall be established to transport waste collected by small cities to prevent illegal dumping and to support these cities in the alternative II and IV. Introduction of recycling system is considered in the alternation III and IV.

Contents of each alternative are summarized in Table 6.1.1.

Solid waste flow of each alternative in 2010 is shown in Figure 6.1.1.

Table 6.1.1 Formulation of the Technical Alternatives

Item	Alternative-1	Alternative-2	Alternative-3	Alternative-4
1. Collection	Container (large/ medium size compactor)	Container (medium size compactor)	Container (large/ medium size compactor) & Separate collection (plastic bag)	Container (medium size container) & Separate collection (plastic bag)
2. Transport	Direct transport	Transfer stations (Jableh, Al-Haffeh and Qurdaha)	Direct transport	Transfer stations (Jableh, Al-Haffeh and Qurdaha)
3. Treatment/ Disposal	Inter-municipal disposal site (sanitary landfill)	Inter-municipal disposal site (sanitary landfill)	Composting & Inter-municipal disposal site (sanitary landfill)	Composting & Inter-municipal disposal site (sanitary landfill)
4. Recycling	None	None	Composting & Sorting of reusable materials	Composting & Sorting of reusable materials

The background for the formulation of each technical alternative shall be explained in the following articles.

Municipal Waste Amount (508 ton/day) / Target Collection Ratio: 95%

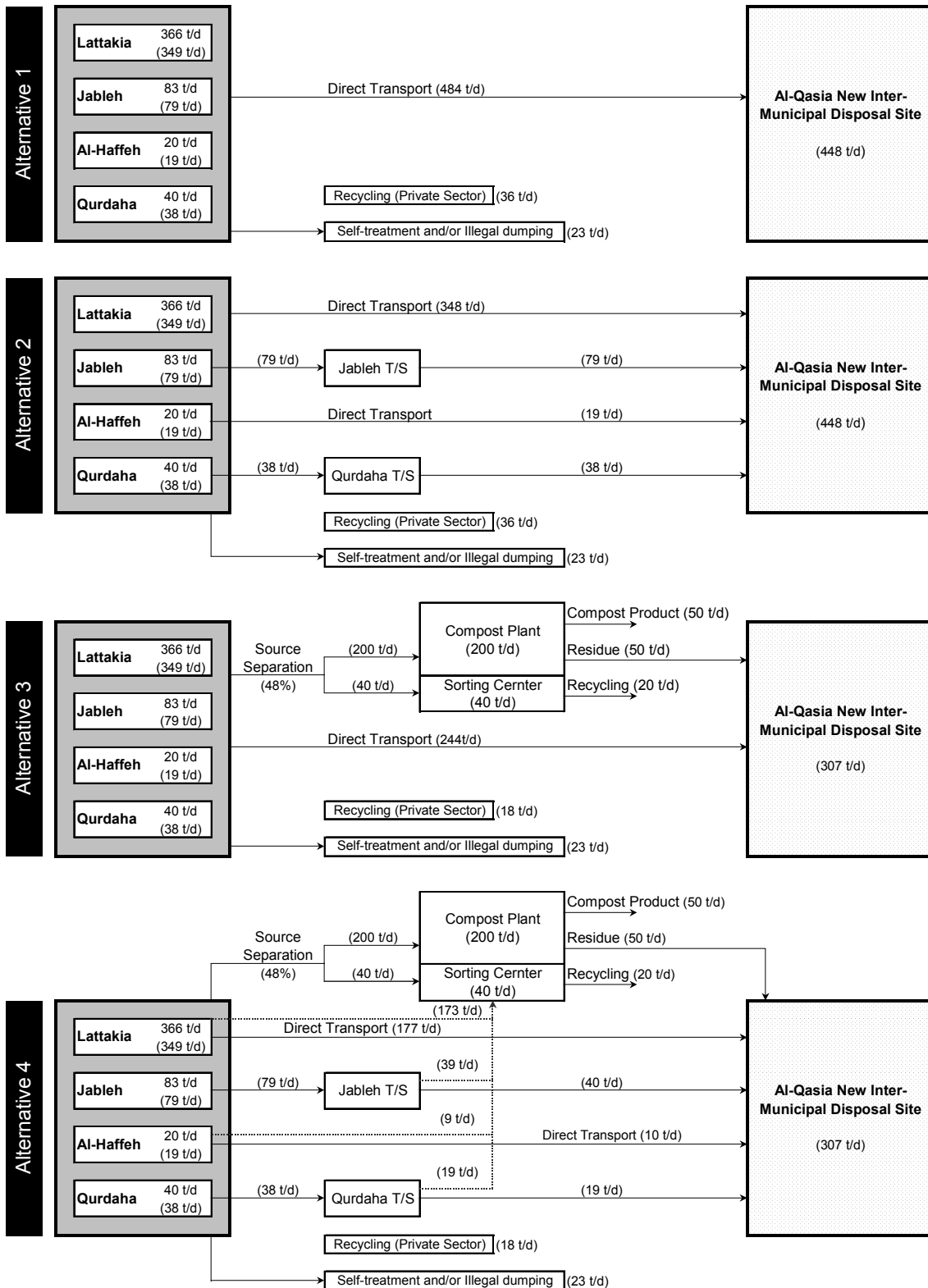


Figure 6.1.1 Waste Flow of Each Alternatives in 2010

6.2 COLLECTION AND TRANSPORT

(1) Policy of Collection Improvement

- a. Many of the existing collection vehicles are deteriorated. Work is carried out over two shifts (daytime and nighttime) in order to deal with breakdowns. It is considered that deteriorated vehicles will be appropriately renewed in future, however, until then it will be necessary to continue the collection work under the present conditions. Accordingly, work over two shifts shall be continued. Moreover, equipment and personnel are assigned separately to each shift, and it is necessary to ensure that work areas do not overlap.
- b. Waste collection is currently mainly carried out by large size container trucks and compactor trucks. However, since each city also contains narrow roads, medium and small size vehicles are also necessary. Therefore, medium size vehicles shall be used when using containers, and small size vehicles shall be used when carrying out manual loading. In Al-Haffeh, small size compactor trucks are appropriate because containers are used.
- c. Street sweeping in city centers is carried out mechanically. As for roads in outlying areas, manual street sweeping is carried out together with primary collection up to containers. Mechanical sweeping will continue to be implemented on main roads. Concerning manual street sweeping and primary collection, the basic policy shall be to resolve equipment shortages and secure higher efficiency with the cooperation of citizens.
- d. Since the new inter-municipal disposal site at Qasia is located just 18 km from Lattakia and 8 km from Al-Haffeh, it is not necessary to introduced transfer operations (transfer of waste from smaller trucks to larger trucks). However, transfer operation shall be considered in the cases of Jableh and Qurdaha since these cities are located 35-40 km from the new disposal site. It is necessary to consider that transfer operation has the following merits. Moreover, in cases where transfer operation is not carried out, it is necessary to consider the introduction of large size vehicles that offer high efficiency.
 - Increased efficiency of transport from Qurdaha and Jableh
 - Introduction of transfer operation can relieve the burden on cities far from the disposal site.
 - When surrounding municipalities carry out waste collection, they will use tractors, however, it will be difficult for tractors to transport waste to Qasia disposal site. Utilizing transfer stations will make it possible for these municipalities to also transport waste to Qasia and help prevent illegal dumping.
- e. Judging from the quality of waste in Lattakia, it is practical for recycling to be implemented based around the composting of organic waste and recovery of reusable materials. In order to produce good quality compost and recover reusable materials, it is necessary to introduce source separate collection. The following two alternatives are available for separation. Since waste in Lattakia and the three surrounding cities has a high organic waste (kitchen waste) content, separation of organic waste and inorganic waste shall be conducted with consideration given to the introduction of composting.

- Organic waste and inorganic waste (when carrying out composting, recovery of reusable materials from inorganic waste is also possible).
- Reusable materials and others (when only recovering reusable materials)

(2) Alternatives of the collection and transport system

The following points are considered to formulate alternatives from the viewpoint of collection and transport plan.

- (1) Separate collection: In order to create society which takes environment into consideration very much, it is necessary to reduce waste amount and to promote recycling. From a viewpoint of separate collection, we formulate two alternatives whether intermediate facilities, namely, compost plants and sorting centers will be constructed and separate collection will be introduced or present mixed collection will be continued.
- (2) Waste transport via transfer station: If the waste transport distance exceeds 20 km, it is generally effective to implement transferred transport from the viewpoint of cost. The distance from Jableh city center to Qasia final disposal site is approximately 32.1km and the one from Qurdaha to the Qasia site is approximately 36.1km. We formulate newly two alternatives whether transfer station will be constructed in Jableh and Qurdaha and newly transferred transport will be introduced or present direct collection will be continued.

Based on these two points, four alternatives were formulated. Basic concept of the 4 alternatives is as follows:

Alternative I Mixed collection and direct transport

All types of municipal waste in four cities will be collected without any separation. Collected waste will be directly transported to the new inter-municipal disposal site.

Alternative II Mixed collection and transferred transport

All types of municipal waste in four cities will be also collected without any separation in this alternative.

Collected municipal waste in Jableh and Qurdaha will be gathered first to the transfer station constructed in each city. Gathered waste will be secondly transported to new inter-municipal disposal site. Otherwise the municipal waste in Lattakia and Al-Haffeh will be directly transported to the final disposal site.

Alternative III Separate collection and Direct transport

In this alternative, a Compost plant and Recycle center will be constructed at the same site of inter-municipal disposal site. Separate collection will be introduced for four cities.

Source separated organic waste will be transported directly to the compost plant. Non-organic waste will be transported to the recycle center. Non-separated waste will be disposed with the same method as Alternative I.

Alternative IV Separate collection and transferred transport

In this alternative, separate collection system as explained in Alternative III and Transferred transport system as explained in Alternative II will be applied.

(3) Collection vehicle to be introduced

1) Necessary considerations

a. Introduction of Separate Collection

As for alternative II, and I only mixed collection will be implemented. Therefore all the types of municipal waste will be discharged into 1m³ class container basically. Open station method with plastic bag will be applied in special areas where don't have enough space to locate containers.

In alternative III and IV, 25-ton scale compost in Al-Bassa, 150-ton scale compost plants and two 20-ton scale sorting centers are constructed. Related to separate collection, source separation will be newly introduced mainly to high-income area since they have enough space to store waste temporary. Therefore discharge system that can be clearly separated between organic waste and non-organic waste will be necessary.

The ratio of organic waste in household waste is estimated approximately 78% of all the waste according to a pilot study of JICA Study Team. Considering this result and the quality of waste, organic waste is collected with 1m³ scale container. Non-organic waste is collected with plastic bag.

In the mixed collection area, discharge and collection method will be the same as alternative I and II.

b. Introduction of transferred transport

In Jableh city and Qurdaha city, new transfer stations will be constructed at approximately 3 km from city center in Alternative II and IV.

c. Specific collection system in Al-Haffeh city

At present, plastic bag collection is implemented in Al-Haffeh city. Also, this collection will be continued in target year 2010 because citizens are quite satisfied with this method.

2) Types of Collection and Transport vehicle

Collection and transport vehicles should be chosen based on mainly following three points;

- Citizens' discharge style
- Collection hours and collection area
- Transport distance

Collection equipment from the existing vehicle that has been recently procured is expected to continue to be in service in 2010. These vehicles are considered in the M.P.

To decide the proper equipment, four types of vehicle are considered as shown in Table 6.2.1. Based on the consideration of each vehicle, the most appropriate vehicle should be selected.

Table 6.2.1 Consideration of Each Vehicle Type for Collection Vehicles

Type	Points	Consideration
Large size compactor (16m ³)	Discharge style	Very efficient if container collection applied
	Collection time/area	Applied on wide road without parking car or obstructs
	Transport distance	Consideration of traffic congestion is needed. Appropriate for long trip transport over 20km
	→Direct transport of organic and non-separated waste from Jableh and Qurdaha	
Medium size compactor (8m ³)	Discharge style	Basically suitable for container collection method Considerable for plastic bag method
	Collection time/area	Wide or medium road Applicable for all the areas of income layer
	Transport distance	Appropriate for medium or small transport distance (less than 20 km)
	Suitable for organic waste and mixed waste transport without long distance trip Applied for non-organic waste which is transported directly to destination	
Small size compactor (4m ³)	Discharge style	Only plastic bag method will be available
	Collection time/area	Suitable for the collection of narrow and crowded road area Generally suitable for low income area
	Transport distance	Appropriate for small trip road transport
	Transferred transport and direct transport less than 20 km transport length →non-organic waste, old city area, narrow road area	
Dump Truck (6m ³)	Discharge style	If the scattered waste is not available to collect by compactors Dump truck will be used with loader
	Collection time/area	-
	Transport distance	Only suitable for transport less than 20 km length
	It is considered to remain large amount of scattered waste in open station in 2010. Proper numbers of dump trucks are introduced with loaders for collecting scattered waste.	

Transport vehicle from transfer station in Jableh and Qurdaha to the final disposal site will be necessary for Alternative II and IV. In this case, 20 m³ Container Truck described in Table 6.2.2 will be considered.

Table 6.2.2 Consideration of Vehicle Type for Transport

Type	Points	Consideration
Container Truck (20m ³)	Discharge style	20m ³ container is applied
	Collection time/area	-
	Transport distance	Suitable for long trip transport more than 20 km
	Suitable for waste transport from transfer station to the Casia inter-municipal disposal site Applied for the waste generated in Jableh and Qurdaha	

Table 6.2.3 shows the appropriate vehicle type for waste collection in 2010.

Table 6.2.3 Applied Vehicle Type for Each City In 2010

Lattakia (358 ton/day)

Alternative	I	II	III	IV
1. Separate collection area				
Organic waste	-	-	Medium	Medium
Non-organic waste	-	-	Small	Small
2. Mixed collection area				
	Medium Small Dump truck (Tractor)	Medium Small Dump truck (Tractor)	Medium Small Dump truck (Tractor)	Medium Small Dump truck (Tractor)

Jableh (81 ton/day)

Alternative	I	II	III	IV
1. Separate collection area				
Organic waste	-	-	Large	Medium
Non-organic waste	-	-	Medium	Small
2. Mixed collection area				
	Large Medium Dump truck (Heil)	Medium Small Dump truck (Heil)	Large Medium Dump truck (Heil)	Medium Small Dump truck (Heil)

Qurdaha (39 ton/day)

Alternative	I	II	III	IV
1. Separate collection area				
Organic waste	-	-	Large	(Heil)
Non-organic waste	-	-	Medium	Small
2. Mixed collection area				
	Large Dump truck (Heil) (Fiat) (Tractor)	Dump truck (Heil) (Fiat) (Tractor)	Dump truck (Heil) (Fiat) (Tractor)	Dump truck (Fiat) (Tractor)

Al-Haffeh (19 ton/day)

Alternative	I	II	III	IV
1. Separate collection area				
Organic waste	-	-	Small	Small
Non-organic waste	-	-	Small	Small
2. Mixed collection area				
	Small Dump truck (Tractor)	Small Dump truck (Tractor)	Small Dump truck (Tractor)	Small Dump truck (Tractor)

Note) Large, medium, small, Heil and Fiat: the size and type of compactor
Bracket indicates present vehicles used in 2010.

3) Collection and transport equipment requirements

Based on the waste amount, expected operation efficiency for each vehicle, appropriate vehicle type for each situation and estimated trip number of each vehicle, required vehicle number were estimated as shown in Table 6.2.4.

Table 6.2.4 Required Collection Vehicles by each Alternative in 2010

Alternative			I	II	III	IV
Lattakia	Medium Compactor	8m ³	45	45	41	41
	Small Compactor	4m ³	4	4	12	12
	Dump truck	6m ³	2	2	2	2
	(Tractor)		2	2	2	2
	Lattakia Total			53	53	57	57
Jableh	Large Compactor	16m ³	10	-	10	-
	Medium compactor	8m ³	2	8	4	7
	Small compactor	4m ³	-	2	-	3
	Dump truck	6m ³	2	2	2	2
	(Heil compactor)		1	1	1	1
Jableh Total			15	13	17	13
Qurdaha	Large Compactor	16m ³	4	-	3	-
	Medium Compactor	8m ³	-	-	1	-
	Small compactor	4m ³	-	-	-	1
	(Heil compactor)		2	2	2	2
	(Fiat compactor)		1	1	1	1
	Dump truck		1	1	1	1
	(Tractor)		1	1	1	1
Qurdaha Total			9	5	9	6
Al-Haffeh	Small Compactor	4m ³	3	3	3	3
	(Tractor)		1	1	1	1
	Dump Truck	6m ³	1	1	1	1
Al-Haffeh Total			5	5	5	5

It is obvious that Alternative III and IV need more vehicles than I and II because of introduction of separate collection. It can be also proposed that Alternative II and IV needs fewer vehicles than I, III. Because new transfer station is introduced and transport distance from city to T/S diminish. However, it's necessary to consider that Alternative II and IV need additional six container trucks.

Table 6.2.5 shows the required number of transport vehicles.

Table 6.2.5 Required Transport Vehicles by each Alternative in 2010

Alternative			I	II	III	IV
Jableh	Container Truck	20m ³	-	4	-	4
	Container	20m ³	-	7	-	7
Qurdaha	Container Truck	20m ³	-	2	-	2
	Container	20m ³	-	5	-	5
Total	Container truck	20m ³	-	6	-	6
	Container	20m ³	-	12	-	12

6.3 DISPOSAL SYSTEM

6.3.1 Introduction

Four (4) technical alternatives for the master plan of solid waste management have been prepared, and each alternative includes construction of a sanitary disposal site. Al-Bassa disposal site has to be utilized until the new site will be constructed. This part, therefore, shows basic measures for the appropriate improvement of both Al-Bassa disposal site and the future sanitary landfill site taking into account the achievement of minimum requirements.

Al-Bassa disposal site is composed of three zones along the seashore of Mediterranean and its total area is estimated at approximately 100 ha. A large number of waste piles are dispersed throughout each zone. It seems that the volume reduction and the stabilization of those dumped wastes have mostly reached at an advanced stage because of open burning and as time went by. Most of the piles of solid waste occur along operation roads, while the internal lands are covered by scattered plastics and other materials which are most likely resulted by wind and scavenging activities. Consequently, it is assumed that the volume of the dumped solid waste is not as great as it appears.

As for the future sanitary disposal site, a valley at Qasia that located near the road from Lattakia to Al-Haffeh was selected. The selected site is expected that it can be utilized for a very long term because of the magnitude of area and the topographic conditions. The disposal system will be developed fulfilling the minimum requirements.

6.3.2 Basic Policy of Rehabilitation and Operation Improvement at Al-Bassa Disposal Site

Disposal will need to be continued at Al-Bassa disposal site until construction of the new disposal site. Rehabilitation of Al-Bassa disposal site will need to take place at the same time as waste disposal, and methods for achieving this can be considered as follows.

- a. Take out all existing waste and dispose of at a separate site.
- b. Build a temporary disposal site in one corner of Al-Bassa disposal site using the existing waste and continue to receive new waste.
- c. Collect exiting waste into corner of Al-Bassa disposal site and cover it with earth.

Even if the above methods are used to deal with waste already brought into the site, there will be no meaning to the rehabilitation if open dumping continues to be practiced unchanged. It will at least be necessary to carry out earth covering from now on. Since the city currently does not have any disposal site equipment, it will be necessary for prevention of environmental pollution to implement earth covering using rented machinery.

In consideration of the above, it is necessary to implement rehabilitation using the method that entails the lightest burden, and it is realistic to start from alternative c. indicated above. Concerning the approach to this, since partial rehabilitation and improvement of disposal methods were implemented in the Pilot Study, these activities shall be continued.

Since it is thought that acquisition of land for the new disposal site will take some time, disposal of waste from Lattakia will need to be continued at Al-Bassa for around five more years. In this case, it will be necessary to develop part of Al-Bassa as a temporary disposal site. Concerning the geological conditions at Al-Bassa, consideration shall be given to the prevention of underground percolation of leachate when using the site for temporary disposal.

6.3.3 Applicable Sanitary Level

(1) Rehabilitation of Al-Bassa Disposal Site

The closure of the Al-Bassa disposal site is planned in the near future when the operation of new disposal site will start the operation. Although the existing disposal site is not applicable for solid waste disposal in terms of future land use plan and geographic conditions, the site has to be used until the opening of new disposal site. Therefore, rearrangement of the existing accumulated waste and a certain level of controlled landfill for daily incoming waste should be urgently introduced in order to mitigate environmental impacts on in/around the site.

In order to provide an example of the rearrangement of the accumulated waste and controlled landfill, a pilot study was carried out in an area of Al-Bassa disposal site. It is observed that the sanitary conditions of the pilot study area have been drastically improved, although the applied countermeasures were minimum level of the controlled landfill. From the viewpoint of the experience of the pilot study as well as financial/technical sustainability, the similar method as the pilot study can be applied for the rehabilitation of the whole Al-Bassa disposal site.

Table 6.3.1 shows the rehabilitation plan of Al-Bassa disposal site.

Table 6.3.1 Rehabilitation Plan of Al Bassa Disposal Site

Item	Contents of Rehabilitation
Urgent measures (First three years)	Rehabilitation of Zone I and II Improvement of landfill works (with cover soil) (Implemented by the Municipality by renting landfill equipment)
Medium term measures (After procurement of landfill equipment)	Rehabilitation of Zone III Construction of medium term disposal site in Zone III Waste disposal in Zone III (For about 5 years)

In Zones I and II, as was implemented in the Pilot Study, by building an embankment around the already dumped waste and continuing disposal within, rehabilitation and earth covering shall be implemented. Moreover, in order to improve operation of the disposal site, it is necessary to implement earth covering and the following heavy machinery will be needed for this. For the immediate future, these equipment shall be rented and procured as soon as possible:

- Bulldozers
- Excavators
- Dump trucks

In Zone III, already dumped waste shall be collected into one place and covered with earth, while the remaining area shall be converted into a temporary disposal site, so that waste can continue to be disposed of here.

(2) Construction/Operation of Qasia Inter-Municipal Disposal Site

It is expected that the activities of the pilot study will largely improve the present method of waste disposal and the experience will be carried over to the new inter-municipal disposal site. The system of sanitary landfill at the new site needs to be further upgraded to a level greater than the sanitary level of rehabilitation of Al-Bassa disposal site given the raised environmental expectations of residents in the surroundings.

The new landfill site has to be equipped with minimum functions of storage, lining and treatment for the purposes of safeguarding living conditions. And the operation system should be established so as not to create problems such as spillage of waste and leachate outside the site, scattering of waste or emission of offensive odor. The minimum requirements of the disposal system for the sanitary landfill site are proposed as shown in Table 6.3.2.

Table 6.3.2 Minimum Requirements for the New Inter-Municipal Disposal Site

Items	Requirement	Functions/Objectives
Structures	Embankment	<ul style="list-style-type: none"> • Creation of enough capacity for daily incoming waste including covering soil. • Prevention of waste outflow from the site.
	Enclosed fence	<ul style="list-style-type: none"> • Prevention of waste outflow from the site. • Access control and identification of boundary.
	Liner	<ul style="list-style-type: none"> • Prevention of water pollution by leachate.
	Leachate collection facility	<ul style="list-style-type: none"> • Collection/discharge of leachate from waste storage to leachate storage. • Provision of air into layer of solid waste through the facility and hastening of waste decomposition.
	Leachate storage and re-circulation facility	<ul style="list-style-type: none"> • Retention/re-circulation of leachate within the disposal site.
	Rainwater collection/drainage facility	<ul style="list-style-type: none"> • Collection/drainage of rainwater from surroundings and internal unpolluted rainwater from completed landfill area.
	Groundwater collection pipe	<ul style="list-style-type: none"> • Collection/drainage of groundwater under landfill area in order to conserve the liner.
	Rainwater retention pond	<ul style="list-style-type: none"> • Control of rainwater runoff from the site.
	Gas removal facility	<ul style="list-style-type: none"> • Releasing decomposition gas and hastening of waste decomposition
	Waste haulage management facility	<ul style="list-style-type: none"> • Bulletin board: Description of landfill site and indication of allowable solid waste. • Management office: Building for waste management. • Truck scale: Facility for measuring the weight of incoming waste. • Car wash facility: Facility to wash trucks that become dirty after entering the landfill site. • Cover soil storage: Place for storing cover soil that is utilized to prevent scattering of waste and offensive odor.
	Access/operation road	<ul style="list-style-type: none"> • Leading road for trucks from ordinary road to landfill site and premises road for hauling waste within landfill site.
Monitoring facility	<ul style="list-style-type: none"> • Monitoring environmental impacts. 	

Items	Requirement	Functions/Objectives
Operation	Hauling waste management	<ul style="list-style-type: none"> • Inspection of hauling waste, indication of landfill location and record of hauling waste.
	Landfill works management	<ul style="list-style-type: none"> • Inspection of landfill method, spreading and compaction, daily cover soil and so on.
	Maintenance of facilities	<ul style="list-style-type: none"> • Regular inspection for embankment, leachate storage/re-circulation facility, drainage and so on.
	Environmental management	<ul style="list-style-type: none"> • Measurement/inspection for water quality of leachate storage and groundwater, offensive odor, degree of decomposition and so on.

The detailed plan for the construction/operation of new disposal site will be prepared taking into account the financial/technical sustainability, geographic/topographic conditions of the site and so on.

6.3.4 Proposed Conceptual Plan of Disposal System

(1) Rehabilitation of Al-Bassa Disposal Site

1) Planning Policies

Although the future inter-municipal disposal site was selected at Qasia, the construction of the site will take a long period of time because of land acquisition and so on. Then it is expected that the new disposal site will be opened in 2008. Accordingly the existing disposal site is planned to continue the operation up to the year 2007. Since a lot of piles of accumulated waste disperse throughout the site, rearrangement of the existing accumulated waste and landfill of the daily incoming waste should be carried out simultaneously.

It is essential that the overall daily incoming waste to Al-Bassa should be controlled in terms of disposable location within the site. The site consists of three zones as shown in Figure 6.3.1. Incoming waste to Zone 1 and Zone 2 can be controlled since a guardhouse was constructed beside the access road to both zones by the pilot study.

A land of 350 meters in width from seashore will be reserved for future tourism road as shown in the above figure. Thus the rehabilitation works will be planned avoiding this setback.

As for method of landfill, a method similar to the pilot study will be applied to the rehabilitation of the Al-Bassa disposal site taking into account the experience of the actual works including the landfill method. It is deemed that creation of working space and daily cover soil are urgently needed in order to cope with the very poor level of sanitary conditions at the site. Therefore, the rearrangement of scattered waste and dispersed piles of waste into a certain area is the first step toward the rehabilitation. In addition, installation of a leachate collection/storage facility will improve the working conditions for waste haulage and carrying out of cover soil, since the difficulty of waste haulage within the site occurs in winter because of leachate spillover.

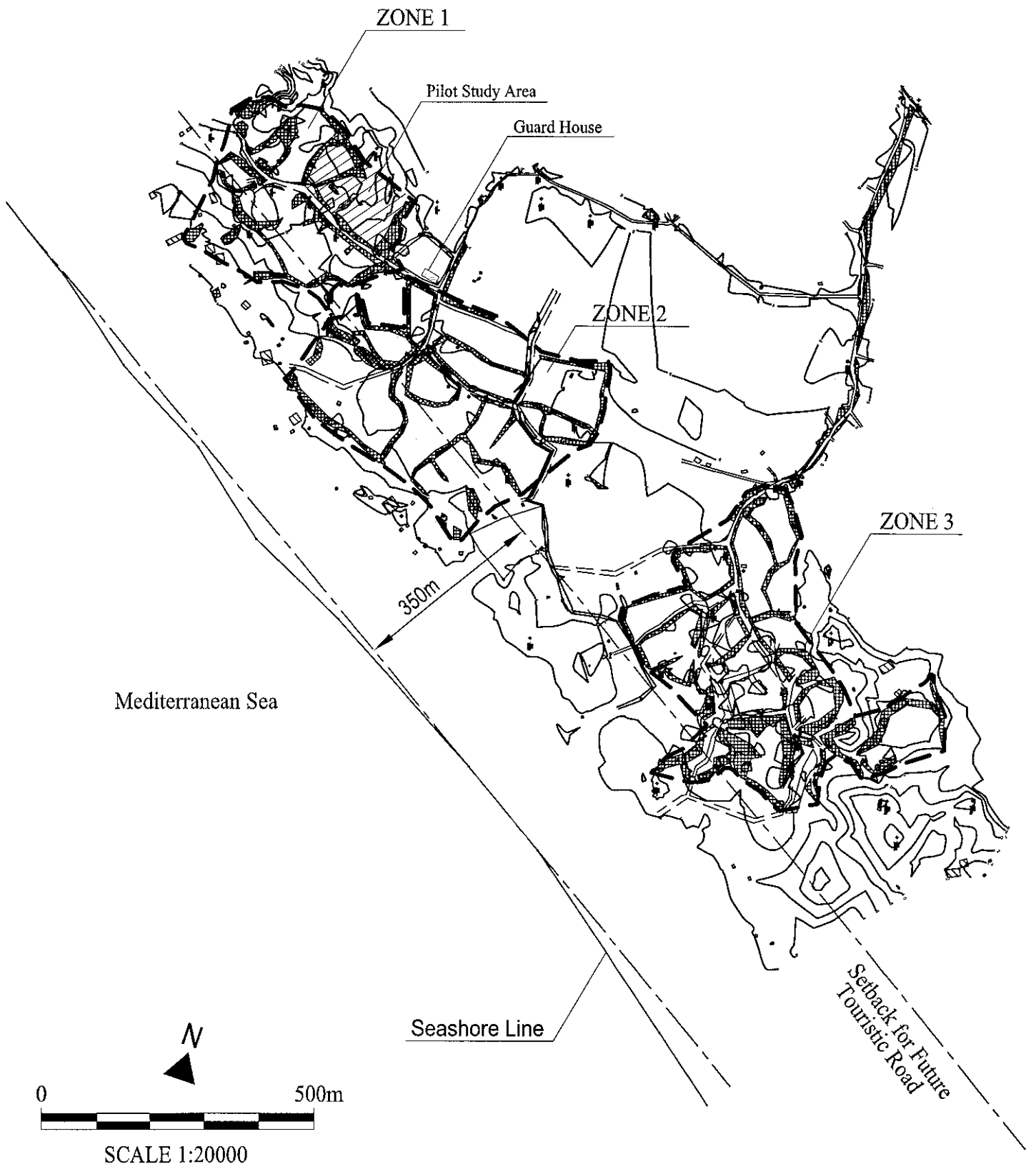


Figure 6.3.1 Zoning Scheme of Al-Bassa Disposal Site

2) Alternatives for Rearrangement of Existing Accumulated Waste

Rearrangement of the existing accumulated waste will be carried out together with controlled landfill operation of the daily incoming waste. The alternatives for the rehabilitation are shown as follows.

- Alternative 1: Landfill at another disposal site by carrying out the whole of the accumulated waste and construction of a tentative disposal site within Al-Bassa disposal site in order to accommodate daily incoming waste.
- Alternative 2: Construction of a tentative disposal site in Al-Bassa disposal site in order to accommodate both existing accumulated waste and daily incoming waste.
- Alternative 3: Landfill with final cover soil of the existing accumulated waste in an area within Al-Bassa disposal site and construction of a tentative disposal site within the site in order to accommodate daily incoming waste

Although Lattakia city council has not any equipment in order to carry out the rehabilitation of the site and the controlled landfill for daily incoming waste, it is necessary to carry out at least daily cover soil due to minimize environmental impacts. Taking into account the present situation and the experience of pilot study, it is deemed that the alternative 3 is the most favorable way to carry out the rehabilitation of Al-Bassa disposal site from the viewpoints of economical and technical aspects. In any case, Lattakia city council should rent heavy vehicles for several years in order to carry out the daily cover soil.

(2) Construction of Qasia Inter-Municipal Disposal Site

Qasia inter-municipal disposal site is proposed as a site for sanitary landfill including both facilities of inter-mediate treatment and recycling. The site's catchments area of rainwater is approx. 83 ha, and the available area for landfill and the related facilities is estimated at 62 ha. The site can accommodate a large quantity of solid waste, if the favorable topographic conditions in terms of landfill site are taken advantage. Figure 6.3.2 shows the conceptual plan of the inter-municipal disposal site. The selected site can be roughly divided into 3 zones; area for facilities, area for flood and leachate control and landfill site. Table 6.3.3 shows the phasing plan of Qasia disposal site.

Table 6.3.3 Phasing Plan in Qasia New Disposal Site

Time for construction	Capacity
Phase 1 (about 10 Years)	Approx. 2 million m ³
Phase 2 (next 10 Years)	Approx. 2 million m ³
After Phase 2	Approx. 6 million m ³

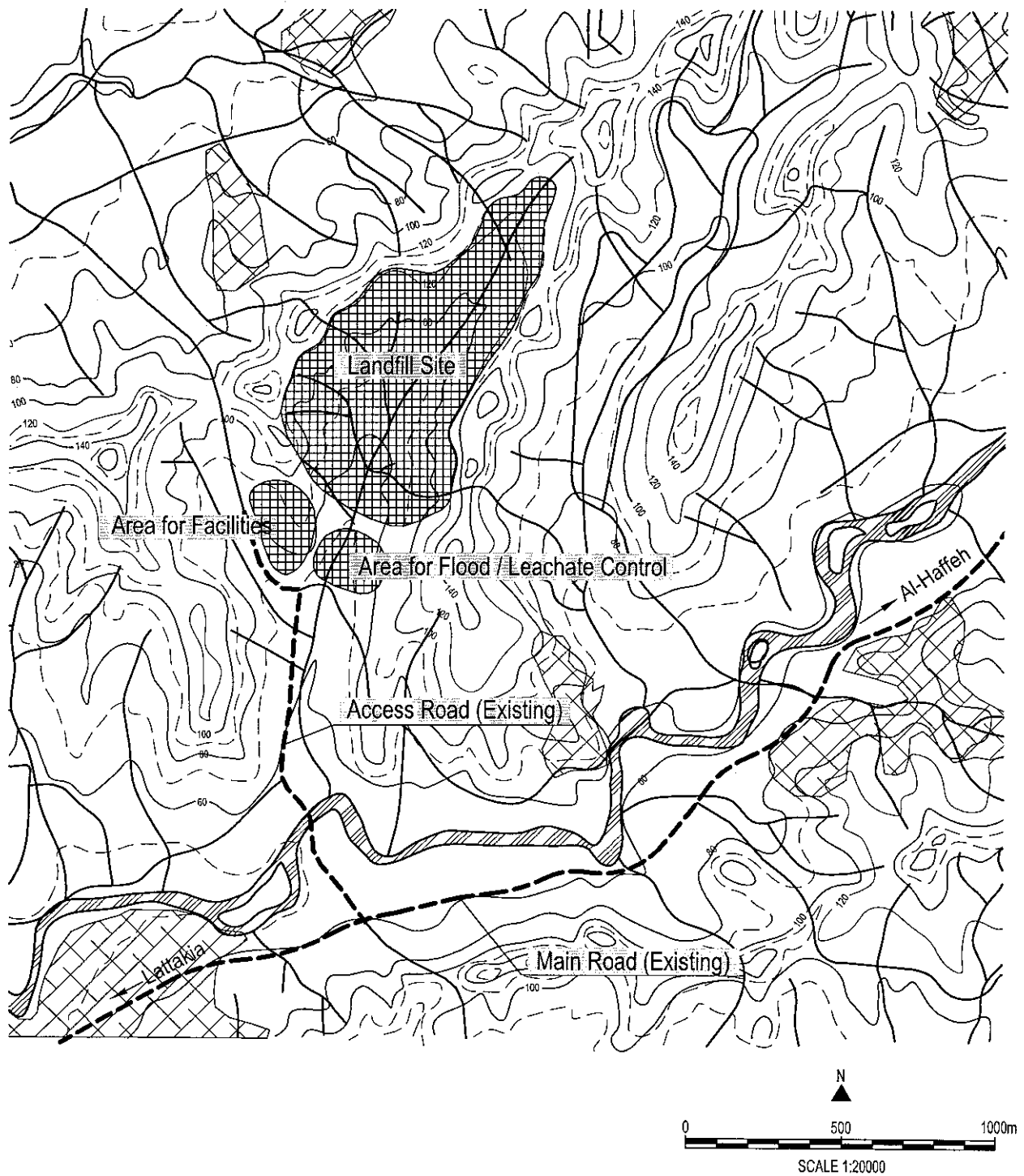


Figure 6.3.2 Conceptual Plan of Qasia Inter-municipal Disposal Site

6.4 INTERMEDIATE TREATMENT

(1) Introduction

In recent years, securing landfill sites adjacent to the city has been getting rather difficult even in developing countries. On the other hand, more than 85% of solid waste generated worldwide is hauled to disposal sites. Given these conditions, several kinds of intermediate treatment systems have been developed and adopted by local governments in developed countries for the purpose of volume reduction and resource recovery/recycling etc. of solid waste. Incineration is the most common method in developed countries. Other processing methods, such as composting, methanization, pyrolysis, RDF (refuse derived fuel), etc. have been introduced on a limited scale.

In Syria, composting is the only system introduced as an intermediate processing system for municipal waste. However, the compost plant in Lattakia, constructed between 1979 to 1980 using French technology, is very old and is now **closed because of bad quality compost production**.

The purposes of intermediate processing recognized worldwide are as follows;

- Volume reduction: to extend the life of disposal sites and to save waste transportation costs
- Resource recovery/Recycling: to recover re-usable materials and resources.
- Prevention of environmental pollution: to protect surrounding environment of the disposal sites.

(2) Possibilities for Intermediate Processing in Lattakia

Considering the rate of diffusion of various processing systems through the world, three processing systems namely incineration, composting and methanization have been provisionally selected and examined for possible application in Lattakia.

Incineration is mainly used in European countries and Japan. The primary purpose of incineration is to render the wastes inert, which also reduces volume and weight, and sometimes provides a waste heat recovery system for power generation.

Composting is the most commonly used aerobic biological decomposition process for the conversion of organic waste to a stable humus-like material called compost. Plastic, metal, glass, and other non-organic material are carefully pre-sorted.

Methanization is an aerobic biological decomposition process for domestic waste, which recovers methane, and the remaining material is similar to compost. This process or technology has been introduced during the last 20 years in European countries and the USA. Careful waste separation of plastic, metal, glass, and other non-organic material is required.

In order to choose a suitable option for the processing of municipal waste as a technical alternative for the SWM master plan in Lattakia (target year is 2010), several characteristics/ factors have to be taken into account. Table 6.4.1 provides a summary of the main factors for each option. Schematic flow diagram for incineration, composting and methanization is shown in Figure 6.4.1, 6.4.2 and 6.4.3, respectively.

Table 6.4.1 Characteristics of Intermediate Processing System

No	Item	Incineration	Composting	Methanization
1	Ease of operation and maintenance	+++	++++	+
2	Contribution to recycling	++	+++	+++
3	Volume reduction	+++++	+++	+++
4	Necessity of waste sorting	+++	+	+
5	Recovery material	Steam, Electricity	Compost	Fuel gas, Compost
5	Marketability of recovered materials	+++++	+++	+++
6	Environmental impact	++	+++	+++
7	Investment cost	++	+++	+
8	Operation & maintenance cost	++	+++	+

Note: [/+] shows magnitude of plus factors for its introduction

Incineration is not recommended as a technical alternative for the following reasons.

- Based on the result of the waste analysis survey conducted by the JICA study team in March and July 2001, municipal solid waste (MSW) in Lattakia is mainly food scraps/vegetables so it should be treated by composting, not incineration.
- Incineration causes environmental pollution. In particular, generated dioxins cause serious problems worldwide.
- Incineration is the most expensive of the three options.

Composting is recommended as a suitable technical alternative for the following reasons.

- The Quality of domestic waste in Lattakia is acceptable for composting; i.e. the content of matter that can be converted into compost is high and the moisture content is enough.
- Market demand for compost in the region is high. However, in order to maintain the quality of the compost, careful waste sorting and/or separate collection at each waste generation source is required.

Methanization is a system that is kind to the environment and positive for energy balance (fuel gas and soil conditioner can be recovered). So far, however, it has not been introduced worldwide as a large scale processing method of municipal waste. Also, it requires careful waste sorting and local marketability for fuel gas to be recovered by this process is considerably weak. Therefore, methanization cannot be recommended as an alternate of technical waste processing in Lattakia.

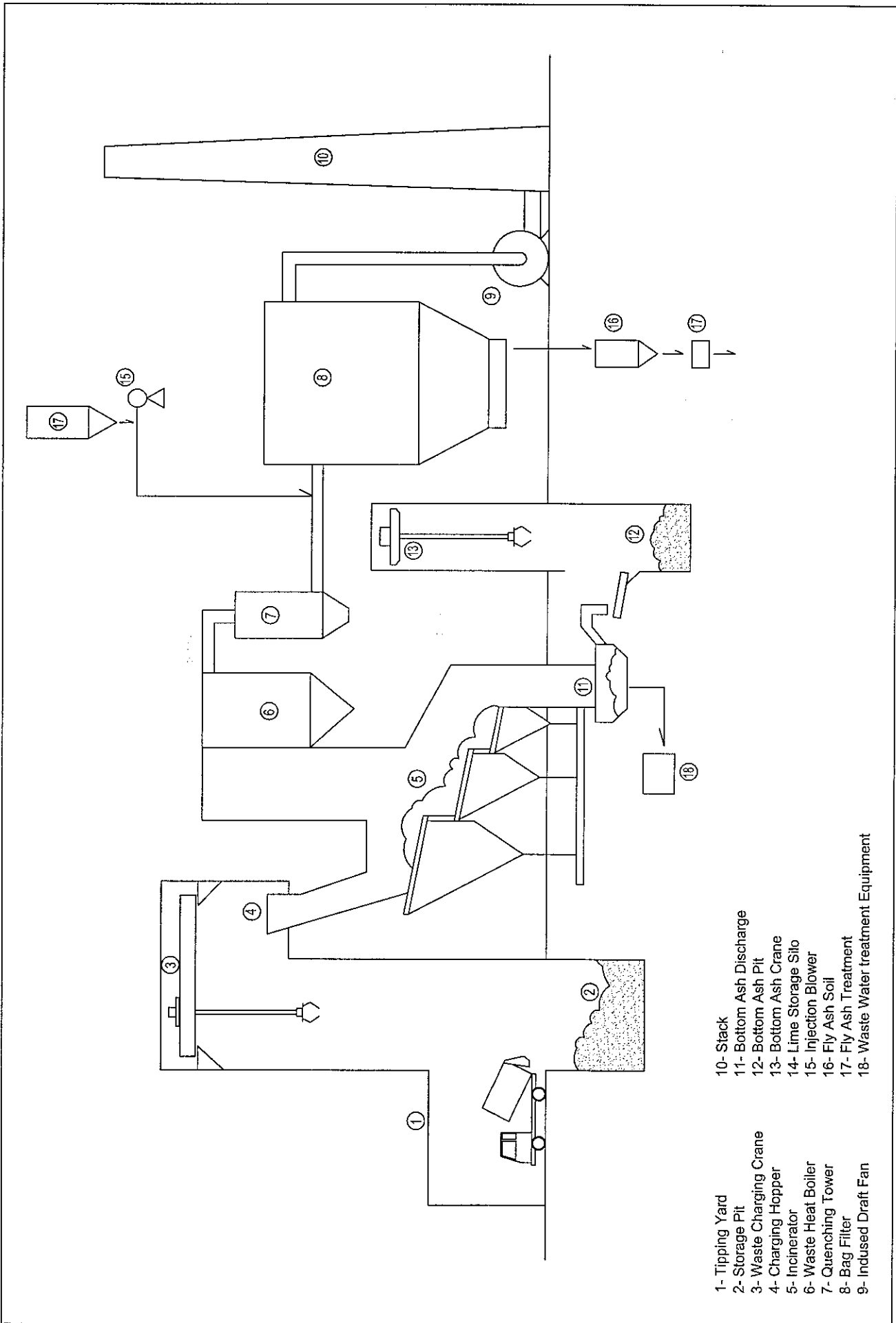
Since the old compost plant in Lattakia was only able to produce poor quality compost, it was not able to deal with latent demand. According to the findings of the compost demand survey, since there appears to be a high potential demand for good quality compost, composting is considered to be appropriate. Moreover, when introducing a new compost plant, in order to ensure that good quality compost is produced, it will be necessary to introduce separate collection and target waste that is suitable for collection.

(3) Scale of Composting

Source separation of domestic waste was carried out at 200 households in the Pilot Study, in which cooperation was obtained from medium and high-income groups. However, introduction of source separation will need to be carried out together with improvement of collection services and will need to be expanded in stages. Concerning low-income groups, current collection services are inadequate and introduction of source separation will not be so easy; therefore, it is realistic to expect that half of all domestic waste will be separated in 2010. Concerning market waste, collection via special routes will be necessary. Therefore the amount of waste suited to composting in 2010 will be as follows:

Source separated domestic waste	$406.4 \text{ tons} \times 0.5 \times 0.78^{*1} = 158.0 \text{ tons}$	*1: Organic waste ratio
Market waste (before separation)	48.2 tons	
Restaurants, hotels (before separation)	5.0 tons	
<hr/>		
Total	211.2 tons	

Targeting the above types of waste, approximately 200 tons/day is appropriate as the scale of composting in 2010.



- 1- Tipping Yard
- 2- Storage Pit
- 3- Waste Charging Crane
- 4- Charging Hopper
- 5- Incinerator
- 6- Waste Heat Boiler
- 7- Quenching Tower
- 8- Bag Filter
- 9- Induced Draft Fan
- 10- Stack
- 11- Bottom Ash Discharge
- 12- Bottom Ash Pit
- 13- Bottom Ash Crane
- 14- Lime Storage Silo
- 15- Injection Blower
- 16- Fly Ash Silo
- 17- Fly Ash Treatment
- 18- Waste Water treatment Equipment

Figure 6.4.1 Schematic Flow Diagram of Incineration Plant

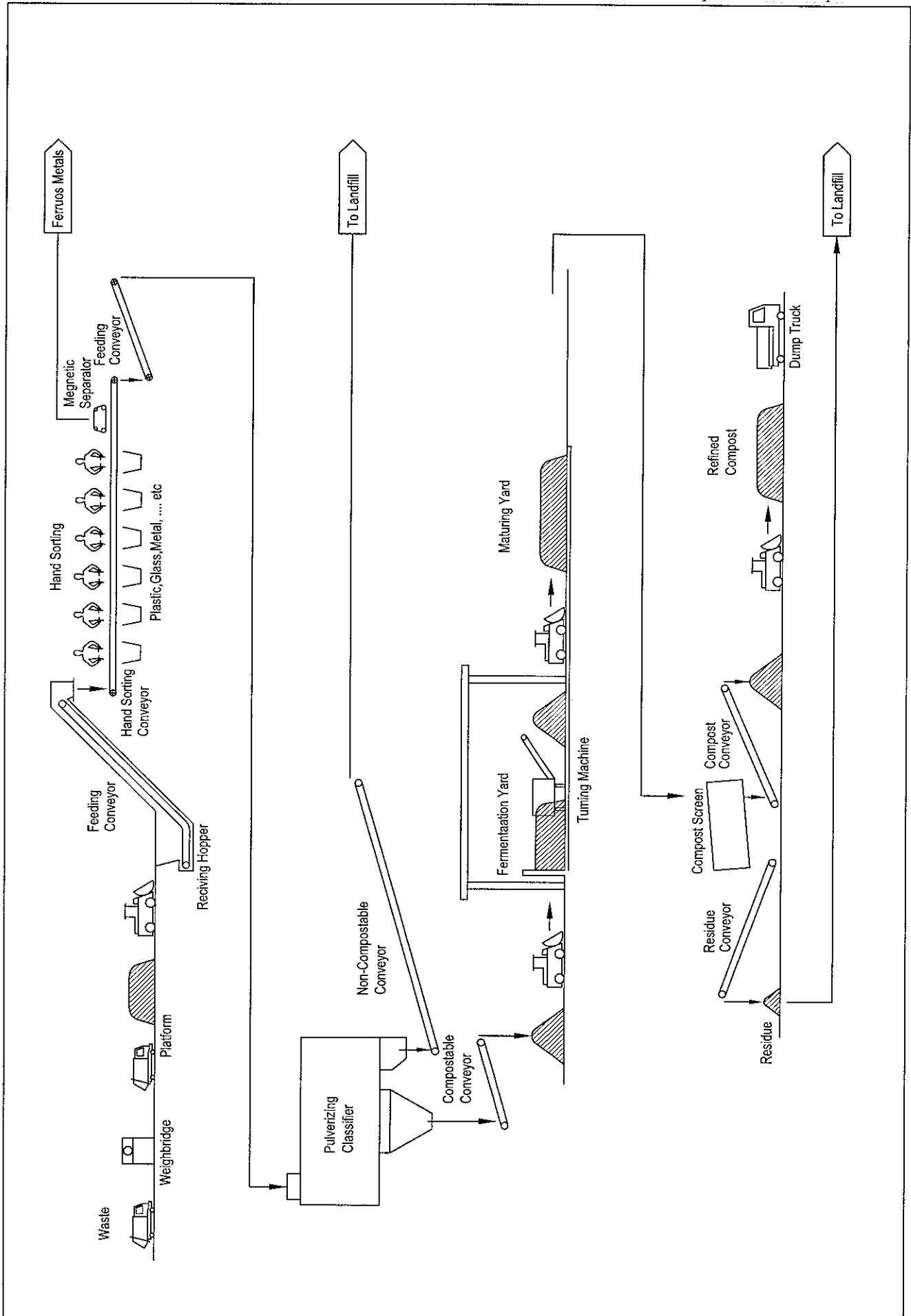


Figure 6.4.2 Schematic Flow Diagram of Compost Plant

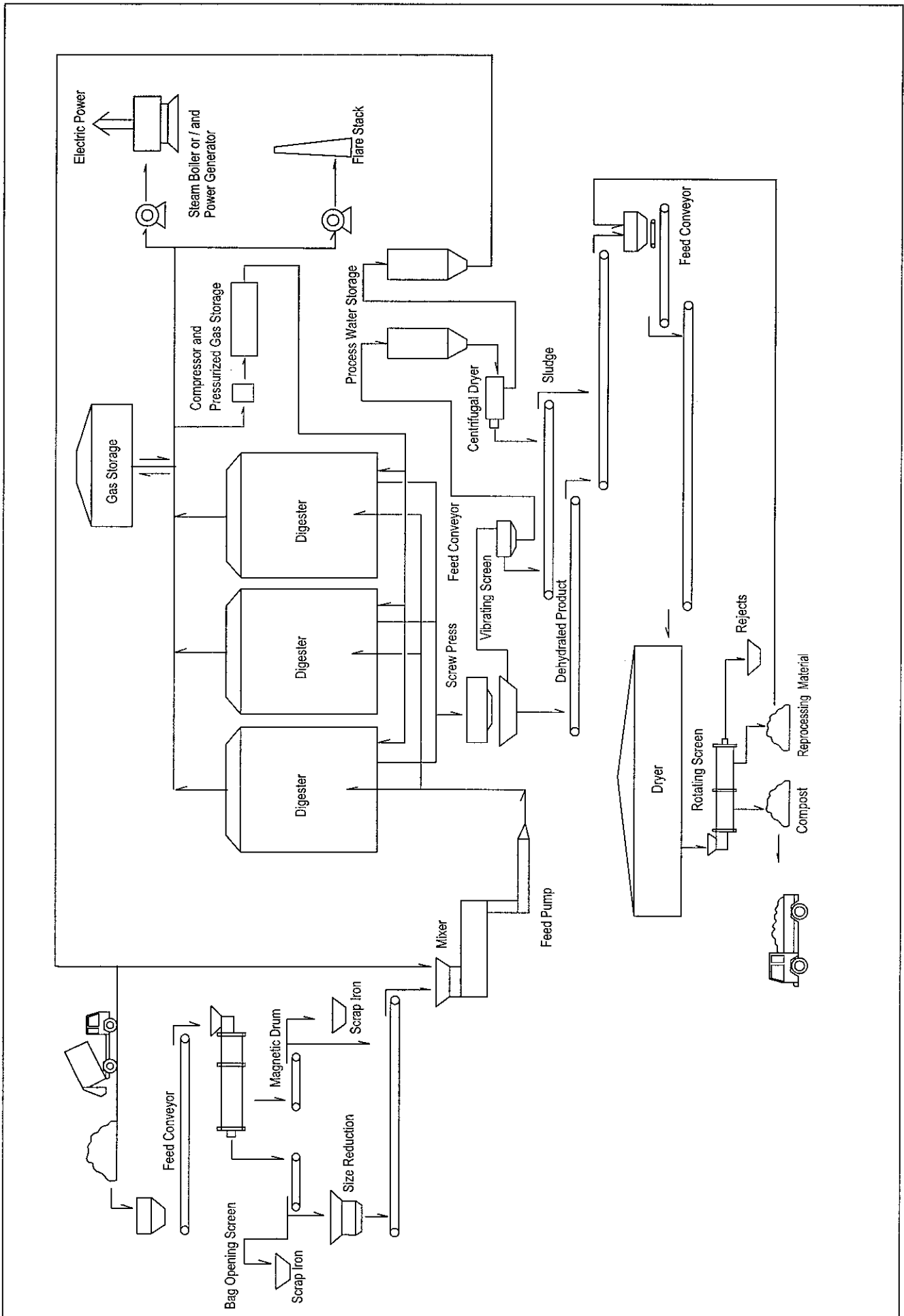


Figure 6.4.3 Schematic Flow Diagram of Methanization System

6.5 RECYCLING

6.5.1 Recycling of Reusable Material

It is commonly acknowledged that recycling as part of SWM confers the following benefits.

- Waste volume reduction that can reduce the burden on waste disposal services
- Reutilization of resources which has been an international trend for the last 10 years.

Recycling can be defined as a process incorporating the following steps.

- a. Separation and collection of recyclable waste materials (both organic and non-organic waste)
- b. Preparation of the recyclable materials for reuse (reutilization and re-manufacture)
- c. Reuse (reutilization and re-manufacture of these materials)

Item a) is heavily reliant on citizen co-operation, guarantees of stable and lasting market values for recyclable waste is indispensable for sustainable/continuous operation of *item b* and *item c* and these guarantees are dependent on the stable economic conditions of the country.

6.5.2 Present Conditions and Issues for Recycling

There are no formal recycling activities carried out by the municipality. In the private sector, between 30-40 mediators in Lattakia and surrounding cities exist and about 100 waste-pickers in Al-Bassa and Jableh disposal site activity recycle waste materials. In addition collection crews are used to separate collect and sell the recyclable materials to the middlemen, and individual collectors also do the same activities with their own three-wheel vehicles. No end-users exist in Lattakia and surrounding cities, therefore, most of the recyclable materials collected by the middlemen are sold/ transported outside the city; i.e. Aleppo, Armanaz, Homs, Hama and Damascus.

Total amount of recyclable materials handled by the middlemen in Lattakia; i.e. cardboard, plastic, clear bottles, ferrous metal, non-ferrous metal etc., are estimated to 47- 50 ton per day (which include about 30 ton/day of the recycling from industrial waste). Table 6.5.1 shows the amount and price of recyclable materials in Lattakia.

Table 6.5.1 Price of Recyclable Materials

Recycled Materials	Recycled Amount (ton/day)	Purchase Price (SP/kg)	Re-sold Price (SP/kg)	Location of End-users
• Paper (Cardboard)	5 - 6	--	2	Aleppo
• Plastic (Bottles)	4 - 5	6 - 7	7 - 8	
• Plastic (Green-house sheets)		6	6.5 - 7	
• Glass (Clean bottles)	5 - 6	1 - 2.5	1.5 - 3.5	Amanaz/Homs
• Ferrous metal	15	0.75 - 4	0.8 - 4.5	Hama
• Aluminum (Cans)	15	25 - 28	27 - 30	Damascus

Recycled Materials	Recycled Amount (ton/day)	Purchase Price (SP/kg)	Re-sold Price (SP/kg)	Location of End-users
• Aluminum (thin/ soft)		60 - 63	64 - 65	Aleppo
• Aluminum (hard)		35 - 38	37 - 41	
• Copper (thin/ soft)	3	55 - 57	57 - 60	
• Copper (hard)		32 - 50	35 - 55	
• Car batteries	--	10	11	
Total (estimation)	47 - 50			

Source: JICA Study Team

As mentioned above, current recycling activities are performed only by the informal sector. In order to reduce the burden on the waste disposal site and to introduce a sustainable urban existence in Lattakia, Jablah, Al-Haffeh and Qurdaha, an affordable recycling system handling both organic and non-organic waste is recommended. Besides, the formal sector's participation is one of the key issues to widening such recycling activities.

6.5.3 Recycling Options

The following two key issues shall be considered in order to promote an affordable recycling system.

- Source separation and collection of reusable waste materials
- Recycling of organic waste and reusable waste materials (non-organic waste)

(1) Source separation and collection of reusable waste materials

There are two ways to separate and collect reusable waste materials from domestic waste as follows.

- a. Separate at source ("source separation") and collect
- b. Sorting at the processing plant from collected mixed waste

Source separation relies heavily on citizen cooperation. Citizens are requested to separate non-organic waste at source. The separated waste are kept at their houses then discharged at collection points on designated days. For the practice and spread of source separation, proper instruction from the municipal side is also necessary.

Waste sorting facilities have been set up to further separate the source-separated waste as well as to sort the mixed waste. At these facilities, in addition to manual sorting, some processing equipment such as classifiers, bag-breakers, magnetic separators, shredders, balers etc. are sometimes used. However the introduction of source separation will be considerably cheaper and involve fewer technical difficulties than the setting up of waste sorting facilities.

The sorting center should target commercial waste, which contains little organic waste, and also separated domestic waste. Targeted waste is generally as follows.

Separated domestic waste	406.4 x 0.5 x 0.22 *2 =	44.7 tons	*2: Ratio of inorganic waste
<u>Shop waste, etc.</u>		<u>31.9 tons</u>	
Total		76.6 tons	

Therefore, the maximum capacity of the sorting center will be around 70 tons. Since valuable materials are collected in an informal manner at the moment, a sorting center with around 40 tons capacity shall be constructed.

(2) Recycling of Organic Waste and Reusable Waste Materials

1) Organic waste recycling

Taking into consideration the rate of diffusion of various processing systems world wide, the targeting of municipal waste, waste quality and the present conditions in Lattakia and the surrounding three cities, two recycling systems for organic waste; namely composting and methanization, are briefly introduced here.

Composting is the most commonly used biological process for the conversion of organic waste to a stable humus-like material called compost. Plastic, metal, glass, and other non-combustibles are carefully separated beforehand. Composting is described in detail in section 6.4 and 7.4 of this report.

Methanization is a biological process for domestic waste that recovers methane and the digested material is similar to compost. This technology has been introduced over the last 20 years in European countries and USA. Careful waste separation of plastic, metal, glass, and other non-combustibles is a preliminary requirement.

2) Recycling of reusable waste materials

With regard to the recycling of reusable waste materials, separation and/or sorting of the mixed municipal waste are the key issues for its proper introduction. As briefly discussed in this section, a combination of “source separation” and “sorting facility” will be the recommended alternative for its successful introduction.

Additionally, private sector involvement under the proper guidance from the municipality side is important in order to systematize and spread widely the present recycling activities by the private sector (waste picker, middlemen and/or end-users).

6.6 MEDICAL WASTE MANAGEMENT

(1) Conditions for Alternatives

The following conditions will be necessary for establishing and evaluating the alternatives related to the medical waste:

- To take the local situation related to medical waste management into consideration
- Not all the waste generated in the medical establishments have the potential risk for infection. The waste having a potential risk of infection should be targeted for an alternative study.
- No infectious waste should be disposed of in final landfills without being sterilized or incinerated before disposal.

- The source separation inside medical establishment and appropriate disposal manners at the final disposal site of receiving medical waste should be essential as appropriate treatment

(2) Waste Amount of Medical Waste

1) Definition of Medical Waste and Waste Type

The medical waste generated in medical waste establishments are mainly classified as follows.

- Infectious waste
- Hospital general waste
- Chemical and pharmaceutical waste including radioactive waste
- Pathological waste

Above waste classifications are defined in Table 6.6.1 in this study.

Table 6.6.1 Definition of Medical Waste

Waste Category	Description of Examples
Infectious waste	Waste suspected to be infectious: Laboratory cultures, waste from isolation wards, tissues, materials or equipment that have been in contact with infected patients, excreta, sharps such as needles, scalpels and knives
Hospital general waste	The waste which can be dealt with by the normal domestic and urban waste management systems (food waste, papers, etc.)
Chemical and pharmaceutical waste	Waste containing chemical substances, waste containing pharmaceuticals, wastes with high content of heavy metals, pressurized containers, radioactive waste
Pathological waste	Human tissues of fluids e.g. body parts, other body fluids and fetuses

2) Waste Amount of Medical Waste

The amount of medical wastes generated obtained in the study varies widely in each medical establishment. This will make it difficult to estimate the actual quantity of infectious waste in the study area.

Therefore, the amount of infectious waste is predicted with the following:

- Determination of total bed number of medical establishment in the study area
- Determination of unit waste generation amount per bed number from the similar studies
- Determination of ratio of infectious waste to total waste generated in the medical establishment
- Determination of amount of infectious waste

a. Bed Number

Total bed number in the study area is shown in Table 6.6.2.

Table 6.6.2 Number of Bed

Name of City	Number of Bed
Lattakia	1,009
Jableh	152
Qurdaha	128
Al-Haffah	0
Total	1,289

Therefore, approximately, 1,300 bed number can be estimated in the study area.

b. Unit Waste Amount per Bed Number

Table 6.6.3 shows the unit waste amount of medical waste in similar studies.

Table 6.6.3 Waste Amount per Unit Bed Number of Medical Waste

(Unit: kg/bed /day)

	Study in Morocco* ¹	Study in Homs* ²	USA	Japan
Unit Waste Amount of Medical Waste	3	1.2	1.2 – 6.5	1.5

Source: *1: "The Study on the National Guidelines for Solid Waste Management for the Kingdom of Morocco", August 1997, JICA.

*2: "Homs Solid Waste Management Study Interim Report", August 2000, METAP.

The generation amount will vary on its locality. The waste amount per unit bed number is assumed as 3 kg/bed/day that is equivalent to the figure of Morocco's case and as the middle of that of the USA.

c. Generation Ratio of Infectious Waste to Total Medical Waste

The ratio of infectious waste to total medical waste is estimated as 20 to 40 % from the current worldwide situation of medical waste. Therefore, approximately 30 % can be applied for the ratio. Chemical, pharmaceutical waste including pathological waste is estimated to generate approximately 5 % of the total medical waste. The remaining is estimated to be hospital general waste that comes from the administrative and housekeeping functions.

d. Amount of Medical Waste

The amount of medical waste as of 2001 in the study area is estimated as follows:

Waste Amount of Medical Waste =

(Generation Amount of Total Medical Waste per Unit Bed Number) x (Total Bed Number)

$$= 3.0 \times 1,300$$

$$= 3,900 \text{ kg/day}$$

- Infectious waste
30 % for amount of medical waste is estimated:
 $0.3 \times 3,900 = 1,170 \text{ kg/day}$

- Hospital general waste
65% for amount of medical waste is estimated:
 $0.65 \times 3,900 = 2,535$ kg/day
- Chemical and pharmaceutical waste including pathological waste
5 % for amount of medical waste is estimated:
 $0.05 \times 3,900 = 195$ kg/day

The future amount of medical wastes is estimated by the increase rate of 1.0% up to 2010.

The figures are shown in Table 6.6.4.

Table 6.6.4 Future Estimate Amount of Medical Waste

(Unit: t/day)

Waste Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Infectious waste	1.17	1.18	1.19	1.20	1.21	1.22	1.23	1.24	1.25	1.26
Hospital general waste	2.54	2.57	2.60	2.63	2.66	2.69	2.72	2.75	2.78	2.81
Other waste	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.22	0.22

(3) Medical Waste Treatment

In Lattakia Governorate, approximately 3.9 tons of medical waste is generated, and around 30% of this is infectious waste. Concerning infectious waste, careful handling and treatment are required. Currently in Lattakia Governorate, infectious medical waste is incinerated at national hospitals, however, in Jableh City, due to the shortage of collection equipment, medical waste is collected and disposed of at the city disposal site together with general waste. Accordingly, it is necessary to build a setup for carrying out the appropriate treatment of medical waste.

Treatment of medical waste is implemented both inside hospitals and outside hospitals. The features of both methods are as shown in Table 6.6.5. The method for treating infectious waste shall be selected from either incineration or sterilization by autoclave.

Table 6.6.5 Medical Waste Treatment

	In-hospital Treatment (Separate Treatment)	External Treatment (Integrated Treatment)
System outline	At each hospital, infectious waste is separated, or treatment facilities are installed and it is discharged after being treated. After treatment, it is collected and disposed together with general waste. Other medical waste is collected with general waste. Treatment facilities are installed at some large hospitals.	At each hospital, infectious waste is separately discharged. The waste is collected separately and carried to treatment facilities for treatment. Other medical waste is collected with general waste. This method is adopted in Damascus.
Merits	Infectious medical waste is treated inside hospitals.	Treatment facilities can be concentrated in a few places, enabling easy management

	In-hospital Treatment (Separate Treatment)	External Treatment (Integrated Treatment)
Demerits	Since facilities are needed in each hospital, the burden on small hospitals is large. Numerous facilities make management difficult.	Thorough separation inside hospitals is necessary. Independent collection is necessary.

In Lattakia Governorate, since incinerators are installed at three hospitals, these shall be utilized, while a system for collecting infectious waste from other hospitals shall be constructed.

Special care is required when collecting infectious waste and it is necessary to implement thorough separation inside hospitals. Also, countermeasures for preventing infection during collection and treatment are necessary. When collecting infectious waste, it is necessary to distribute special containers to each hospital and to carry out collection that is suited to these.

As for non-infectious medical waste, this shall be collected together with general waste as done so far.

6.7 INDUSTRIAL WASTE MANAGEMENT

(1) Conditions for Alternatives

The following conditions should be taken into consideration for setting up alternatives;

- The current situation of industrial waste management in Lattakia and surrounding three cities should be fully analyzed
- Basically the study should aim at small-scale industries (the estimated employee number is less than 50 persons)
- The study should aim at industrial wastes excluding hazardous wastes

(2) Waste Amount of Industrial Waste

Assessment of the current waste treatment generated by small-scale industries is based on the review for existing reports, and findings through the interviews with the workshops.

1) Type of Industry

There are various types of industries in Lattakia and the other three cities. Most of the workshops are private factories.

The industries are classified as follows:

- Food industry (olive oil pressing, drinks, etc.)
- Chemical industry (painting, plastics)
- Manufacturing (Furniture, wood cutting, stone cutting, marble cutting, mechanical printing, wood and metal processing, battery, electrical parts, etc.)

- Textile industry (men, woman and children clothes)

The industry of the study area is characterized by the local special products (olives and fruits etc.) and its geology (limestone).

Most of the industries have less than 50 employees.

2) Current Treatment of Industrial Waste

The following industrial waste are generated from the above industries:

- Waste oil
- Scrap metal
- Plastics
- Slag
- Rock
- Paper

The following treatment methods were identified by the interview survey.

- Re-use inside establishment
- Selling to middlemen
- Hauling to neighboring empty plot
- Transport to open dumping site

Hazardous waste is currently treated at the special landfill in a desert area.

As for metal manufacturing, some metal slag such as aluminum is re-used inside the establishment and some slag is sold to middlemen for recycling.

At the car repair workshops for car repairing in Lattakia Industrial Area, many metal scraps were hauled near the workshops.

Some of the wastes are transported to Al-Bassa open dumping site.

3) Waste Amount of Industrial Waste

There is no official data related to the amount of industrial waste generated. The generation amount itself depends on their ability to recycle and the production process inside each establishment.

Table 6.7.1 shows the results of the interview survey for waste generation at small industries in the study area.

Some of the wastes in the study area are recycled by selling to middlemen, some wastes are dumped indiscriminately, and others are disposed of at open dumping site.

Table 6.7.1 Results of Interview Survey for Industrial Waste

No.	Type of Industry	Number of Employee	Waste Generation	Treatment
1	Car Repair	1	Battery: 1 piece/month Aluminum: N/A	Battery: Selling to middlemen Aluminum: Sell to middlemen
2	Car Repair	2	Steel: N/A Painting can: 10 can/month	Steel: Hauling to outside Painting Can: Collection by Municipality car
3	Printing	20	Waste Paper: 100 pieces/day	Waste Paper: Selling to middlemen
4	Painting	5	Paper bag: 2 ton/year	Paper bag: Throw to Al-Bassa dumping site
5	Olive Oil pressing	4	Olive core: 200kg/day	Olive Core: Selling to governmental factory

Table 6.7.2 shows the number of small industries in the study area.

About 3,600 ton/year of industrial waste is estimated by comparing this study to the study in Homs City (“ METAP-Homs Solid Waste Management Study “).

Table 6.7.2 Number of Establishments

Type of Industry	Number of Establishment
Food Industry	64
Car Repair	27
Textiles	69
Bricks & Construction	30
Metal Manufacturing	22
Marble Cutting	15
Plastic Production	17
Detergent Production	10
Printing	1
Furniture	3
Electrical Manufacturing	34
Wood Cutting	16
Make-up Production	2
Painting Production	19
Perfumery Production	1
Kitchens	8
Foundry	1
Pumps Production	5
Glass Production	2
Total	346

(3) Current Issues related to Industrial Waste

The following issues related to industrial waste were identified:

- No laws and penalties apply to industrial waste, hence the indiscriminate hauling and dumping.
- There are many quarries and a great deal of waste has accumulated.
- Most industries cannot treat the generated wastes inside their establishments because of their small-scale management.

- There are no systems for inspecting/auditing establishments by the municipal authorities or third parties.
- There is no training conducted by the municipality.
- Most of the facilities and production processes are old and in home manufacturing, thus it appears to have been difficult to reduce industrial waste inside these establishments.

(4) Collection and Treatment

The target for collection and disposal is the non-hazardous waste generated by small industries. Each municipality should carry out the collection of industrial waste. As for the treatment, there are currently between 30 to 40 private middlemen in the study area. In addition, the collection crews currently separate/collect and sell the recyclable materials (aluminum, ferrous metal, papers, etc.). In future, the recyclable waste generated from small industries should be sold to these middlemen, while other non-recyclable waste should be disposed of at the final landfill.

(5) Non-hazardous Industrial Waste

Since industrial waste also includes hazardous products, it is first necessary to separate the hazardous items. Since hazardous waste requires special treatment according to the waste composition, handling in each Governorate and city is difficult. Therefore, it is necessary for hazardous waste treatment facilities to be constructed on the national level.

Concerning non-hazardous industrial waste, it is desirable for large factories to treat their own waste. As for waste discharged by small and medium factories, this shall be collected and disposed of together with general waste. In either case, it is important to separate waste at the source to ensure that hazardous waste does not get mixed in.

6.8 SELECTION OF OPTIMUM ALTERNATIVE

The technical systems in each alternative were selected as explained in preceding sub-sections. Table 6.8.1 summarizes and compares the alternatives. Table 6.8.2 shows cost comparisons.

Table 6.8.1 Evaluation of Each Alternative

Item	Alternative-1	Alternative-2	Alternative-3	Alternative-4
Facilities provided	Disposal site Collection equipment	Disposal site Collection equipment Transfer stations	Disposal site Collection equipment Separate collection Compost plant & Sorting center	Disposal site Collection equipment Separate collection Transfer stations Compost plant & Sorting center
Institutions build-up	Inter-municipal disposal	Inter-municipal disposal Waste transfer	Inter-municipal disposal Compost plant & Sorting center	Inter-municipal disposal Waste transfer Compost plant & Sorting center
1. Environmental impact	+++	+++	++++	++++
2. Burden to disposal site	+++++	+++++	++	++
3. Collection efficiency	++	++++	++	++++
4. Waste minimization	+	+	++++	++++
5. Recycling	+	+	+++++	+++++
6. Contribution to agriculture	+	+	+++++	+++++
7. Cost	++	++	++++	++++

Note: [+] shows the magnitude of each evaluation factor

Source: JICA Study Team

Table 6.8.2 Cost of Each Alternative

(Unit: Million SP)

Item	Alternative-1	Alternative-2	Alternative-3	Alternative-4
Investment cost (2001 - 2010)	586.3	638.8	1,388.9	1,441.5
O/M cost (2001 - 2010)*	1,113.5	1,107.5	1,156.7	1,143.6

Note: * Depreciation is not included

Alternatives 1 and 2 are basic systems, while Alternatives 3 and 4 also include introduction of recycling. Investment cost and operation and maintenance cost are smaller in Alternatives 1 and 2 than in 3 and 4, and Alternative 1 has the lowest cost. However, this alternative does not promote the volume reduction and recycling of waste.

Alternatives 3 and 4 include introduction of source separate collection and recycling facilities for the promotion of recycling. As a result, costs are higher than in Alternatives 1 and 2. In future, since society will demand the volume reduction of waste, the utmost effort should be made to select Alternatives 3 or 4. Moreover, cost in Alternatives 3 and 4 is less than 1% of the gross regional domestic product in Lattakia and the three surrounding cities and is a permissible level for the society. Therefore, it is desirable that Alternatives 3 or 4 be selected.

Alternative 4 entails introduction of transfer stations. As is indicated in this report, transfer stations are costly, however, it should be considered that these facilities relieve the burden placed on cities located far from disposal sites and they can be utilized by surrounding municipalities. Incidentally, Alternative 4 entails the introduction of separate collection, recycling facilities and transfer stations to the solid waste

management by 2010. Careful investigation of facilities will be required in future, however, Alternative 4 is desirable as the master plan for waste management.

CHAPTER 7 SWM MASTER PLAN

7.1 SOLID WASTE FLOW

SWM Master Plan for Lattakia, Jableh, Al-Haffeh and Qurdaha has been prepared with the target year 2010, based on the targets/ conditions summarized in Table 7.1.1. Accordingly, the solid waste flows for 2010 and for 2006 (medium-term target) are shown in Figure 7.1.1 and 7.1.2, respectively. Table 7.1.2 shows the annual solid waste amount for the M/P period. Figure 7.1.3 shows the location of proposed SWM facilities for the master plan.

Table 7.1.1 Targets/Conditions of the Master Plan in 2010

Targets/ Conditions of M/P	
1.	Waste Amount Generated Waste generation rate, amount etc. of each type of waste are described in Section 1.5.1 of this report. (Based on the field survey conducted by JICA study team.)
2.	Waste Collection Collection coverage ratio of municipal waste is 95% in 2010 and 85% in 2006.
3.	Waste Source Separation Target ratio of the waste source separation at households is approx. 48% in 2010 and 26% in 2006. Source separation will be introduced from 2005. 78% of source separated waste is assumed to be organic waste, while, 22% will be non-organic waste. (Based on the field survey carried out by JICA study team.)
4.	Recycling Center Recycling center which is composed of a <i>compost plant</i> and <i>sorting center</i> will be established at Al-Bassa (in 2005) and at Qasia (in 2010).
5.	Composting Waste received at the compost plant in 2010 will be market waste (100%) and organic waste obtained by source separation (capacity: 200 ton/day). Compost plant will start operation in 2005 as a pilot plant in Al-Bassa (capacity: 25 ton/day, 1 shift operation). After verifying the compost demand and quality, the plant will operate with the capacity of 50 ton/day by 2 shift. Waste mass balance at the compost plant assumed to be; 25% compost product, 5% recyclables and 25% residue of receiving waste in weight ratio, respectively.
6.	Sorting Center Waste received at the sorting center will be non-organic waste obtained by source separation. 25% of waste received (source-separated waste) is assumed to be recyclables.
7.	Waste Recycling Target ratio for the recycling of non-organic waste is approx. 8% (performed at sorting center and compost plant and by private sector).
8.	Transfer Stations Jableh and Qurdaha transfer stations will start operation in 2008. All collected waste in each city will be transported through each transfer station.
9.	Waste Disposal Qasia new inter-municipal disposal site will start operation in 2008 as a sanitary landfill. Existing Al-Bassa disposal site shall be rehabilitated and continue operation until 2007.
10.	Seasonal Waste in Summer 100% seasonal waste in summer (July, August and September) will be collected and disposed of in 2010.
11.	Medical Waste 100% medical waste shall be independently collected/disposed of. Infectious waste shall be incinerated in a proper manner.
12.	Small-scale Industrial Waste Small-scale industrial waste shall be collected/disposed of by the generators responsible for the waste in cooperation with the municipality.

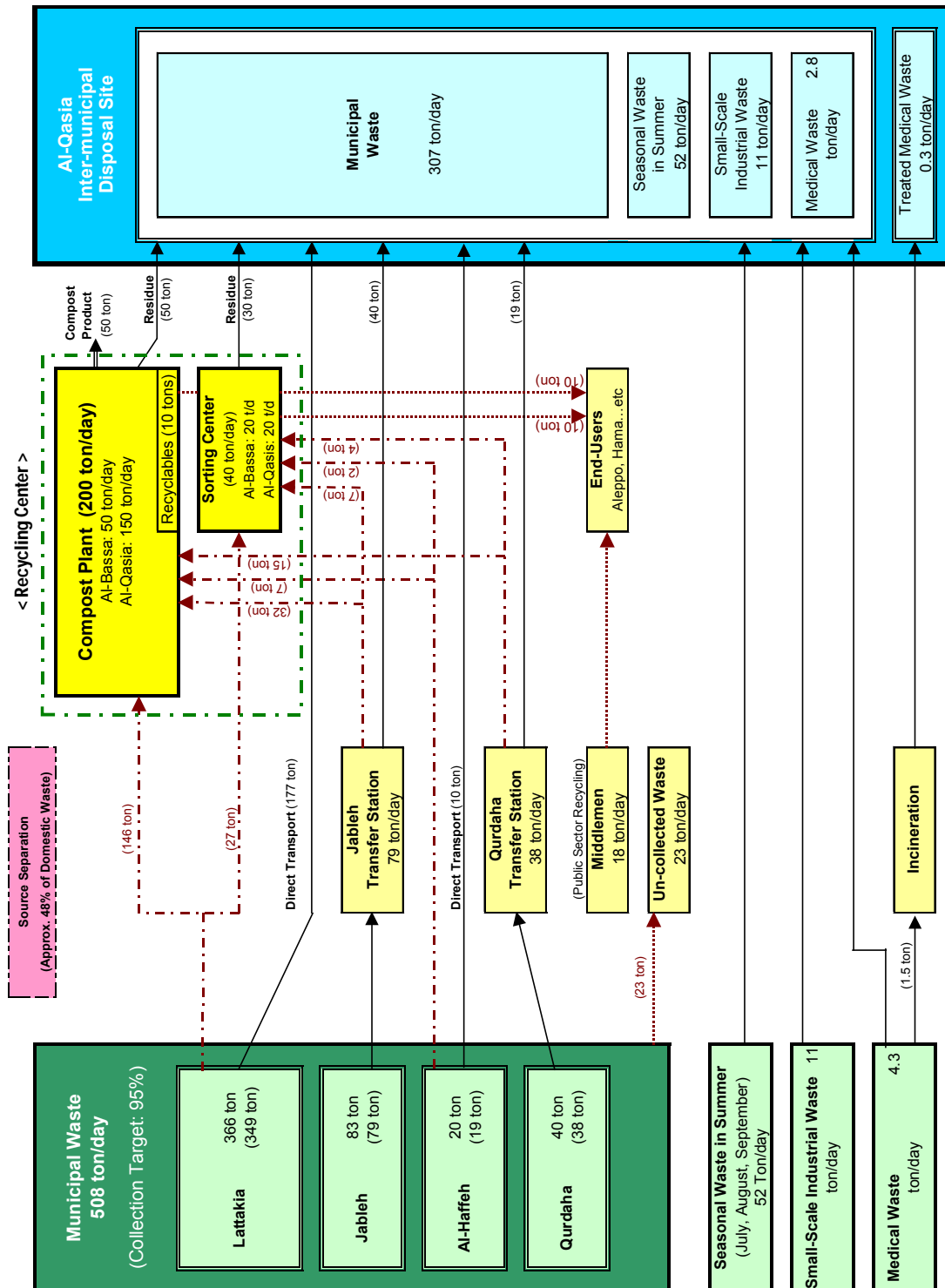


Figure 7.1.1 Solid Waste Flow in the Year 2010

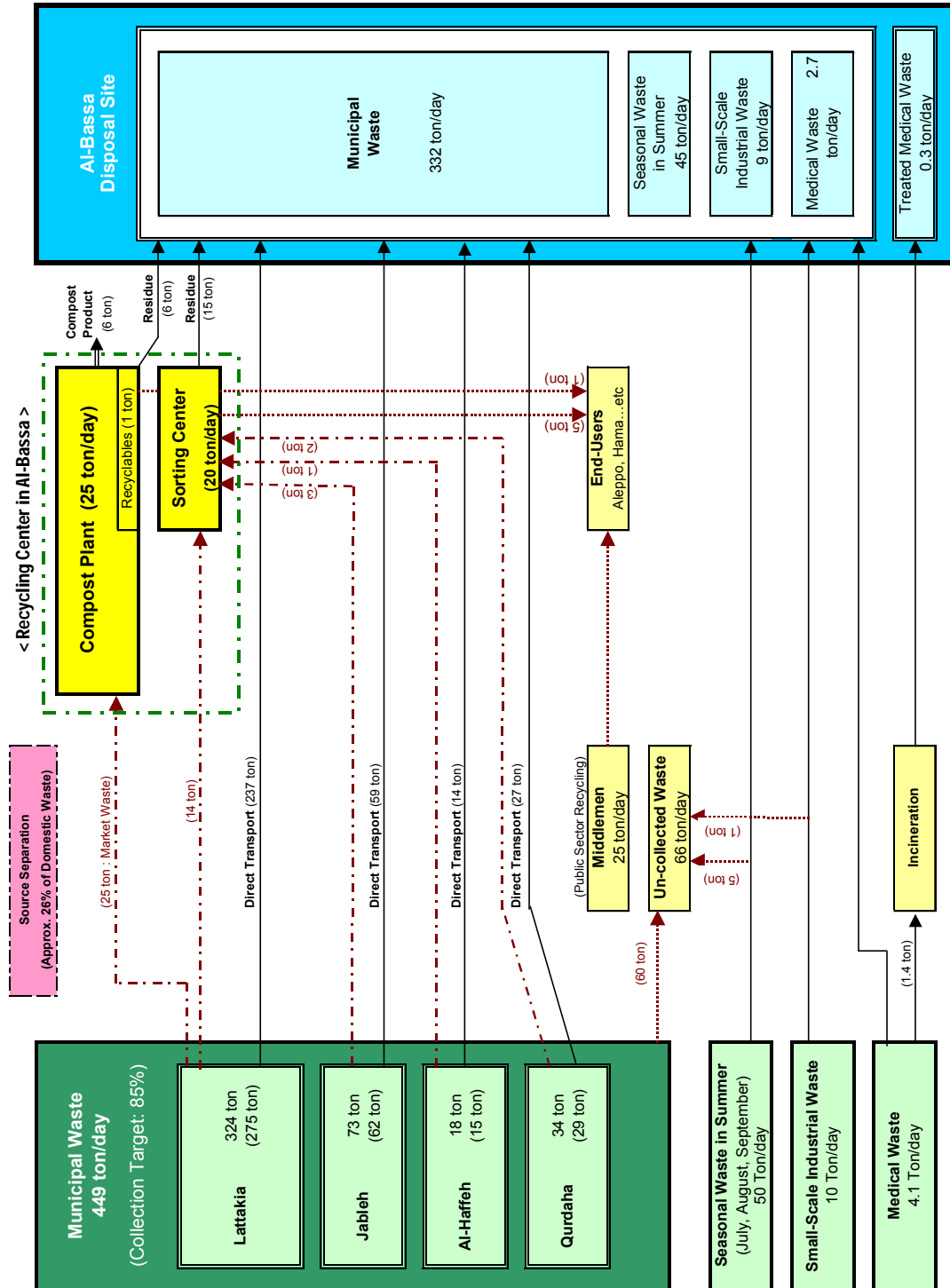


Figure 7.1.2 Solid Waste Flow in the Year 2006

Table 7.1.2 Annual Solid Waste Amount in the Master Plan Period

Item	Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
I. Municipal Waste											
1. Waste Amount Generated											
1) Domestic waste	ton/day	293	303	315	326	339	351	364	378	392	406
a. Lattakia	ton/day	203	211	218	227	235	244	253	262	272	282
b. Jabla	ton/day	50	52	54	56	58	60	62	65	67	70
c. Al-Haffeh	ton/day	13	13	14	14	15	15	16	16	17	18
d. Quardaha	ton/day	27	28	29	30	31	32	33	34	36	37
2) Commercial waste	ton/day	78	79	79	80	81	82	83	83	84	85
- Market waste	ton/day	44	45	45	45	46	46	47	47	48	48
a. Lattakia	ton/day	37	37	37	38	38	39	39	39	40	40
b. Jabla	ton/day	6	6	6	6	6	6	6	6	6	6
c. Al-Haffeh	ton/day	1	1	1	1	1	1	1	1	1	1
d. Quardaha	ton/day	1	1	1	1	1	1	1	1	1	1
- Other commercial waste	ton/day	34	34	34	35	35	35	36	36	36	37
a. Lattakia	ton/day	29	29	30	30	30	31	31	31	32	32
b. Jabla	ton/day	3	3	3	4	4	4	4	4	4	4
c. Al-Haffeh	ton/day	1	1	1	1	1	1	1	1	1	1
d. Quardaha	ton/day	0	0	0	0	0	0	0	0	0	0
3) Road & Park waste	ton/day	15	15	16	16	16	16	16	16	17	17
a. Lattakia	ton/day	11	11	11	11	11	11	11	11	11	12
b. Jabla	ton/day	3	3	3	3	3	3	3	3	3	3
c. Al-Haffeh	ton/day	1	1	1	1	1	1	1	1	1	1
d. Quardaha	ton/day	1	1	1	1	1	1	1	1	1	1
Total	ton/day	386	398	410	422	435	449	463	478	493	508
2. Waste Collection Amount	ton/day	270	278	287	359	370	389	401	456	470	485
- Collection coverage ratio	%	70	70	70	85	85	85	85	95	95	95
3. Source Separation Amount	ton/day	0	0	0	0	88	91	95	98	102	195
1) Organic waste	ton/day	0	0	0	0	69	71	74	77	79	152
2) Non-organic waste	ton/day	0	0	0	0	19	20	21	22	22	43
- Source separation ratio	%	0	0	0	0	26	26	26	26	26	48
4. Waste Mass Balance at Compost Plant											
1) Received waste amount	ton/day	0	0	0	0	25	25	25	50	50	200
- Separated domestic waste	ton/day	0	0	0	0	0	0	0	25	25	152
- Market waste	ton/day	0	0	0	0	25	25	25	25	25	48
2) Compost products	ton/day	0	0	0	0	6	6	6	13	13	50
3) Recyclables (Separated at the plant)	ton/day	0	0	0	0	1	1	1	3	3	10
4) Residues	ton/day	0	0	0	0	6	6	6	13	13	50
5. Waste Mass Balance at Sorting Center											
1) Received waste amount	ton/day	0	0	0	0	19	20	20	20	20	40
2) Recyclables (Separated at the center)	ton/day	0	0	0	0	5	5	5	5	5	10
3) Residues	ton/day	0	0	0	0	15	15	15	15	15	30
6. Lattakia											
1) Collection amount	ton/day	196	201	207	260	267	275	284	329	339	349
2) to Compost	ton/day	0	0	0	0	25	25	25	42	42	146
3) to Sorting Center	ton/day	0	0	0	0	13	14	14	14	14	27
4) to Disposal Site	ton/day	196	201	207	260	229	237	244	273	283	177
5) Un-Collected Waste	ton/day	84	86	89	46	47	49	50	15	16	16
Total (2-5)	ton/day	280	288	296	305	315	324	334	344	355	366
7. Jableh											
1) Collection amount	ton/day	44	45	46	58	60	62	64	74	76	79
2) to Compost	ton/day	0	0	0	0	0	0	0	6	6	32
3) to Sorting Center	ton/day	0	0	0	0	3	3	3	3	3	7
4) to Disposal Site	ton/day	44	45	46	58	57	58	61	65	68	40
5) Un-Collected Waste	ton/day	19	19	20	10	11	11	11	4	4	4
Total (2-5)	ton/day	62	64	66	68	71	73	75	78	80	83
8. Al-Haffeh											
1) Collection amount	ton/day	11	11	11	14	15	15	16	18	19	19
2) to Compost	ton/day	0	0	0	0	0	0	0	1	1	7
3) to Sorting Center	ton/day	0	0	0	0	1	1	1	1	1	2
4) to Disposal Site	ton/day	11	11	11	14	14	14	15	16	17	10
5) Un-Collected Waste	ton/day	5	5	5	2	3	3	3	1	1	1
Total (2-5)	ton/day	15	15	16	17	17	18	18	19	19	20
9. Quardaha											
1) Collection amount	ton/day	20	21	22	27	28	29	30	35	36	38
2) to Compost	ton/day	0	0	0	0	0	0	0	1	1	15
3) to Sorting Center	ton/day	0	0	0	0	2	2	2	2	2	4
4) to Disposal Site	ton/day	20	21	22	27	27	27	28	32	33	19
5) Un-Collected Waste	ton/day	9	9	9	5	5	5	5	2	2	2
Total (2-5)	ton/day	29	30	31	32	33	34	36	37	38	40
10. Recycling by Middlemen	ton/day	20	21	21	27	24	25	26	29	30	18
11. Waste Disposal Amount	ton/day	250	258	266	332	322	332	343	385	398	307
12. Un-Collected Waste	ton/day	116	119	123	63	65	60	62	19	20	23
II. Seasonal Waste in Summer (July, August and September)											
1. Waste Amount Generated	ton/day	48	48	49	49	50	50	51	51	52	52
2. Waste Amount Collected/ Disposal	ton/day	43	44	44	45	45	45	51	51	52	52
III. Medical Waste											
1. Waste Amount Generated	ton/day	3.9	3.9	4.0	4.0	4.1	4.1	4.2	4.2	4.2	4.3
2. Waste Amount to be Incinerated	ton/day	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5
VI. Small-scale Industrial Waste											
1. Waste Amount Generated	ton/year	10	10	10	10	10	10	10	11	11	11
2. Waste Amount Collected/ Disposal	ton/year	9	9	9	9	9	9	10	11	11	11

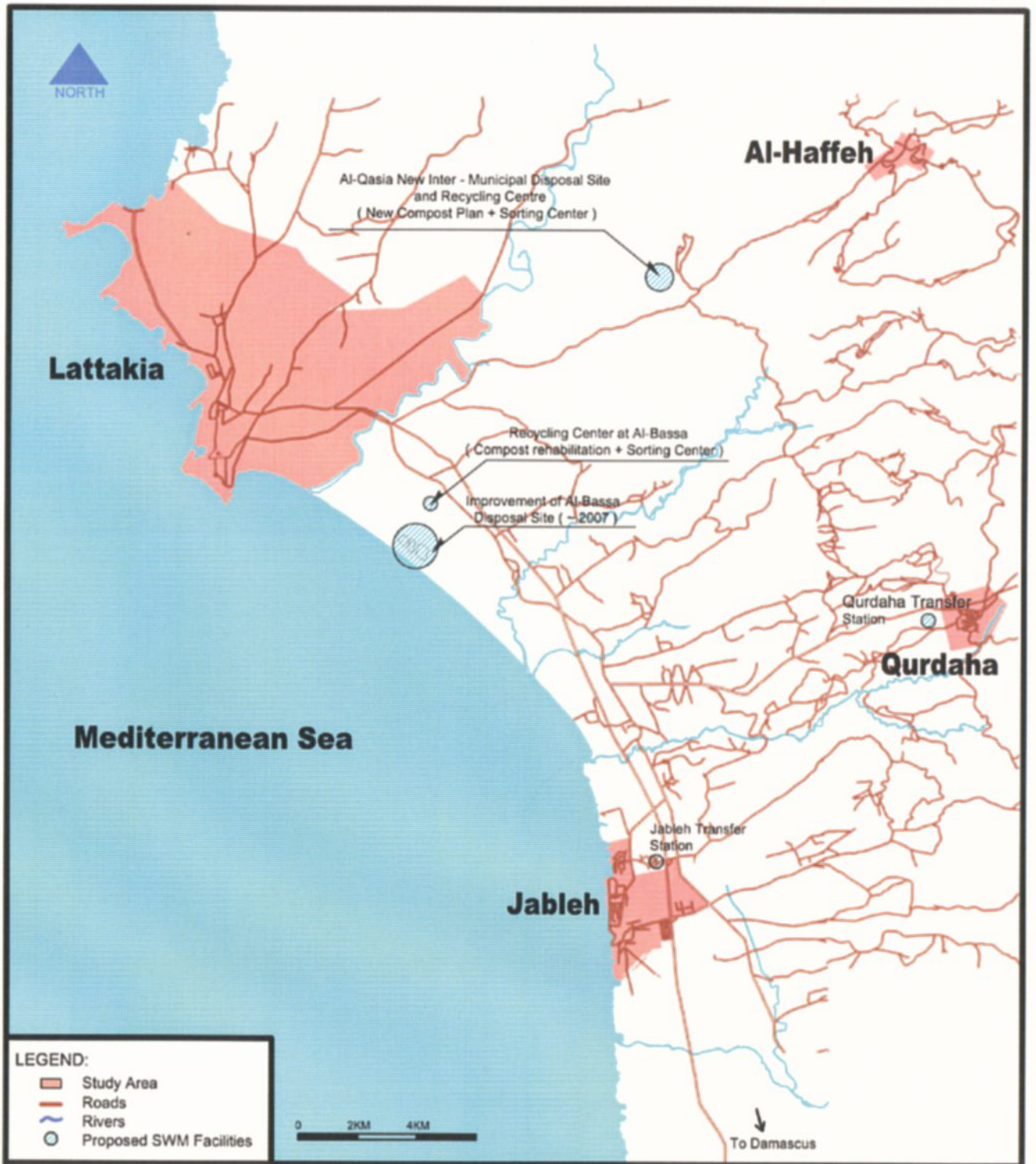


Figure 7.1.3 Location of Proposed SWM Facilities for the M/P

7.2 COLLECTION, STREET SWEEPING AND TRANSPORT

(1) Outline

The issues of waste collection and transportation are first, the preparation of a well-organized system for the procurement and renewal of the required collection vehicles. If the present conditions of maintenance and service for vehicles working in the city center continue, it is obvious that the collection service coverage will decrease due to the deterioration of equipment similar to what the City of Jableh is currently facing. A second issue is to extend the collection service to the surrounding areas and this is especially a very serious and urgent matter for the cities of Lattakia and Jableh.

On the other hand, the current trend is to construct a society that generates the least environmental pollution as possible, and for this purpose the introduction of source separation as well as the promotion of recycling waste are necessary. In consideration of these facts, by the year of 2010 the source separation of the waste should be introduced in almost half of all high and middle-income residential districts. This introduction of source separation practice shall also be required in the three cities surrounding Lattakia and the reasons are as follows.

- a. In case the source separation practice is introduced only in Lattakia, an unfair feeling among the people of the urban area will result because of the increased service fee burden, and on the other hand, the complaints from other cities concerning non- introduction of the same separation practice will occur. Maintaining fairness among the people of the cities becomes very important.
- b. The source separation practice is easily introduced in small cities and moreover, introduction in small cities will become a model case for large cities.

Additionally, by the year of 2010, waste disposal at a new final disposal site, Qasia, shall be started. The distance from Qurdaha and Jableh to the said disposal site is estimated to be about 35 to 40 km and for the improvement of transportation efficiency, transfer stations shall be constructed in line with the opening of Qasia new final disposal site.

(2) Collection Target and Planning Condition

- a. The target waste collection rate shall be 85 % in 2006 and 95 % in 2010, and domestic waste, commercial waste (including market waste), park and street waste, non-infectious medical waste and small-scale factory waste shall be collected.
- b. By the year of 2010, the source separate collection in nearly half of high and middle-income residential regions shall be started. Under this program, the separation shall be done for organic and inorganic waste. Market waste shall be collected as organic waste. In the rest of cities, mixed collection shall be continued as it is currently being done.
- c. The forecast for waste collection amount, as shown in Table 7.2.1 will be 390 ton/day by 2006 and 499 ton/day by 2010.

Table 7.2.1 Waste Collection Amount in 2006 and 2010

(Unit: ton/day)

Item	2006		2010	
	Generation amount	Collection amount	Generation amount	Collection amount
Domestic waste	351.2	298.5	406.4	386.1
Separated organic waste	-	71.2	-	152.1
Separated in-organic waste	-	20.1	-	42.9
Mixed waste	-	207.2	-	191.9
Commercial waste	81.8	69.6	85.1	83.3
Market waste (organic waste)	-	25.0	-	48.2
Others (mixed collection)	-	44.6	-	35.1
Road & park waste	16.1	15.3	16.7	15.9
Medical waste (non-infectious)	2.8	2.8	2.8	2.8
Industrial waste (small scale)	10.4	9.3	10.8	10.8
Total	462.3	395.5	521.8	499.0

Note: All figures showing the total waste in Lattakia and surrounding three cities

The forecast collection amount for each city is shown in Table 7.2.2.

Table 7.2.2 Waste Collection Amount by City

(Unit: ton/day)

Year	Item	Lattakia	Jableh	Qurdaha	Al Haffeh	Total
2006	Mixed collection waste	201.3	45.3	21.3	11.2	279.1
	Separated organic waste	74.4	12.2	6.5	3.1	96.2
	Separated in-organic waste	14.0	3.4	1.8	0.9	20.1
	Total	289.7	60.9	29.6	15.2	395.4
2010	Mixed collection waste	183.3	42.0	19.9	10.6	255.8
	Separated organic waste	145.7	32.0	15.1	7.5	200.3
	Separated in-organic waste	29.8	7.3	3.9	1.9	42.9
	Total	358.8	81.3	38.9	20.0	499.0

(3) Collection System

As for the collection system, the current system of using containers shall be continued in principle, considering its suitability at Lattakia, Jableh and Qurdaha. At Al-Haffeh, collection shall be done using plastic bags. In addition, large compactor trucks are currently used for container collection. However, in consideration of the existing conditions in the collection area, medium size compactor trucks may be more suitable.

For mixed collection and separated organic waste collection, the current container collection shall be adopted and daily collection shall be implemented, except at Al-Haffeh where plastic bag collection shall be continued. Separated inorganic collection and plastic bag collection shall be done twice per week because small waste amounts are generated and there are no storage problems at the household level.

(4) Street Sweeping

At Lattakia, Jableh and Qurdaha, street sweeping is mainly being carried out with mechanical equipment, and in future the same sweeping practice shall also be continued. For other streets, manual sweeping in combination with waste collection

shall be carried out as it is currently being done. Furthermore, at the smallest city of Al-Haffeh, all street sweeping shall be performed manually. The total length of streets to be swept is shown in Table 7.2.3.

Table 7.2.3 Length of Street Sweeping

(Unit: km)

Item	Lattakia	Jableh	Qurdaha	Al Haffeh
Main street	76.7	54.0	NA	NA
Other street	229.1	52.0	NA	NA
Total	305.8	106.0	14.8	NA

(5) Renewal of Equipment

The equipment introduced into service before 1990 shall be renewed promptly after being used over 10 years. The equipment procured before 1995 shall also be renewed by the year of 2010. The necessary collection vehicles are shown in Table 7.2.4.

Table 7.2.4 Required Equipment for Collection and Street Sweeping

(Unit: nos)

Equipment	Lattakia	Jableh	Qurdaha	Al Haffeh	Total
2006 Collection					
Compactor (9ton)	(9)	(1)	(3)		(13)
Compactor (8m ³)	15	7			22
Compactor (4m ³)	7	3	1	3	14
Dump truck (6m ³)	2 (1)	2	1	1	6 (1)
Tractor	(2)	0	(1)	(1)	(4)
Shovel loader	1	1			2
Wash container	1				1
Sub total	26 (12)	13 (1)	2 (4)	4 (1)	45 (18)
2010 Collection					
Compactor (9ton)		(1)	(3)		(4)
Compactor (8m ³)	41	7			28
Compactor (4m ³)	12	3	1	3	19
Dump truck (6m ³)	2	2	1	1	6
Tractor	(2)		(1)	(1)	(4)
Wheel loader	1	1			2
Wash container	1				1
Sub total	57 (2)	13 (1)	2 (4)	4 (1)	76 (8)
2006 Sweeping					
Mechanical sweeper	(3)	(1)	(1)		(5)
Water tank	2		(1)		2 (1)
Sub total	2 (3)	(1)	(2)	0	2 (6)
2010 Sweeping					
Mechanical sweeper	(3)	(1)	(1)		(5)
Water tank	2		(1)		2 (1)
Sub total	2 (3)	(1)	(2)	0	2 (6)

Note: () Existing Vehicle

(6) Operation Plan

Waste collection and street sweeping work shall be implemented as shown in Table 7.2.5.

Table 7.2.5 Waste Collection and Street Sweeping Work

Item	Contents
1. Collection day	In principal, daily collection.
2. Collection system	In Lattakia, two (2) shifts operation, day and night, and necessary vehicles and personnel for each shift shall be arranged (8 operation hours). In other cities, one (1) shift operation, daytime, and operation hour shall be 8 hours. Further, in summer time the operation hours shall be extended to cope with increased waste amount.
3. Organization of waste collection crew	One operator for a collection vehicle with 2 workers. One supervisor for every 5 vehicles. One supervisor, one operator and one worker for a wheel loader.
4. Organization of street sweeping crew	One operator with one sweeper. For manual sweeping, one handcart for each worker. One team consists of one manager and ten workers.
5. Method of discharge	Daily discharging of mixed collection and separated organic waste to containers. In Al-Haffeh, discharging of waste by use of plastic bags to collection points. Discharging of separated inorganic waste in plastic bags to collection points twice a week.
6. Maintenance of equipment	Daily maintenance shall be carried out by operator and periodical inspection and repairing shall be contracted out to a specialized private company.

The numbers of personnel required for waste collection and street sweeping are as shown in Table 7.2.6. At present, a total of 818 personnel are engaged in waste collection and street sweeping in the four (4) cities. Except for Lattakia City, the numbers of personnel in the other three (3) cities must be increased. However, in Lattakia it is necessary to decrease the number of people doing manual sweeping in accordance with the upgrading of the equipment and improvement of residents cooperation in waste issues. It is also necessary to switch over those surplus people to the waste treatment and disposal divisions, for the purpose of cost reduction in waste disposal.

Table 7.2.6 Number of Personnel for Waste Collection and Street Sweeping

(Unit: Person)

Year	Person	Lattakia	Jableh	Qurdaha	Al Haffeh	Total
2006	Collection					
	Supervisor	9	4	2	2	17
	Driver	41	16	6	6	69
	Worker	82	30	11	11	134
	Sub total	132	50	19	19	220
	Sweeping					
	Supervisor	40	5	2	1	48
	Driver	6	2	3		11
	Worker	6	2	3		11
	Manual sweeper	374	31	9	6	420

Year	Person	Lattakia	Jableh	Qurdaha	Al Haffeh	Total
	Sub total	426	40	17	7	490
	Total	558	90	36	26	710
2010	Collection					
	Supervisor	14	4	2	2	22
	Driver	64	16	6	6	92
	Worker	128	30	11	11	180
	Sub total	206	50	19	19	294
	Sweeping					
	Supervisor	27	5	2	1	35
	Driver	6	2	3		11
	Worker	6	2	3		11
	Manual sweeper	250	31	9	6	296
	Sub total	289	40	17	7	353
	Total	495	90	36	26	647

(7) Transfer Station

a. Waste Transportation Volume

In line with the construction of a new landfill disposal site at Qasia, all of the waste generated in Jableh and Qurdaha shall be transported through transfer stations to the final disposal site. Under the system of the transfer stations, waste shall be separated into the mixed and separated organic waste and the separated inorganic waste. The waste volume of both cities, Jableh and Qurdaha in the year of 2010 is estimated as 120 ton/day as shown in Table 7.2.7.

Table 7.2.7 Waste Volume to be Transported in 2010

(Unit: ton/day)			
Item	Jableh	Qurdaha	Total
Mixed waste	41.8	20.0	61.8
Separated organic waste	32.1	15.1	47.2
Separated in-organic waste	8.6	4.6	13.2
Total	81.2	39.0	120.2

b. Transfer System

In consideration of the small amount of waste, 120 ton/day in total, and also of necessity of waste separated transportation, the roll-on type container truck shall be adopted. The capacity of containers is 20 m³, a large type container for this type, and the collected waste is directly dumped onto the container from the collection vehicle.

c. Transfer Equipment and Personnel

At each transfer station, one manager shall be stationed; and for each container truck, one driver and worker are needed. Working hours shall be eight (8) per day and the work shifts shall match the regulations of each city. Transfer equipment and personnel are shown in Table 7.2.8.

Table 7.2.8 List of Transportation Equipment and Required Personnel

Item	Unit	Jableh	Qurdaha	Total
Equipment				
Container truck	Nos.	4	2	6
Container	Nos.	7	5	12
Container booth	Nos.	4	4	8
Personnel				
Manager	Person	1	1	2
Driver	Person	4	2	6
Worker	Person	4	2	6
Total		9	5	14

7.3 FINAL DISPOSAL

7.3.1 Basic Policy of Final Disposal

Inter-municipal final disposal of waste targeting Lattakia, Jableh, Al-Haffeh and Qurdaha shall be introduced. Until 2007, this shall be carried out at Al-Bassa final disposal site, and from 2008 onwards this shall be implemented at the new disposal site in Qasia.

The existing disposal site at Al-Bassa causes environmental pollution because waste here is scattered over a wide area. In the master plan, Al-Bassa disposal site shall be treated as an intermediate disposal site and accumulated waste shall be rearranged and organized in the same way as adopted in the Pilot Study. Next, in order to carry out final disposal of waste until the new disposal site at Qasia is commissioned, facilities for implementing sanitary landfilling shall be prepared. At Qasia disposal site, facilities shall be constructed and sanitary landfilling introduced in view of this experience.

Concerning operation and maintenance, Lattakia City shall continue to be responsible for Al-Bassa disposal site, while a newly established inter-municipal waste management department setup within Lattakia Governorate shall be responsible for Qasia disposal site.

The amount of waste treated in 2010 is 373 tons/day, and the quantity of waste that will be treated between 2001 and 2010 will be approximately 1,250,000 tons. The disposal sites will accept the following kinds of waste:

- Mixed collection waste (domestic waste)
- Commercial waste
- Street sweeping waste
- Summer tourist waste (July, August, September)
- Recycling center residue
- Waste from small and medium factories
- Non-infectious medical waste
- Residue from treatment of infectious medical waste

7.3.2 Rehabilitation Plan of Al-Bassa Disposal Site

(1) Estimation of the Existing Waste Volume

A topographic survey was carried out covering the whole of Al-Bassa Disposal site including access road to the site. Table 7.3.1 shows the volume of the existing accumulated waste resulted from the topographic survey. The total volume of the waste was estimated at 158,900 m³ including dispersed waste along the access road.

Table 7.3.1 Estimation of the Existing Waste Volume

Zone	Area (ha)	Existing Waste Volume (m ³)
I	10.1	28,800
II	15.6	57,300
III	16.4	63,500
Along Access Road	-	9,300
Total	42.1	158,900

(2) Capacity Requirement for the Daily Incoming Waste up to the Year 2007

Al-Bassa disposal site will be operated up to the year 2007 since the operation of Qasia inter-municipal disposal site is proposed to start in the year 2008. The capacity requirement for the controlled landfill of daily incoming waste is estimated in accordance with the future waste collection volume as shown in Table 7.3.2.

Table 7.3.2 Capacity Requirement for Daily Incoming Waste up to the Year 2007

	Year	2001	2002	2003	2004	2005	2006	2007
Daily Waste Disposal Amount	ton/day	305	313	322	389	380	390	408
Yearly Waste Disposal Amount	ton/year	55,663	114,245	117,530	141,985	138,700	142,350	148,920
Compacted Waste (1.0ton/m ³)	m ³ /year	55,663	114,245	117,530	141,985	138,700	142,350	148,920
Cover Soil (20%)	m ³ /year	11,133	22,849	23,506	28,397	27,740	28,470	29,784
Required Landfill Volume	m ³ /year	66,796	137,094	141,036	170,382	166,440	170,820	178,704
Accumulated Landfill Volume	m ³	66,796	203,890	344,926	515,308	681,748	852,568	1,031,272

Note: Yearly waste disposal volume in 2001 is summed up for the latter 6 months.

Based on the projection of the daily incoming waste up to the year 2007, a total of 1.03 million cubic meters is required for the capacity of controlled landfill in Al-Bassa disposal site as a whole.

(3) Proposed Procedures of the Rehabilitation

It is proposed that the procurement of heavy vehicles for the rehabilitation and the controlled landfill be planned in 2003. In accordance with the procurement schedule, the needed works for the rehabilitation and those schedules are shown in Table 7.3.3.

Table 7.3.3 Proposed Procedure of the Rehabilitation of Al-Bassa Disposal Site

Zone	Works for Rehabilitation	Year
I and II	- Rearrangement of existing accumulated waste	2001-2002
	- Controlled landfill of daily incoming waste	2001-2003
III	- Rearrangement of existing accumulated waste	2003-2004
	- Construction of tentative disposal site	2003-2004
	- Controlled landfill of daily incoming waste	2004-2007

In order to rearrange the existing accumulated waste in Zone I and II, the same method of pilot study can be extended to the whole of both zones. Namely, the existing waste will be utilized for embankment materials. of. Then controlled landfill with cover soil will be carried out within the embankment by rented heavy vehicles.

As for Zone III, the accumulated waste is to be collected in an area and to be covered by soil, while the daily incoming waste is accommodated by a tentative disposal site which will be constructed within the zone in advance.

(4) Facility Plan

Major facilities for the rehabilitation of Zone I and II are proposed as follows.

Table 7.3.4 Major Facilities for the Rehabilitation of Zone I and II

Facilities	Designing Outline
Waste Retaining Structure	Soil embankment (filling material: existing accumulated waste)
Enclosing Fence	Netted fence 2 meters in height
Leachate Collection Facility	Perforated reinforced concrete pipes covered by gravel
Leachate Control Reservoir	Retaining structure by reinforced concrete for prevention of leachate spilling, aerobic treatment facility and leachate re-circulation facility
Gas Removal Facility	Perforated PVC pipes covered by gravel within wire basket
Operation Road	Gravel with 20 centimeters thick

The facilities in the tentative disposal site should be upgraded compared with those of Zone I and II, since the site will be utilized for long period of time relatively and accommodate only daily incoming waste. The major facilities for the tentative disposal site are proposed as follows.

Table 7.3.5 Major Facilities for the Tentative Disposal Site in Zone III

Facilities	Designing Outline
Waste Retaining Structure	Soil embankment (filling material: sand)
Enclosing Fence and Gate	Netted fence 2 meters in height
Liner	Layer of clay 60 centimeters thick
Leachate Collection Facility	Perforated reinforced concrete pipes covered by gravel
Leachate Retention Pond and Re-circulation Facility	Retaining structure by reinforced concrete for prevention of leachate spilling, aerobic treatment facility and leachate re-circulation facility
Rainwater Collection Facility	Ditch enclosing landfill area
Gas Removal Facility	Perforated PVC pipes covered by gravel within wire basket
Control Building	One story building for staff who controls landfill operation
Car Wash Facility	
Cover Soil Storage	
Access Road	7 meters in width with pavement (improvement of existing access road)
Operation Road	Gravel with 20 centimeters thick
Groundwater Monitoring Well	Reinforced concrete pipes 350mm in diameter

As for the area of rearrangement of existing accumulated waste in Zone III, the necessary facilities are similar to those of Zone I and II.

In accordance with the above-mentioned facility plan, the overall rehabilitation plan of Al-Bassa Disposal Site is proposed as shown in Figure 7.3.1.

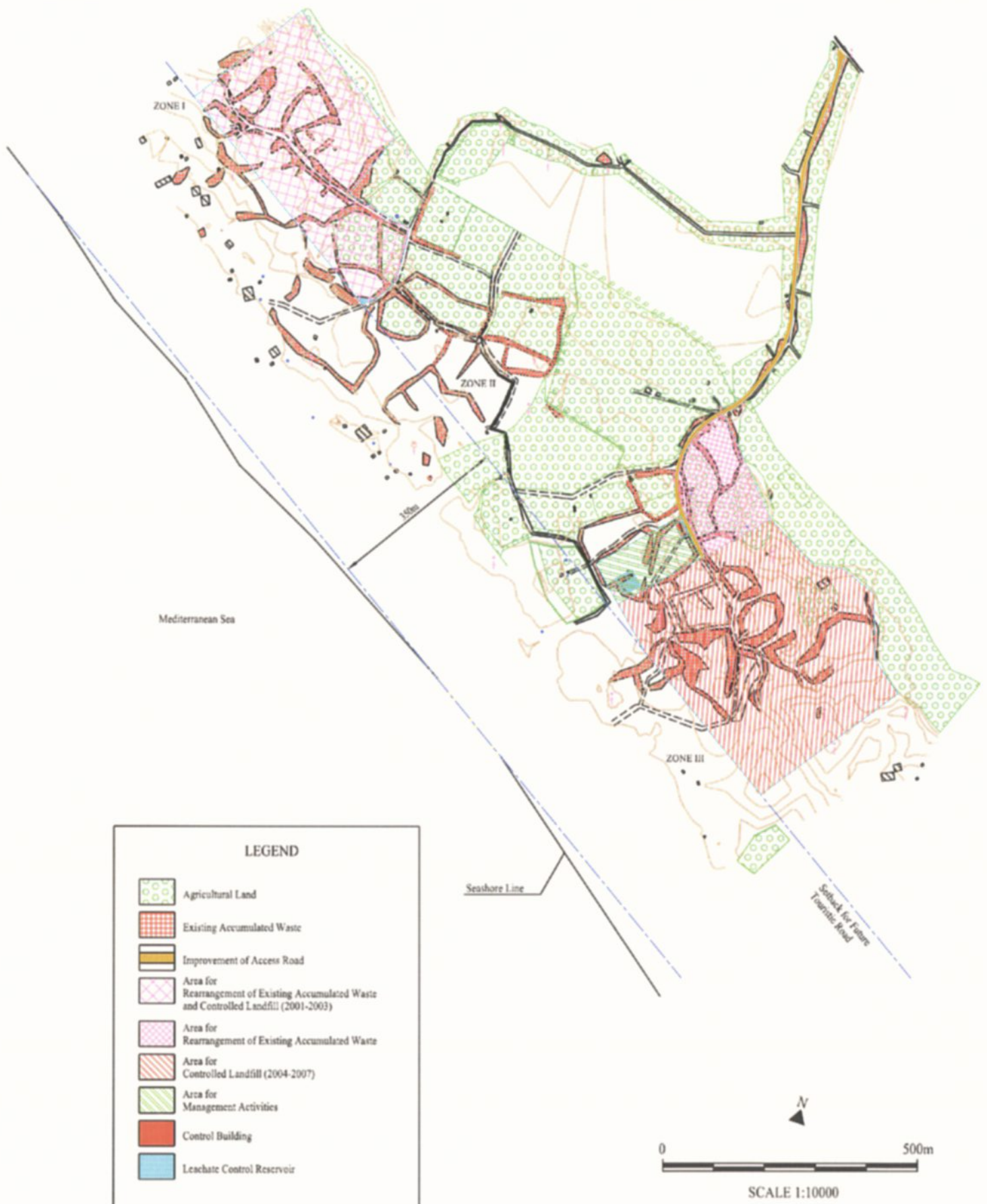


Figure 7.3.1 Overall Rehabilitation Plan of Al-bassa Disposal Site

(5) Equipment Plan

1) Required Heavy Equipment and Vehicles

Heavy equipment is needed to carry out daily cover soil, which is essential to improve the operation of landfill. Required quantities and major specifications of heavy equipment are estimated based on the projected waste amount at the target year for closing of the site, and taking into account the required heavy equipment and vehicles for the new disposal site at the target year of the Master Plan. The list of heavy equipment required is shown in Table 7.3.6.

Table 7.3.6 List of Heavy Equipment for Landfill Operation

Items	Number
Bulldozer (200HP)	1
Excavator (0.7m ³)	1
Dump Truck (10ton)	1

Since Al-Bassa disposal site will be closed at the end of the year 2007, above-mentioned heavy equipment will be transferred to the Qasia inter-municipal disposal site.

2) Operational Organization at Al-Bassa Disposal Site

Projected staffing requirements can be estimated according the number of staff needed to satisfactory carry out daily controlled landfill and management activities. Table 7.3.7 shows the detailed staffing and composition of the team for the Al-Bassa disposal site.

Table 7.3.7 Operational Organization of the Disposal Site

Staffing	Number	Responsibility
Site Manager	1	All the responsibility of handling the site.
Secretary (Accountant)	1	Control of the schedule for the site manager and daily management of account
Site Inspector	2	Indication of the designated landfill area, and inspection of the safety against disaster of the site and illegal dumping
Chief Operator	1	Control of the daily operator's work and detailed indication of landfill point to hauling trucks
Operator/Driver	6	Daily landfill works - Bulldozer: 1+1=2 - Excavator: 1+1=2 - Dump Truck: 1+1=2
Worker	2	
Guard	2	
Total Number of Site Stuff	15	

Some of the staff in the organization will be transferred to Qasia Inter-municipal disposal site when Al-Bassa disposal site will be closed.

7.3.3 Construction of Qasia Inter-Municipal Disposal Site

(1) Overall Phased Scheme

It is required that Qasia inter-municipal disposal site should be utilized for a long period of time because it is deemed that there are very few candidates for the next disposal site in the administrative area of Lattakia governorate. Thus the landfill activities should be carried out by an ordered manner. In order to realize the ordered landfill, the new site should be divided into several lots and a phased scheme should be introduced.

The available area for landfill and the related facilities is approx. 62 ha, and the possible area for landfill is estimated at 50 ha. From a viewpoint of magnitude of the waste generation in Lattakia governorate, it is deemed that the site can accommodate the waste for several decades. As the first phase, a landfill site for 10 years' availability should be planned within the entire potential of the landfill site.

(2) Capacity Requirement up to the Year 2010

The operation of Qasia inter-municipal disposal site will be opened the year 2008. The required capacity of the disposal site up to the target 2010 of the master plan is estimated at approx. 465,000 cubic meters as shown in Table 7.3.8.

Table 7.3.8 Capacity Requirement for Qasia Inter-Municipal Disposal Site up to the Year 2010

	Year	2008	2009	2010
Daily Waste Disposal Amount	ton/day	450	464	373
Yearly Waste Disposal Amount	ton/year	82,125	169,360	136,145
Compacted Waste (1.0ton/m ³)	m ³ /year	82,125	169,360	136,145
Cover Soil (20%)	m ³ /year	16,425	33,872	27,229
Required Landfill Volume	m ³ /year	98,550	203,232	163,374
Accumulated Landfill Volume	m ³	98,550	301,782	465,156

Note: Volume of cover soil for sanitary landfill is assumed to be 20 % of the volume of waste landfill.

(3) Availability/Capacity of the Disposal Site

The landfill site for the first phase will be planned at the upper stream of the disposal site with a capacity of approx. 2 million cubic meters. It is expected that the possible available period is for 10 years (2008-2017). As a whole, possible capacity of Qaisia inter-municipal disposal site will be around 10 million cubic meters.

(4) Facility Plan

Since the landfill operation at Qasia disposal site is planned to start in 2008, the facilities needed should be constructed in 2006 and 2007. The landfill operation is planned as sanitary landfill. Taking into account the minimum requirements for the sanitary landfill as mentioned in previous section, the proposed major facilities are shown in Table 7.3.9.

Table 7.3.9 Major Facilities of the Qasia Inter-municipal Disposal Site

Component	Designing Outline
(General)	
Ultimate Waste Retaining Structure	Earthed dam (slope: inclination of 1:3)
Enclosing Fence	Netted fence 2 meters in height, enclosing the whole of the site
Groundwater Collection Facility	Perforated reinforced concrete pipes covered by gravel
Flood Control Reservoir	Excavated pond 8 meters in depth with a structure of flood control
Rainwater Collection Facility	Gutter (in-site of areas for facilities and flood/leachate control)
Main Gate and Guardhouse	
Main Control Building	One story building for staff who controls landfill operation and incoming/outgoing vehicles
Compost Plant	Refer to the corresponding section
Sorting Center	Refer to the corresponding section
Truck-scale	Capacity of 40 ton
Car Wash Facility	
In-site Road	7 meters in width with pavement within the area for facilities
Operation Road	Gravel with 20 centimeters thick, connecting between area for facilities and landfill site of phase 1
Monitoring Well	Reinforced concrete pipe 350mm diameter
Waste Retaining Structure	Soil embankments including embankment for the first 10 year's landfill
(Landfill Site of Phase 1)	
Waste Retaining Structure	Earthed dam (slope: inclination of 1:3)
Groundwater Collection Facility	Perforated reinforced concrete pipes covered by gravel
Liner	Layer of clay 60 centimeters thick
Leachate Collection Facility	Perforated reinforced concrete pipes covered by gravel
Leachate Control Reservoir (Tentative)	Liner (synthetic membrane) covered by layer of clay 60 centimeters thick for prevention of leachate spilling, aerobic treatment facility and leachate re-circulation facility
Rainwater Collection Facility	Gutter enclosing landfill area of phase 1
Gas Removal Facility	Perforated PVC pipes covered by gravel within wire basket

The area for the facilities and area for flood/leachate control will be constructed as well as the landfill site of phase 1. A leachate control reservoir, which will be tentatively utilized for the period of phase 1, will be constructed adjacent to the landfill site of phase 1. Main leachate control reservoir in the area for facilities, therefore, will be constructed in later stage.

In accordance with the above-mentioned facility plan, the layout plan of Qaisia inter-municipal disposal site is proposed as shown in Figure 7.3.2, and the typical longitudinal cross section is shown in Figure 7.3.3.

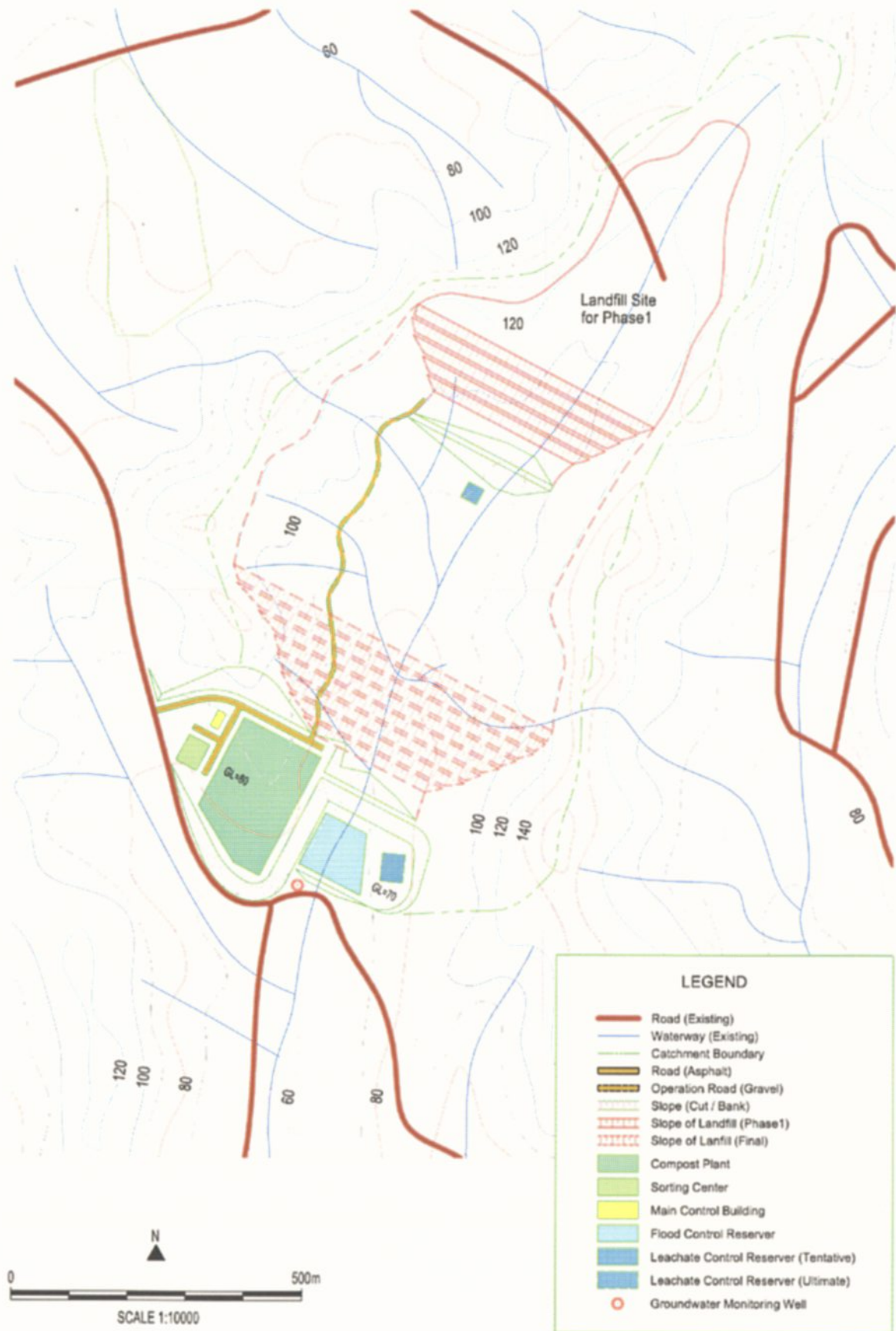


Figure 7.3.2 Layout Plan of Qasia Inter-municipal Disposal Site

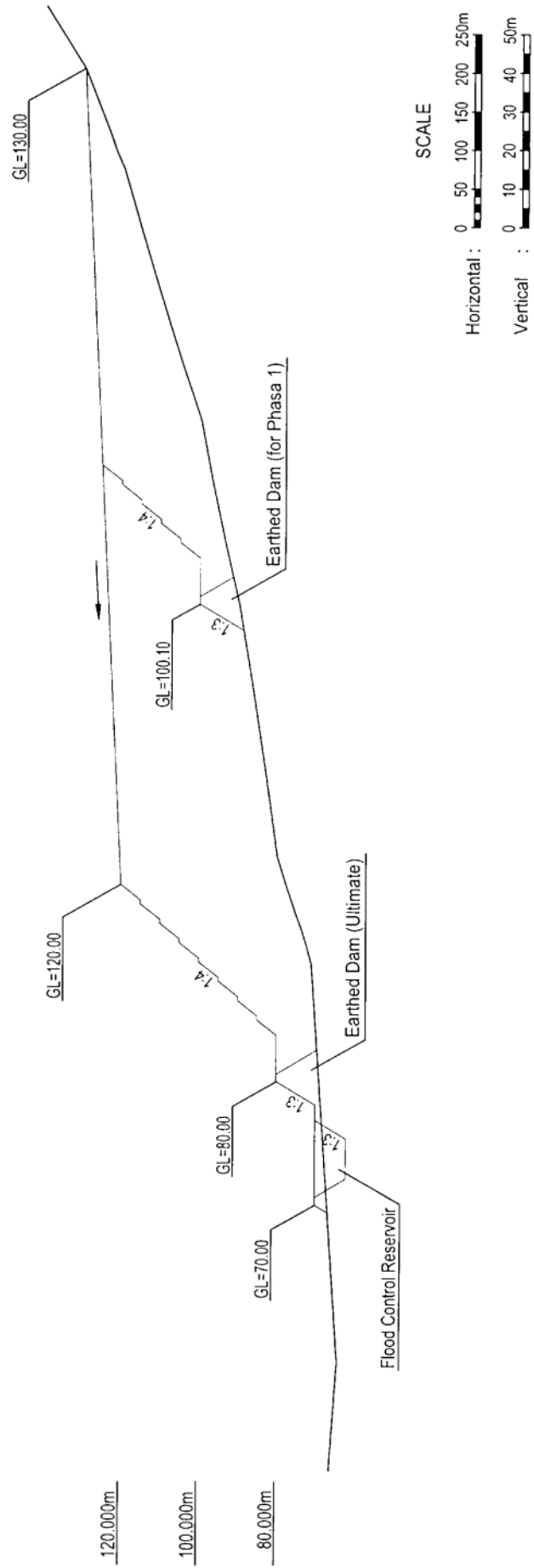


Figure 7.3.3 Typical Longitudinal Cross Section of the Disposal Site

(5) Equipment Plan

Quantities required and major specifications of heavy equipment and vehicles are estimated based on the projected waste amount at the target year of the Master Plan. The list of heavy equipment required is shown in Table 7.3.10.

Table 7.3.10 List of Heavy Equipment for Landfill Operation

Items	Number
Bulldozer (200HP)	1
Excavator (0.7m ³)	1
Dump Truck (10ton)	1
Pick-up (4WD)	1

Above-mentioned heavy equipment includes the transferred equipment from Al-Bassa disposal site after its closing.

(6) Operational Organization

Table 7.3.11 shows the detailed staffing and composition of the team for the disposal site.

Table 7.3.11 Operational Organization of Qasia Inter-municipal Disposal Site

Staffing	Number	Responsibility
Site Manager	1	All the responsibility of handling the site.
Secretary (Accountant)	1	Control of the schedule for the site manager and daily management of account at the site
Chief of Engineering Section	1	Management of all engineering matters including planning and conduction of suitable landfill operation
Truck Scale Engineer	2	Operation of truck scale to measure the waste quantity and quality, and indication of the designated landfill area
Site Inspector	2	Inspection of the safety against disaster of the site and illegal dumping
Chief Operator	1	Control of the daily operator's work and detailed indication of landfill point to hauling trucks
Operator/Driver	6	Daily landfill works - Bulldozer: 1+1=2 - Excavator: 1+1=2 - Dump Truck: 1+1=2
Worker	3	
Guard	2	
Total Number of Site Stuff	19	

Some of the staff in the organization will be transferred from Al-Bassa disposal site after its closing.

(7) Management of Landfill Operation

1) Management System of Sanitary Landfill

It is essential that the sanitary landfill system should be appropriately managed in order to preserve its neighboring environment and treat the daily incoming waste with proper manner. Figure 7.3.4 shows the outline of the proposed sanitary landfill system in Qasia inter-municipal disposal site.

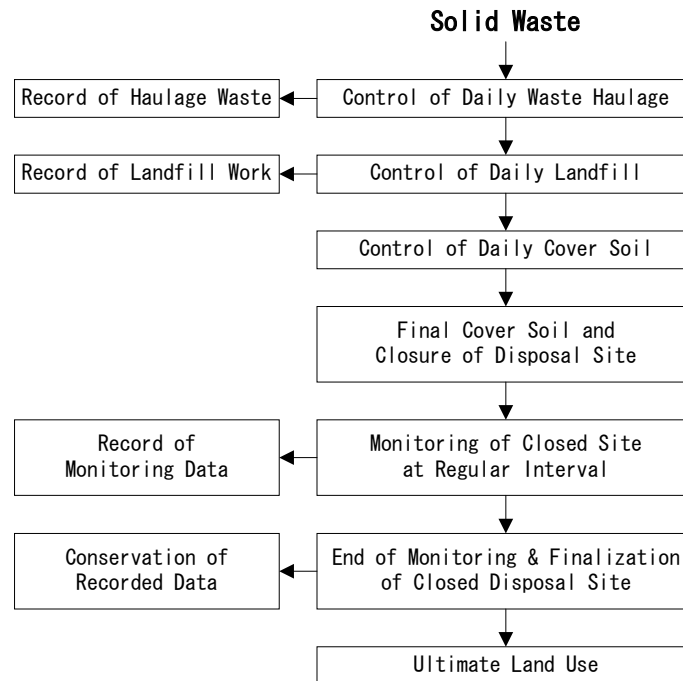


Figure 7.3.4 Management System in Qasia Inter-municipal Disposal Site

As for the overall management system of Qasia inter-municipal disposal site for landfill operation, the following works are proposed for its minimum requirements.

- Inspection/prevention of illegal waste dumping,
- Appropriate designation of landfill location in the site for waste hauling vehicles,
- Operation of sanitary landfill with daily covering soil,
- Record of daily hauling waste, location of landfill operation, monitoring data of groundwater and so on,
- Implementation of final cover soil and closure of site,
- Monitoring on groundwater pollution and stabilization of waste at regular intervals,
- End of the monitoring and finalization of the closed disposal site, and
- Preparation of ultimate land use, if necessary.

2) Landfill Operation

Dumped waste should be covered with soil everyday for the following reasons.

- Prevention of open burning and offensive odor,
- Reduction of the number of insects and rodents, and
- Prevention of waste scattering in/around disposal site.

The procedure for the sanitary landfill in Qasia inter-municipal disposal site is proposed as follows.

a. Spreading and Compaction of Solid Waste

Waste hauled into disposal site should be spread out, mixed and compacted through several runs by bulldozer/compactor in order to hasten stabilization of waste, secure the capacity of disposal site and improve the site conditions for the future ultimate land use.

b. Formation of Waste Cell and Daily Cover Soil

In order to maintain a certain level of sanitary condition of disposal site, it is essential that the compacted waste should be covered by soil everyday. In terms of efficiency/effectiveness for covering soil, the cell method for sanitary landfill is recommended. The concept of the cell method is shown in Figure 7.3.5.

c. Final Cover Soil

If the sanitary landfill is achieved at a planned level, a soil layer of an appropriate thickness should cover the whole surface of the compacted waste. This final cover soil will be rehabilitated because the layer of the final cover soil will subside as the waste decomposes.

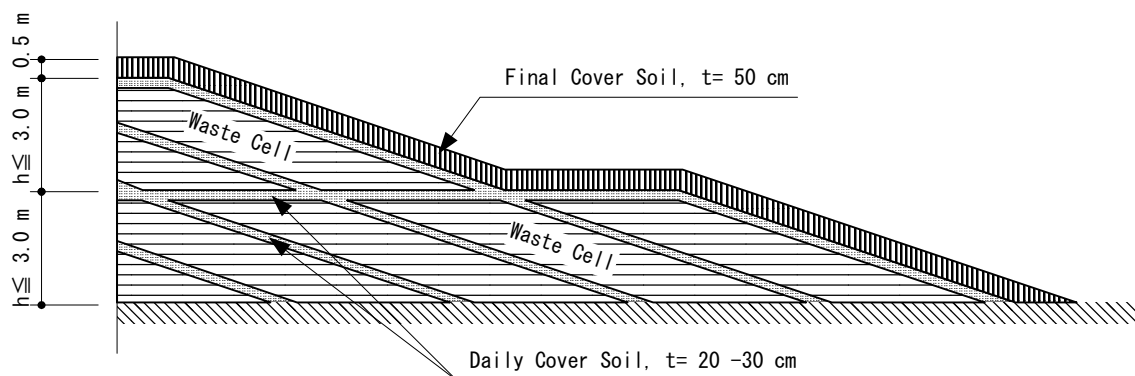


Figure 7.3.5 Conceptual Cross Section of Cell Method

7.4 COMPOSTING

From the viewpoints of reducing the volume of waste and introducing recycling, composting of 200 tons/day of kitchen waste (market waste and separated organic domestic waste) shall be carried out.

Two potential sites for composting facilities are the old compost plant site (Al-Bassa) and the new disposal site at Qasia, however, it is forecast that a few years will be required before land at Qasia is acquired. Accordingly, in the master plan, composting facilities shall be developed over the following two phases:

- Phase 1 development: rehabilitation of the old compost plant (Al-Bassa)
- Phase 2 development: construction of new compost plant (inside Qasia disposal site)

Moreover, concerning rehabilitation of the old compost plant to be conducted in the Phase I development, since questions remain concerning the demand for compost, the site shall be developed as a Pilot Plant with emphasis placed on the production of good quality compost. Therefore, the plant shall be operated over one shift with capacity of 25 tons/day, and capacity shall be raised to 50 tons/day after it has been confirmed that compost quality that is capable of satisfying the demand has been secured.

(1) Design Conditions

The design conditions for composting facilities are as shown in Table 7.4.1.

Table 7.4.1 Planning Condition of Compost Plant

Item	1 st stage implementation (Rehabilitation of existing compost plant)	2 nd stage implementation (Construction of new compost plant)
Location	Al-Bassa	Qasia
Operation year	2005	2010
Capacity	25 ton/day (50ton/day ^{*)}	150 ton/day
Receiving waste	Market waste: 25ton, Separated domestic waste (organic): 25ton	Market waste: 48 ton, Separated domestic waste (organic): 102 ton
Material balance	Compost product : 25% Recyclables : 5% Residue : 25%	Compost product : 25% Recyclables : 5% Residue : 25%
Operation hour	1sift (2sifts)	2 sifts

Note ^{*)} 1 sift operation: receiving waste is market waste (25ton)

2 sift operation: receiving waste is market waste (25ton) + separated domestic waste (25ton) = total 50ton

Based on data obtained in the separate collection experiment (Pilot Study), the design quality of waste accepted by the composting facilities is indicated in Table 7.4.2.

Table 7.4.2 Waste Quality for the Plan

(Unit: % wet base)

Waste type	Food, vegetable	Paper	Plastic	Metal	Glass	Others	Total
Market	83.3	3.6	7.1	0.6	0.5	4.9	100
Domestic	83.6	5.8	5.4	1.0	0.8	3.8	100
Design	83.5	5.3	5.8	0.9	0.7	4.1	100

Note: Design waste quality is calculated as a weighted average between market and domestic waste.

(2) Treatment Flow

The treatment flow of composting facilities is composed of the following six stages. The material balance of composting is shown in Figure 7.4.1.

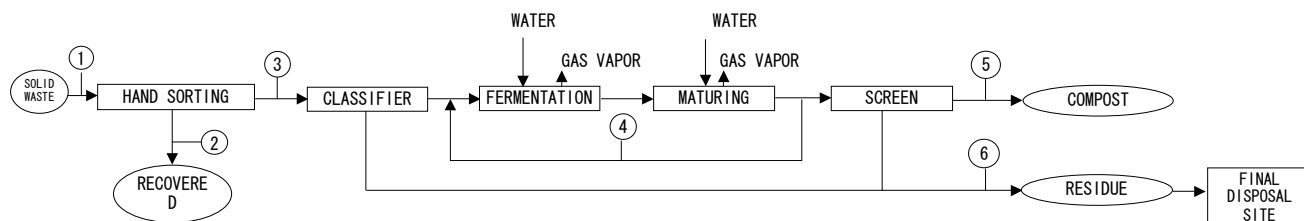
- Waste receiving
- Removal of unsuitable items and recovery of valuable materials by hand sorting
- Crushing by classifier
- Primary fermentation (turning by wheel loader)
- Secondary fermentation (turning by wheel loader)
- Screening

(3) Facilities Development Plan and Personnel

The main facilities and equipment required for developing the project composting facilities are as indicated in Table 7.4.3. The necessary operation and maintenance personnel on both shifts are 92 in total. Figure 7.4.2 shows the general layout of Qasia compost plant.

Table 7.4.3 Major Facilities and Equipment for the Compost Plant

Item	Facility and Equipment		1 st stage implementation (Rehabilitation of existing Plant)	2 nd stage implementation (Construction of new plant)
Facility	Reception	Truck scale	50 ton	50 ton
		Receiving yard	270m ² (Repair existing bldg.)	750 m ²
	Pre-treatment	Hand sorting conveyor	5.0 t/h, 0.75 m width	12.5 t/h, 1.3 m width
		Pulverizer	5.0 t/h, 110 kw	12.5 t/h, 240 kw
	Primary fermentation	Primary fermentation yard	1,280 m ² (Repair existing bldg.)	8,000 m ² (with roof)
		Turning method	Wheel loader	Turning machine
	Secondary fermentation	Secondary fermentation yard	1,040 m ² (Repair existing bldg.)	8,000 m ² (without roof)
		Turning method	Wheel loader	Turning machine
	Refining	Screen	1.3 t/h, trommel type	3.5 t/h, trommel type
	Building		Repair existing bldg.	Control bldg., parking lot, guard house
Equipment	Wheel loader		1.2 m ³ : 3 nos, 3.1 m ³ : 1 nos	1.2 m ³ : 3 nos, 3.1 m ³ : 1 nos
	Turning machine		--	630 m ³ /h: 1 nos
	Dump truck		8 ton: 1 nos	8 ton: 1 nos



ITEM	① MSW INPUT	② RECOVERD MATERIAL	③ AFTER HAND SORTING	④ RECYCLE COMPOST	⑤ FINE COMPOST	⑥ TOTAL RESIDUE
WET WEIGHT (t)	200.0	10.1	190.0	32.0	50.0	50.0

① SOLID WASTE	COMPSITION (%)	WEIGHT (t)
FOOD, VEGETABLE	83.5	167.0
PAPER	5.3	10.6
PLASTIC	5.8	11.6
METAL	0.9	1.8
GLASS	0.7	1.4
OTHERS	4.1	8.2
TOTAL	100	200

RECOVERED MATERIAL	
MATERIAL	② HAND SORTING
PAPER	2.7
PLASTIC	5.8
METAL	0.9
GLASS	0.7
TOTAL	10

INPUT(t/d)		OUTPUT (t/d)	
SOLID WASTE	200	CONPOST	50
WATER	1.2	RESIDUE	50
		RECOVERED MATERIAL	10
		GAS VAPOR	91.2
TOTAL	201.2	TOTAL	101.2

Figure 7.4.1 Material Balance of Composting (2010)

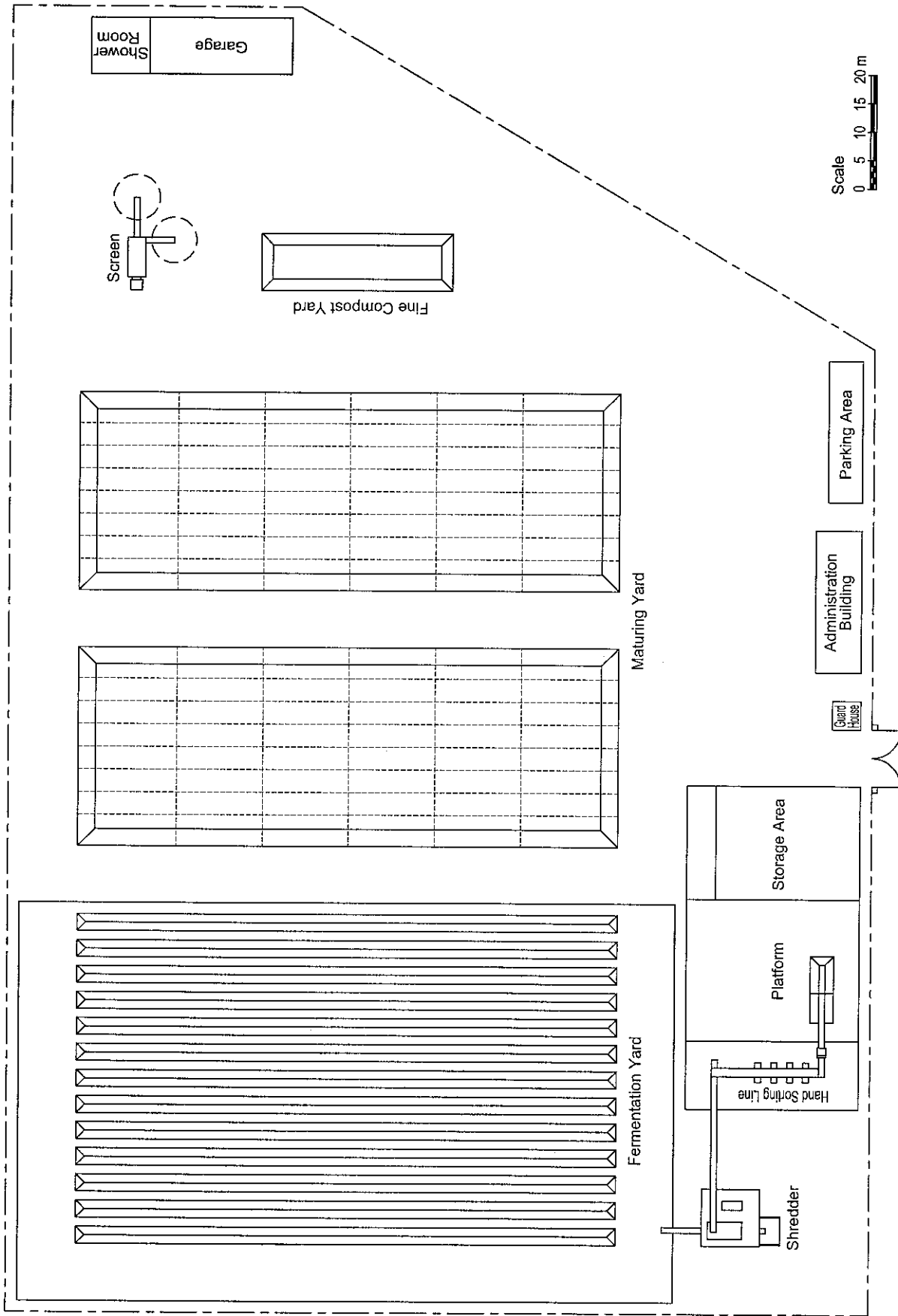


Figure 7.4.2 General Layout of Casia Compost Plant

7.5 RECYCLING

In the master plan, recycling of organic waste and reusable waste material (non-organic waste) are introduced in Lattakia, Jableh, Al-Al-Haffeh and Qurdaha. Organic waste, recycling as “composting” is explained in Section 1.6.4 and 1.7.4 of this report, and, recycling of reusable waste materials is described in this section.

7.5.1 Target of Recycling

The master plan has set a recycling target of 8% of generated municipal waste (domestic and commercial waste) by the year 2010.

Waste amount generated and an estimated amount of recyclable materials in each waste type for 2010 are shown in Table 7.5.1. As shown in the table, potentially about 49 ton/day of waste can be recycled in 2010; i.e. 23.7ton for papers, 13.7ton for plastic, 2.4ton for textiles, 5.5ton for metals and 3.5ton for glass. In other words, the targeted recycling amount for the master plan (38 ton/day) is approximately 80% of potential recyclable materials (49 ton/day).

Waste materials proposed for recycling in Lattakia, Jableh, Al-Al-Haffeh and Qurdaha are as follows:

- Paper: cardboard, newspaper, magazines, office paper
- Textile: clothes
- Plastic: pet-bottles, plastic bags, packaging, plastic sheets etc.
- Metal: ferrous and non-ferrous metals including steel and aluminum cans
- Glass: bottles and broken glass

Table 7.5.1 Estimated Amount of Reusable Waste Materials in 2010

Waste types	Domestic Waste (ton/day)	Commercial Waste (ton/day)	Total (Ton/day)	Recyclable materials	
				Ratio (%)	Amount (ton/day)
Food, Vegetables	295.5	55.8	351.2		
V Paper	37.4	21.8	59.2	40%	23.7
V Plastic	34.1	11.4	45.5	30%	13.7
Rubber & Leather	1.6	0.2	1.8		
Wood	1.2	1.3	2.5		
V Textiles	8.9	0.6	9.6	25%	2.4
V Metal	6.1	1.7	7.8	70%	5.5
V Glass	4.9	2.1	7.0	50%	3.5
Ceramics	1.2	0.0	1.2		
Stone & Sand	5.7	3.0	8.6		
Others	9.8	3.9	13.6		
Total	406.4	101.8	508.2	9.6%	48.7

Note: 1. “v” shows proposed recyclable waste types in 2010.

2. Waste amount in each waste type in 2010 is estimated based on the waste composition survey in 2001 conducted by JICA study team.
3. Ratio of reusable waste material is settled based on Japan’s experience and recent recycling conditions in Lattakia.
4. “Metal” includes ferrous and non-ferrous metal.

7.5.2 Recycling Plan

Recycling plan for reusable waste materials in the master plan is composed of the following.

- Introduction of source separation
- Construction of sorting center
- Improvement of existing recycling activities by private sector

(1) Source Separation

Separation and collection of reusable waste materials from domestic waste is the starting point for the introduction of an affordable recycling system in the study area. In the master plan, waste separation at source is proposed.

The targeted ratio of this source separation in 2010 is about 48% of domestic waste (195 ton/day). Based on the pilot study result on source separation, approx. 78% is estimated to be organic waste and the remaining 22% is non-organic waste that may contain reusable waste material.

Source separation relies heavily on citizen cooperation. Accordingly the introduction of source separation cannot be expected to proceed effectively in the absence of public awareness of SWM issues and citizen cooperation and initiatives in recycling activities. Citizens are requested to separate the waste into organic and non-organic waste at their houses. The separated non-organic waste shall be kept in the plastic bag at their houses then discharged at collection points on designated days.

One of the pilot studies of this JICA study introduces source separation at 200 households in Lattakia with the coordination of a public awareness campaign (detail of this pilot study is described in PART IV, Chapter 3 of this report). The practice of source separation in Lattakia, Jableh, Al-Al-Haffeh and Qurdaha shall be introduced based on the pilot study and expanded in the future in the proper manner.

(2) Sorting Center

The sorting centers shall be provided in order to receive inorganic domestic waste and recover valuable materials from this. The sorting centers shall be constructed in stages at Al-Bassa and Qasia, in tandem with the two-stage development of composting facilities. Design conditions and contents of the sorting centers are shown in Table 7.5.2. Moreover, the system flow and layout plan of the sorting centers are indicated in Figure 7.5.1. Moreover, the number of operation and maintenance personnel required at each sorting center will be 19.

Table 7.5.2 Planning Conditions of Sorting Center

Item	1 st stage implementation	2 nd stage implementation
Location	Al-Bassa	Qasia
Operation year	2005	2010
Capacity	20 ton/day	20 ton/day
Receiving waste	Separated domestic waste (in-organic)	Separated domestic waste (in-organic)

Item	1 st stage implementation	2 nd stage implementation
Material balance	Sorted recyclables : 25% (5 ton/day) Residue: 75% (15 ton/day)	Sorted recyclables: 25% (5 ton/day) Residue: 75% (15 ton/day)
System	Manual sorting	Manual sorting
Sorted recyclables	Paper, textile, plastic, metal, glass	
Facilities	Receiving pit/ hopper, feeding conveyor, hand-sorting conveyor, control office, container, etc.	
Equipment	Wheel loader : 1 nos.	Wheel loader : 1 nos.

Layout plan of sorting center and schematic flow of non-organic waste sorting is shown in Figure 7.5.1. The costs for construction, operation and maintenance are included in the master plan total costs.

In addition, the center may also accept pre-separated hazardous domestic waste (such as batteries etc.) In the future, the center may receive bulky reusable waste (such as old furniture, broken electric products, etc.) for repair and resale.

(3) Improvement of Present Recycling Activities

At present in Lattakia and surrounding three cities, there are no formal recycling activities carried out by the municipality. In the private sector, between 30-40 middlemen exist and about 100 waste-pickers at Al-Bassa and Jableh disposal site actively involved in collecting the waste materials. In addition, individual collectors also do the same activities with their own three-wheel vehicles.

In the master plan, an improvement of present recycling activities by the private sector mentioned above is proposed. In order to support their activities and promote an affordable recycling system, it is proposed to establish a “social system for recycling”.

In this social system, each responsible body i.e. manufactures, merchandisers, waste generators (residents of Lattakia and surrounding three cities), middlemen, end-users and local government, should understand their role in a recycling society and carry out their responsibilities properly. The effort of local government seems to be the key issue in Lattakia for its introduction. Required efforts by the local government are summarized as follows.

- Establishment of recycling plan
- Legislation for recycling
- Promotion of citizen awareness
- Promotion of middlemen and/or end-users to be able to keep sustainable activities

At any rate, full-scale establishment of this recycling society is not a target for the master plan of the study, because it will probably take much longer. However, the master plan has recommended the necessary process as a first step to developing such a society.

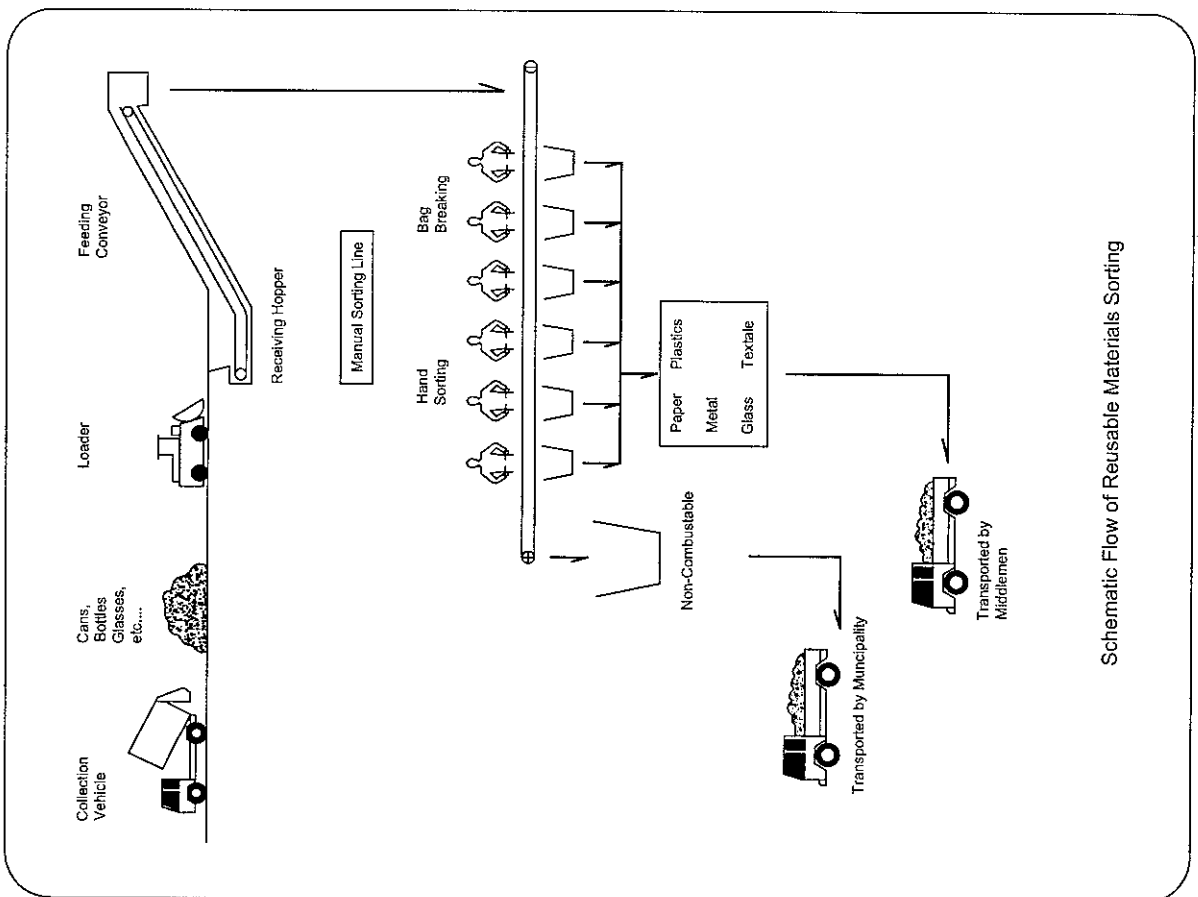
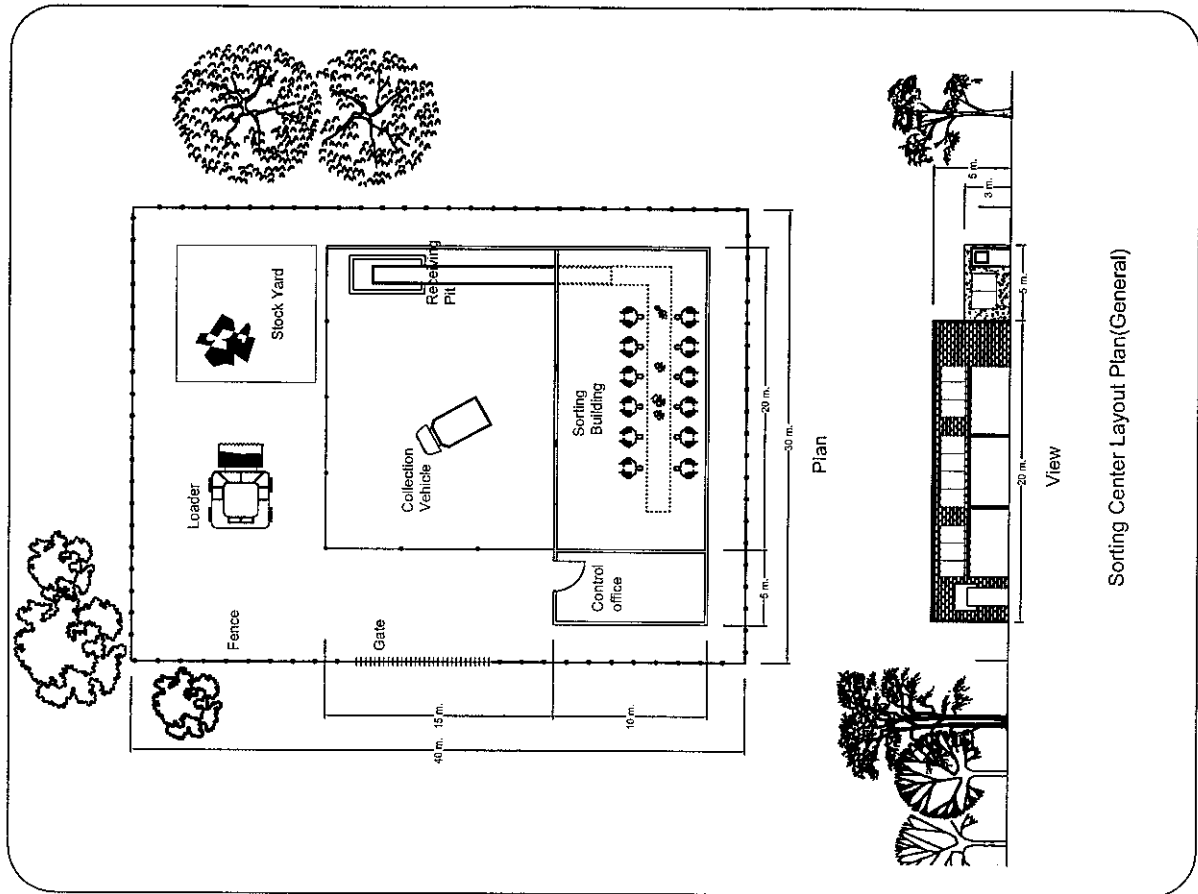


Figure 7.5.1 Sorting Center

7.6 MEDICAL WASTE MANAGEMENT

(1) General

Medical waste management is currently unsatisfactory in the points that the appropriate separation and collection have not been conducted and that no appropriate disposal rules have been observed at the final disposal site.

SWM Master Plan is being carried out with the target year of 2010. However, from above situations the establishment of appropriate treatment management on medical waste is urgently required.

In this study, the appropriate treatment shall be established for the infectious waste. The general hospital waste should be treated by the municipal waste system. The pharmaceutical, chemical and pathological waste including radioactive waste should be appropriately treated in compliance with the governmental laws/regulations or religious customs.

(2) Source Separation

Source separation will be necessary as a starting point for overall management of medical waste based on the definition defined in Table 6.6.1. Source separation should be implemented by year 2006 as a short-term objective. This should be conducted by using the dedicated containers and appropriate manners for color-coding and markings.

Table 7.6.1 shows the recommended separation manners for medical waste and its container type.

Table 7.6.1 Recommended Color-coding, Markings and Type of Containers

	Type of Waste	Color-coding & Markings	Type of Container
Infectious waste	Highly infectious waste	Yellow, marked "HIGHLY INFECTIOUS"	Strong, leak-proof plastic bag or container capable of being autoclaved
	Other infectious waste, pathological and anatomical waste	Yellow	Leak-proof plastic bag or container
	Sharps	Yellow, marked "SHARPS"	Puncture-proof container
Chemical and pharmaceutical waste	Chemical and pharmaceutical waste	Brown	Plastic bag or container
	Radioactive waste	-	Lead box, labeled with the radioactive symbol
Hospital general waste		Black	Plastic bag

Source: "Safe management of waste from health-care activities", WHO, 1999

Table 7.6.2 shows the daily requirement of containers in the study area.

The containers of 60-80 litter will be used in a large hospital, while the containers of 20-40 litter in a small hospital and others. The required number of containers is estimated based on the field investigation of the existing medical establishment. Number of containers will need the modification in the future according to the generation amount of infection waste obtained through an actual source separation at the medical establishment.

Table 7.6.2 Estimated Daily Requirement of Containers

Type of Establishment	Number of Establishment	Number of Plastic Bag for Infectious Waste by Establishment	Number of Hard Cardboard Box for Sharps by Establishment	Number of Plastic Bag	Number of Hard Cardboard Box
	(A)	(B)	(C)	(D = A x B)	(E = A x C)
Public Hospital	8	5	3	40	24
Private Hospital	10	3	1	30	10
Health Center	93	2	1	186	93
Clinics	685	1	1	685	685
Total	796			941	812

(3) Collection/Transport

Separate collection/transport will be necessary for separating the infectious waste and other wastes in medical establishments. The infectious waste should be collected/transported by the special collection body to be newly established, while general hospital waste should be collected/transported by municipal collection service. The collection/transport of the infectious waste should be carried out by dedicated collection vehicles with the special specification as mentioned in Chapter 1.6.6. These collection vehicles should be supplied/procured by 2006.

Daily collection should be conducted for public and private hospitals listed in Table 7.6.1, while the collection for health center and clinics should be made twice a week. The collection section in the newly established body should be responsible for collection/transport. 3 (Three) collection vehicles will be required for collection/transport in the three zones of Lattakia city, Al-Al-Haffeh city and two cities of Jableh and Qurdaha.

(4) Intermediate Treatment

The intermediate treatment is necessary in order to eliminate the remaining infectious risk during the treatment process. Two incinerators in National Hospital and Al-Assad Universal Hospital are currently operating with 100 kg/h capacity, and another hospital with an incinerator is being constructed in Al-Al-Haffeh. Therefore, these incinerators should be operated continuously for the intermediate treatment of infectious medical waste.

(5) Final Disposal

The final disposal site is essential for receiving the treated medical waste. The development scheme for final disposal site is composed of the rehabilitation of existing Al Bassa open dumpsite as short-term goal by year 2006 and the development of new landfill site as long-term goal by 2010. The following appropriate manners for final disposal of infectious waste should be taken by 2006 at latest.

- To develop the special area only for receiving the infectious medical waste at two final disposal sites
- The special area shall have the liner with a material of low permeability to prevent the seepage of the leachate

- The daily cover of soil should be conducted after daily landfill of the infectious waste
- Regular monitoring

Final disposal section newly established will be responsible for the final disposal of the infectious medical waste.

(6) Implementation Plan

1) Task Requirement for Implementation

The appropriate management of the medical waste requires a phased development from the establishment of a basic framework for institutions and a system for the procurement and construction of relevant equipment/facilities that will be required for realizing this framework. Especially, the establishment of separation system including supplying/distributing the dedicated containers should be immediately implemented. The operation unit for collection, transportation and final disposal should be also established at its early stages.

As shown in Table 7.6.3, the establishment of relevant tasks for appropriate management for medical waste management is urgently required.

Table 7.6.3 Task Items required for Appropriate Treatment of Medical Waste

Task Items required for Appropriate Treatment	Authorities Concerned	Target Year
1 Establishment of separation/coloring/marketing systems for medical waste	Governorate / Municipality / Medical Establishment	Up to 2003
2 Establishment of supply/distribution system for dedicated containers for medical waste	Governorate / Municipality / Medical Establishment	Up to 2003
3 Establishment of separate collection system for dedicated vehicles for medical waste	Governorate / Municipality	Up to 2003
4 Establishment of operation (collection, transportation & final disposal) body for medical waste treatment	Governorate / Municipality	Up to 2005
5 Establishment of final disposal system for medical waste	Governorate / Municipality	Up to 2003
6 Construction of special area at final disposal site for infectious medical waste	Governorate / Municipality	Up to 2003 Up to 2007
7 Procurement of dedicated collection vehicles for infectious medical waste	Government / Governorate	Up to 2005

2) Implementation Body for Medical Waste Management

An implementation body should be established under Lattakia Governor only for collecting and final disposal of infectious waste.

The implementation structure is estimated in Figure 7.6.1

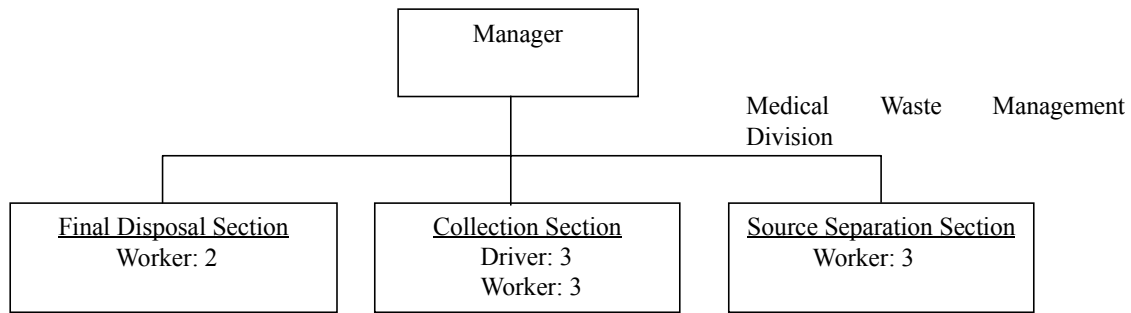


Figure 7.6.1 Implementation Structure for Medical Waste Management

3) Equipment/Facility Plan

a. Up to 2006

Three dedicated collection vehicles should be procured for the collection of infectious medical waste.

A special area of approximately 1,600 m² for the infectious medical waste at the rehabilitated landfill of Al Bassa will be necessary at minimum.

b. Up to 2010

A special area of 1 ha for the infectious medical waste will be necessary at the new final landfill site.

7.7 INDUSTRIAL WASTE MANAGEMENT

(1) General

Industrial waste generated by large-scale factories shall be treated and disposed of by producers. As for industrial waste from small and medium factories, non-hazardous waste shall continue to be collected together with general urban waste.

However, all factories must take responsibility for separating hazardous waste and only discharging non-hazardous waste. Since hazardous waste needs to undergo special treatment according to its properties and it is difficult to do this on the municipal or Governorate levels, management by the national government is required. It is necessary to construct facilities for receiving and disposing of hazardous waste on the national level.

(2) Generation Amount

The annual generation amount is estimated in Table 7.7.1 based on the existing figure and annual increase ratio of 1%.

Table 7.7.1 Waste Generation Amount of Small-scaled Industrial Waste

(unit in ton/year)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Generation Amount	3,607	3,643	3,680	3,716	3,753	3,791	3,829	3,867	3,906	3,945

(3) Collection/Transport

Some factories currently transport their waste to Al Bassa open dumping site. However, most waste is directly hauled in the open space neighboring the factories. This will spoil the surrounding environment and aesthetic beauty. Therefore, to some extent, each municipality should participate in the collection of the small-scaled industry waste. The municipal collection system should be applied in collection of such waste. The municipal dump truck should be utilized for the collection of the waste in each municipality.

(4) Final Disposal

The small-scaled waste excluding hazardous waste should be accepted at the final disposal site. Therefore, proper space should be secured in the final landfill site.

(5) Recycling

The small-scaled industry waste will include some recyclable materials such as steel, glass and papers. The selling of this waste to the middlemen should be continued to the future for volume reduction.

(6) Equipment/Facility Plan

Each municipality should procure the collection vehicle (dump truck) for collection of small-scaled industry waste.

7.8 INSTITUTION AND ORGANIZATION

7.8.1 Establishment of New Institution on the Governorate Level

Up to the year 2010, new inter-municipal disposal site (sanitary landfill) and recycling center (compost plant and sorting center) will be introduced in Qasia and the waste generated in Lattakia, Jableh, Al-Haffeh, and Qurdaha will be treated at and/or disposed of here. In Jableh and Qurdaha, taking into account the long distance between the city center and Qasia site (35 - 40km), the construction of transfer stations are proposed in the master plan. Meanwhile, it is recommended that infectious waste contained in the medical waste be controlled at the Governorate level.

In addition, it should be noted that the small cities are under difficult circumstances for the procurement of equipment and introduction of such a facilities, even it is stipulated in the Local Administration Law of October 10, 1974 that local government should have the responsibility for their SWM respectively.

Based on the above understandings, in the master plan, in order to introduce the proper management and operation of the above facilities etc., a new institution on the Governorate level shall be established. The responsibility of the new institution is described as follows.

- Inter-municipal treatment and disposal of the waste
- Introduction of waste transfer system
- Transport and treatment of infectious waste

Financially, this new institution shall be managed by the subsidies from the Governorate and each city and also fees from users (such as medical entities, etc.)

First, the new institution shall be established as a provisional organization under the jurisdiction of Lattakia city up to an inter-municipal disposal site in Qasia start its operation in the year 2008. As of the operation start of Qasia disposal site, the management body of the new institution shall be transferred to Lattakia Governorate.

Organization chart of the new institution, including the required personnel in each section, is shown in Figure 7.8.1. The new institution is composed of 6 divisions; i.e. new disposal site division, compost plant division, sorting center division, transfer station division, medical waste management division, and financial division.

7.8.2 Ratification of Existing Cleansing Department

Existing Cleansing Departments in each Lattakia, Jableh, Al-Haffeh, and Qurdaha will continue their responsibility of waste collection, road sweeping, etc. as before.

Organization chart of Cleansing Department of each city will not be changed, except adding the Public Awareness Section in each city. Public Awareness Section may

carry out the work for enlighten citizen's public awareness on environment and solid waste through public campaigns in cooperation with and under the guidance of the Public Awareness Section of each city's Cleansing Department. Figure 7.8.2 shows the organization chart of Lattakia city as a represented city of the study area.

Table 7.8.1 shows required personnel in each city on SWM.

Table 7.8.1 Required Personnel on SWM in 2010

Item	Lattakia	Jableh	Qurdaha	Al Haffeh	Total
Manager	1	1	1	1	4
Administration	3	1	1	1	6
Collection	206	50	19	19	294
Road sweeping	289	40	17	7	353
Others	59	1	1	1	62
Total	558	93	39	29	719
Present personnel	723	77	32	18	850

Source of revenue for the Cleansing Department in each city will be covered by the subsidy from general revenue and waste fee collection, and by each city respectively. While each municipality shall be responsible for the management and operation of new institution described in section 7.8.1, financially.

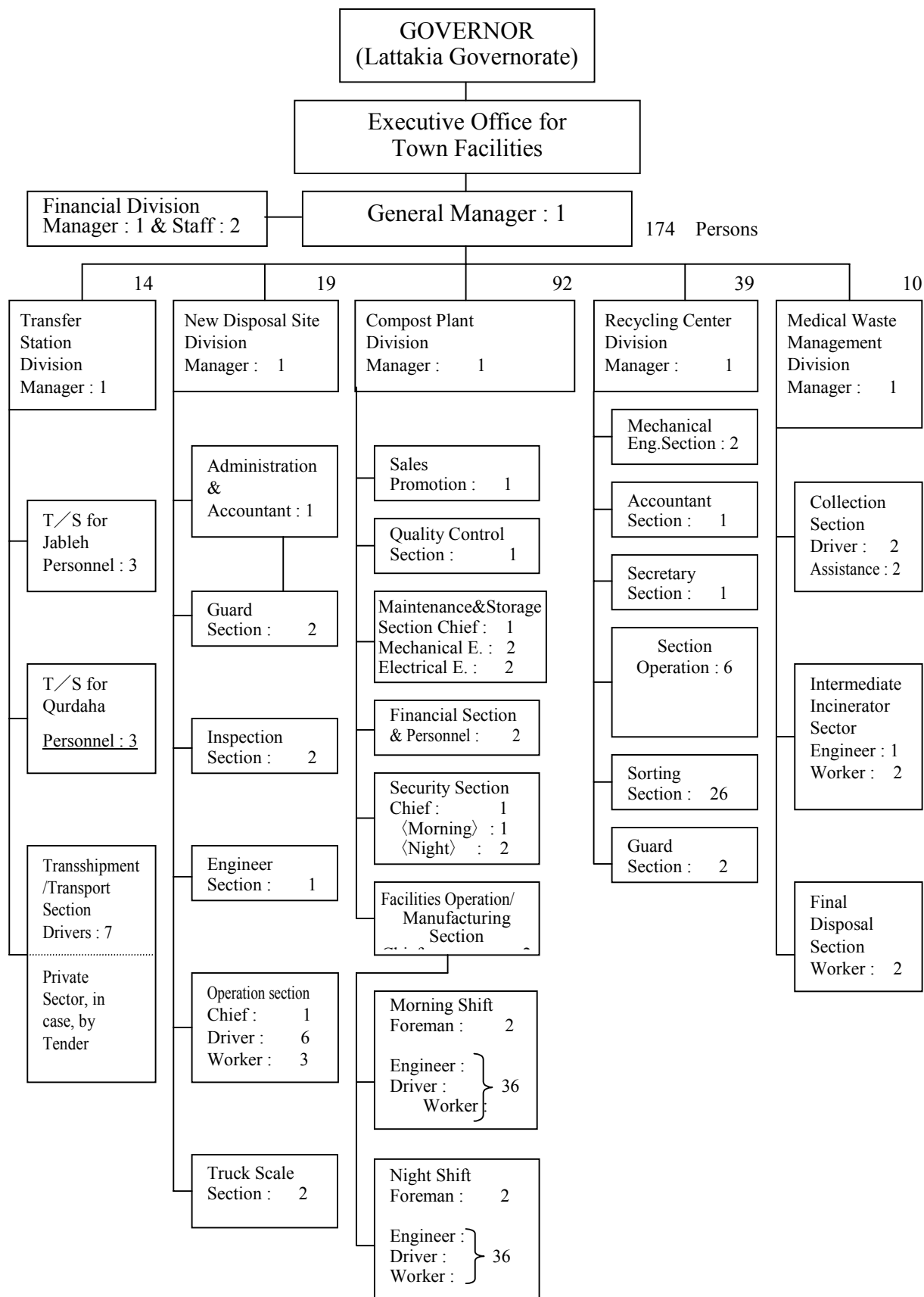


Figure 7.8.1 Organization Chart of New Institution on the Governorate Level

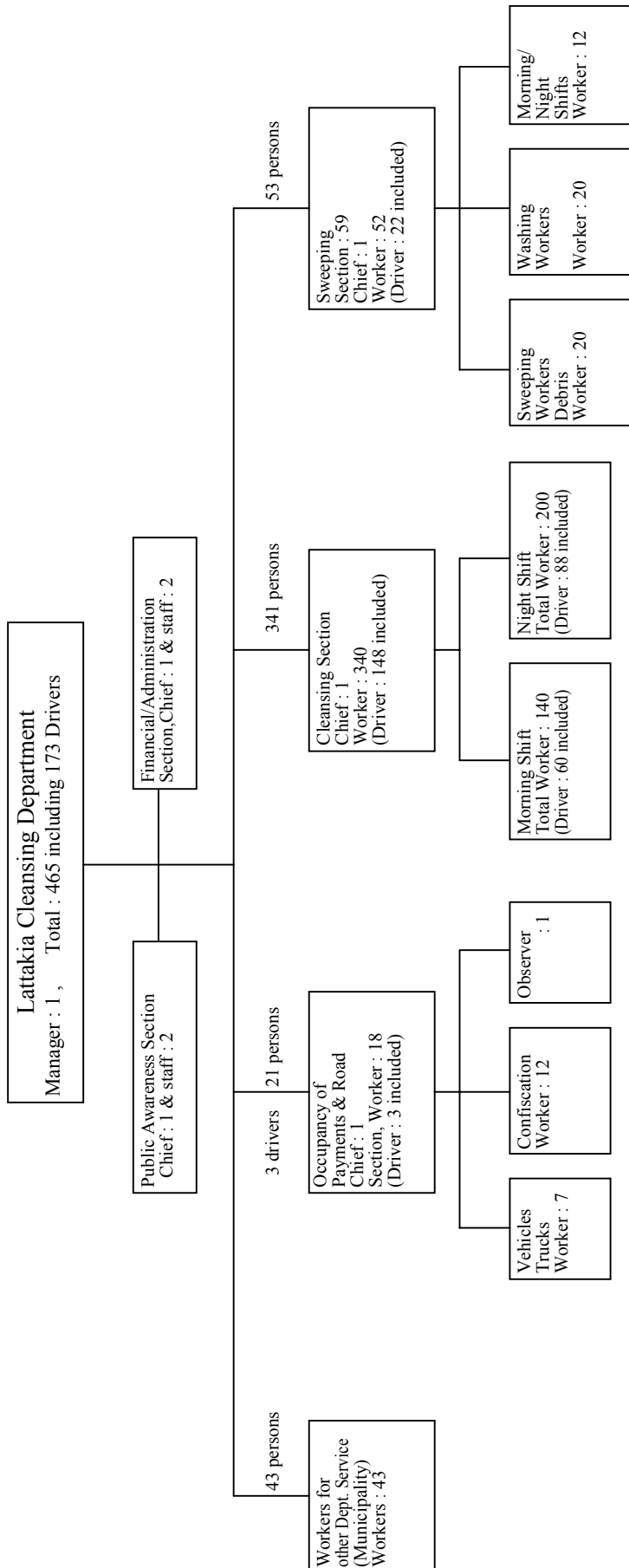


Figure 7.8.2 Organization Chart of Lattakia Cleansing Department

7.9 PUBLIC AWARENESS ON ENVIRONMENT AND SWM

7.9.1 Introduction

In order to improve SWM and keep the city clean, namely creation of an environmentally-friendly society, it is necessary to have the cooperation of the waste generators (residents, the private and the public entities, and so on) on proper waste storage, separation, discharge, recycling/reuse and reduction, etc.

To attain such a society in the region as the final target of the public awareness activities in the master plan, public awareness on environment and SWM shall be heightened through certain activities including related campaigns as follows.

7.9.2 Organizational Arrangement

(1) Public Awareness Section

In accordance with the master plan schedules, actions on heightening public awareness on source separation should be prepared in the study area. As well, the activities of enhancement of public awareness should be an important part of SWM in *Lattakia*, *Jableh*, *Al-Haffeh* and *Qurdaha*.

Accordingly, each city shall prepare a public awareness section to enforce necessary actions on the public awareness on SWM as shown in Table 7.9.1. The sections are expected to set up in 2002 for preparation of the future activities mentioning below.

Table 7.9.1 Organizational Arrangement

City	New Section	Position	Persons
<i>Lattakia</i>	Public Awareness Section	Cleansing Department	3
<i>Jableh</i>	Public Awareness Section	Cleansing Department	1
<i>Al-Haffeh</i>	Public Awareness Section	Cleansing Department	1
<i>Qurdaha</i>	Public Awareness Section	Cleansing Department	1

(2) Internal Training

To raise their capacity to handle activities on heightening public awareness concerned, the public awareness section in each city shall jointly conduct an internal training to the all staff of the section in each city. The training shall be started annually from 2002.

7.9.3 Actions to be Taken

It is proposed to carry out several actions to be taken periodically so as to attain an environmentally-friendly society as follows.

- Publicity campaigns
- Demonstration campaigns
- Source separation campaigns
- Yearly Campaigns

- Regular Activities (Cleansing day or week)

(1) Timing

It is reasonable to consider that efforts on heightening public awareness on SWM shall concentrate on related events/ topics in the future actions on SWM, in order to implement efficiently the related campaigns. Accordingly, the campaigns shall be planned and conducted in parallel with the schedule of these events and topics.

According to the implementation schedule of the master plan, the main topics on SWM as well as suitable timing of launching the campaigns are summarized in Table 7.9.2.

Table 7.9.2 Topics in Priority Projects and Campaign Timing

Topics	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1 Improvement of Collection/Vehicles			Phase1				Phase2			
2 Waste Separate Collection				Implementation						
3 Improvement Al-Bassa Disposal Site			Rehabilitation							
4 New Disposal Site						Construction				
5 Recycle Center at Al-Bassa			Compost/Sorting							
6 New Recycle Center at Qasia								Compost/Sorting		
7 Transfer Station						Construction				
Campaigns	△	▲	▲	▲	▲	▲	▲	▲	▲	▲

■ : Procurement, Rehabilitation & Construction ▬ : Implementation △ : JICA's Pilot Campaign ▲ : Campaigns

(2) Municipal Effort

It is important to provide relevant information about present situation, problems, and future actions to be taken on solid waste management by a municipality for waste generators, through as many different channels and manners as possible.

Publicity campaigns, demonstration campaigns and other related actions shall be undertaken periodically to disseminate such an important information and to improve public awareness on SWM. In the occasion, the municipality's effort has an important role to launch such campaigns.

(3) Participatory Approach and Methods

As one of the pilot studies of the JICA study, a demonstration campaign "Put the Waste in the Container" was implemented during Al-Mahabba festival in Lattakia in August 2001, under the slogan "Let's Keep Our City Clean and Beautiful". Based on the experiences in this demonstration campaign, it is recommended to launch the future publicity, demonstration and other campaigns in accordance with the participatory approach and methods taken in the campaigns of JICA study. The full details on the campaign appear Chapter 3 in Part IV in this report.

7.9.4 Publicity & Demonstration Campaigns

(1) Publicity Campaigns

The main purpose of publicity campaigns is to advertise widely the related information on the future actions on SWM in advance to the population, and to expect possible understanding of the population on the future SWM in the study area through the mass media, printed materials and other appropriate media. Therefore, the publicity campaigns shall be launched before the implementation of each topic of the master plan schedule as shown in 7.9.3.

Table 7.9.3 Publicity Campaigns

Publicity Campaigns	Possible Year
Opening of the Public Awareness Section	2002
Procurement of new collection vehicles	2002, 2006
Introduction of new collection systems	2002, 2004
Rehabilitation and construction of the recycle center, disposal sites and transfer stations	2003, 2006, 2007

(2) Demonstration Campaigns

The main purpose of the demonstration campaigns is to demonstrate widely the related actions on the future SWM in advance to the population in the study area, and to expect possible understanding of the population on the future SWM. Therefore, the demonstration campaigns shall be launched in accordance with the topics of the master plan schedule as shown in 7.9.4.

Table 7.9.4 Demonstration Campaigns

Publicity Campaigns	Possible Year
Commencement of the new collection system	2004
Commencement of operation of the recycle center and the controlled disposal site in <i>Al-Bassa</i>	2005
Commencement of operation of new transfer stations	2008
Commencement of operation of new disposal site, new recycle center in <i>Qasia</i>	2008, 2010

7.9.5 Source Separation Campaigns

(1) Source Separation

A recycle center in *Al Bassa* which consists of a compost plant and a sorting center starts operation in 2005 as well as a similar center in *Qasia* that starts operation in 2010 to introduce waste reduction and to promote recycling in *Lattakia*, *Jableh*, *Al-Haffeh* and *Qurdaha*. These facilities are planned to operate on the basis of the introduction of a source separation system with the positive cooperation of the residents and community participation.

In the master plan, approximately 26% of households in the study area in 2005 and 48% of the households in 2010 are requested to carry out source separation at each targeted household. Table 7.9.4 shows the number of households would be requested to separate organic waste (which will provide the raw material for composting) and non-organic waste (which contains reusable waste materials) from their waste on the premises. Such separated waste materials shall be kept in a plastic bag at their houses then discharged at collection points at designated time and/or days.

(2) Schedule and Targets

In order to implement efficiently further campaigns for source separation, it is reasonable to consider that efforts on heightening public awareness on SWM shall concentrate on the future actions on waste separation in SWM. Accordingly, source separation campaigns shall be planned and conducted in parallel with the schedule of these events and topics. According to the implementation schedule of the master plan, proposed source separation targets and campaigns are summarized in Table 7.9.5.

Table 7.9.5 Schedule and Targets for the Campaign for Waste Separation

Plans	2001	2005	2010
Target ratio of households to join a source separation (%)	-	28	48
Estimated number of households to join source separation (households)	-	30,000	65,000
Possible years to carry out the campaigns in large scale (year)	-	2004	2009

Note: Number of family members per household is estimated to 5.3 person/ household (Syrian Statistics)

(3) Cooperation and Participation

Waste separation at source relies heavily on resident's cooperation and community participation. The successful introduction of source separation and recycling activities can only be assured if a heightened public awareness on source separation and SWM results in full citizen compliance. Therefore, the following experiences of the JICA Study Team shall be applied for the implementation of the campaign.

As has mentioned above, In JICA study, as one the pilot study of the team, conducted a public awareness campaign for source separation for 200 households in *Al-Slaibah* District, *Lattakia* City. Based on the experiences and the approach taken in this source separation campaign, it is recommended to lunch similar campaigns as a part of SWM in *Lattakia*, *Jableh*, *Al-Haffeh* and *Qurdaha*. The full details on the campaign appear Chapter 3 in Part IV in this report.

7.9.6 Yearly Campaign and Regular Actions

(1) Yearly Campaign

As one of the important actions for the continual efforts, a yearly campaign should be implemented during *Al Mahabba* Festival at the Sport City in *Lattakia* every year, in accordance with same methods of the demonstration campaign in August 2001 carried out by the JICA Study Team. The details appear in Chapter 3 in Part IV in this report.

(2) Cleansing Day & Week

For heightening public awareness on environment and SWM continually, periodic activities and related (monthly and yearly) general actions are necessary in addition to the specific actions on campaigns discussed above.

For example, it may be considered to set up a public holiday of "Cleansing Day" or prepare a "Week of Clean City", and so on. On the setting up a specific week, schoolchildren shall be the special target group to enhance their awareness on environment and SWM. As a matter of fact, such a day or a week has not been seen in the study area as shown in the Table 7.9.6 and Table 7.9.7.

Table 7.9.6 National & Local Holidays

Month	Day	Name of Holiday	Note
January	1 st	New year's day	
February			
March	5 th	Great Bairam	Islamic feast changes every year
	8 th	Revolution Day	AL Baath Party
	10 th	Teacher's Day	Ministry of Education
	21 st	Mother's Day	
	25 th	New Hegira Year's day	Islamic feast changes every year
April	15 th	Easter	Christian's feast, changes every year
	17 th	Independence day	Ministry of Defense
May	1 st	Labor Day	
	6 th	Martyr's Day	Ministry of Defense
June	3 rd	Prophet's birthday	Islamic feast changes every year
July			
August			
September			
October	6 th	October War	Ministry of Defense
November	16 th	Correction Movement	AL Baath Party
December	16 th	Lesser Bairam	Islamic feast changes every year
	25 th	Christmas	

Table 7.9.7 Day and Week of Commemoration, and Cultural Events

Month	Day & Week	Name of day or week	Note
January	13 th	Cozalli Day	Ceremonies in Lattakia's villages
February	1 st	Arabic Women's Day	Women Union
	14 th	Valentine's Day	
March	8 th	Women's International Day	Women Union
	9 th	Arbaeen Shaheed	Christian's Ceremony in Lattakia
	22 nd	Arabic League Day	
April	4 th	AL Zehorra Day	Ceremonies in Lattakia's villages
	7 th	World Health Day	Ministry of Health
	7 th	AL Baath party establishment	AL Baath Party
	17 th	AL Zohor Day	A ceremony in Lattakia
	23 rd	Ayop Day	Christian Feast (Changes every year)
May	28 th	Gaorgeos Oay	Christian's Ceremony
	4 th	World Traffic Day	Ministry of Transportation
June	31 st	International day for smoking prevention	Ministry of Health
	26 th	International day for drugs prevention	Ministry of Health
July			
August	1 st	Syrian Arab Army's Day	Ministry of Defense
	2 nd – 12 th	AL Mahabba Festival	Ministry of Education
	15 th	Virgin Lady day	
	25 th	AL Helou feast	Ceremonies in Lattakia's villages
September	8 th	Cross Day	Christian's Ceremony in Lattakia
	27 th	International Tourist Day	Ministry of Tourism
October	3 rd	International Child Day	
	13 th	Esraa and Almeearaj Night	Islamic feast changes every year
	14 th	Arabic Environmental Day	Ministry of Environmental
	31 st	Nesef Shaaban Night	Islamic feast changes every year
November			
December	1 st	International Aids Day	Ministry of Health
	4 th	Saint Barbara Day	
	11 th	AL Kader Night	Islamic feast changes every year
	29 th	Tree's Day	Ministry of Agriculture

It should be noted that in addition to several Islamic Days above such as *Al Gadeer* day and *Ashoraa* day, are celebrated in accordance with the Islamic calendar, namely the days are changed on the western calendar every year.

7.9.7 Consideration of Scavengers

From the point of view of social consideration, some measures should be taken against the following accidents in the landfill site.

- Traffic accidents by waste collection vehicles during the tipping and heavy vehicle operation in the site.
- Infection of a serious communicable disease by infectious waste in the site.

In order to avoid such accidents and to keep safe operation of the heavy vehicles, the following necessary actions are required as an important part of the public awareness sections.

- To recognize danger of traffic accidents in the site
- To create a regulation to avoid such accident
- To instruct the risks of medical waste

7.10 ENVIRONMENTAL CONSIDERATION

It is predicted in general that the significant environmental impacts caused by solid waste management facilities is final disposal site, and it is also predicted that the impacts are occurred intensively during the operation stage rather than construction stage.

On this proposed master plan, two disposal sites are proposed that one is located in existing dumping site, namely Al Bassa disposal site and the other one is proposed in Qasia as an inter-municipal disposal site. The Al Bassa disposal site is used till the year 2007, then the dumping site shifts to new Qasia site after year 2008.

The Al Bassa site includes existing waste disposal facilities and the proposed plans are mainly focusing on rehabilitation of them so that new negative environmental impacts are hardly expected there and it is essential that the Initial Environmental Examination shall carry out for the inter-municipal disposal site in Qasia in order to clarify environmental factors to be surveyed at design stage. Though environmental consideration in Al Bassa site shall be made in the course of the study. Figure 7.10.1 shows Qasia site and surroundings.

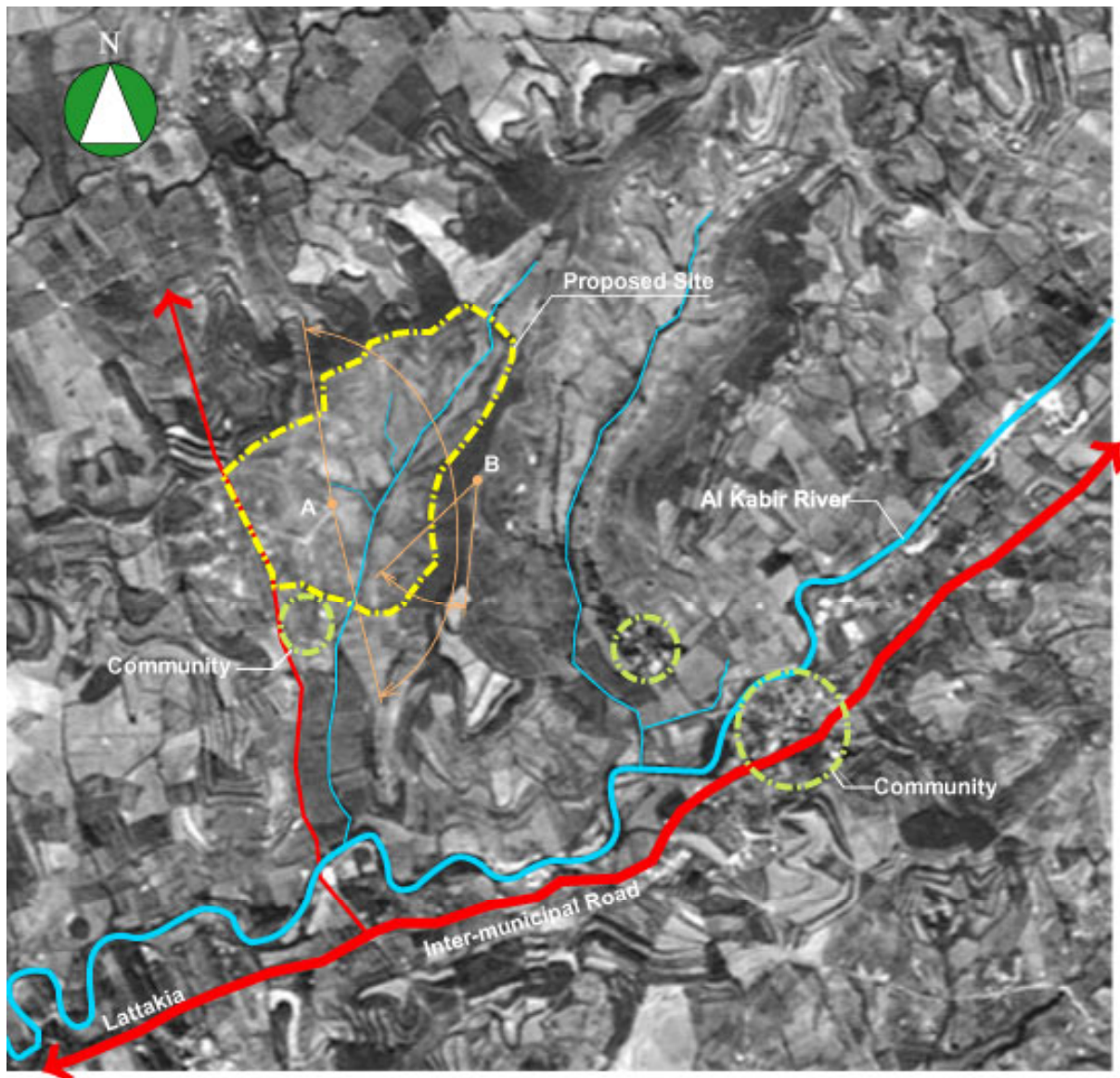


Figure 7.10.1 Location of the Site (Qasia)

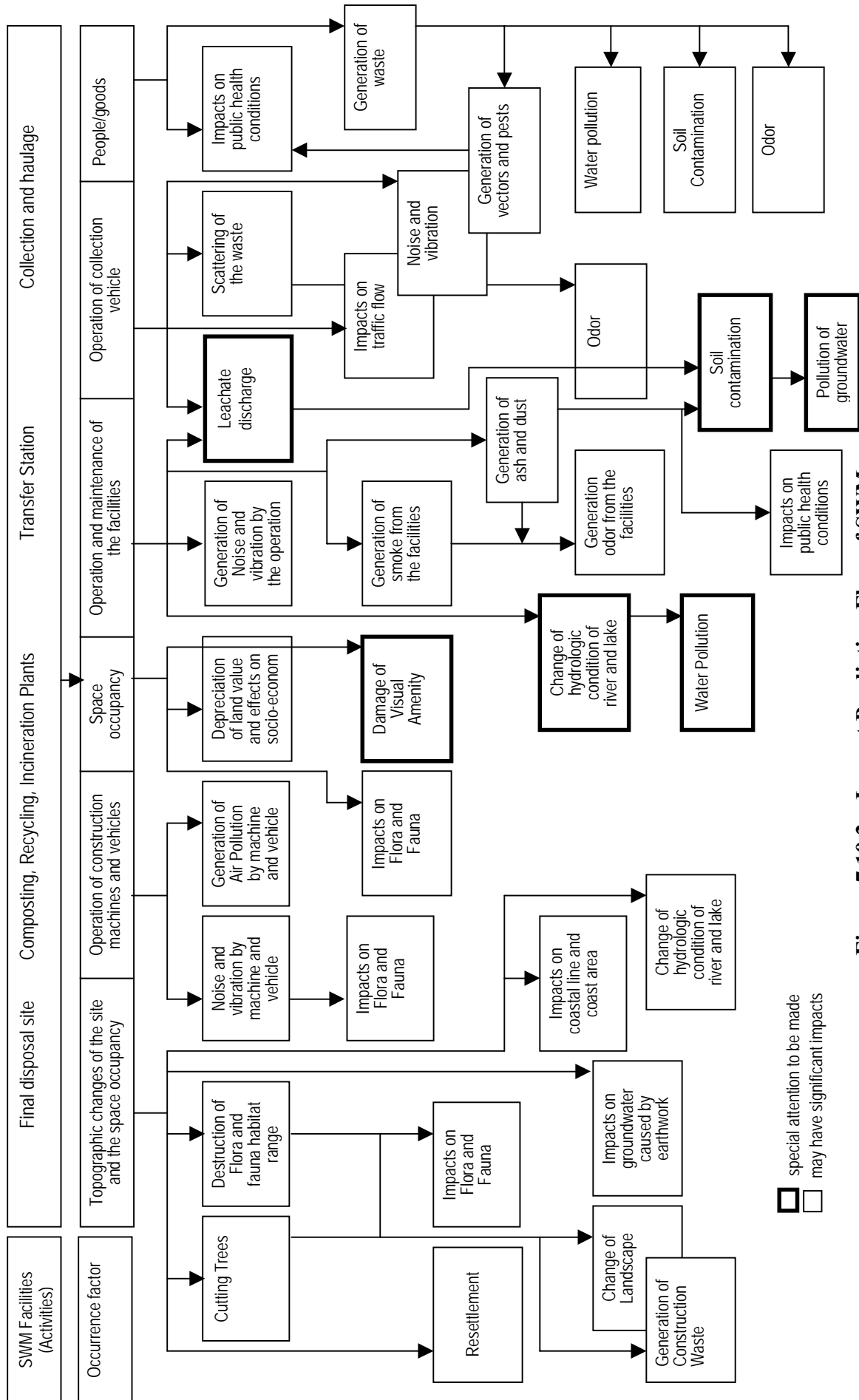
7.10.1 Initial Environmental Examination (IEE) of New Inter-municipal Disposal Site

IEE was carried out for a new inter-municipal disposal site based on existing information collected in reference with the occurrence and environmental factors of disposal site and the occurrence and environmental factors of solid waste disposal project shown in Table 7.10.1 and Figure 7.10.2.

Table 7.10.1 Occurrence and environmental factors of Disposal Site

Stages	Environmental Factors								
	Occurrence Factors	Air Pollution	Water Pollution	Noise and Vibration	Odor	Topography/ Geology	Flora/Fauna	Visual amenity	
Construction	Transport of construction materials	✓		✓					
	Earth work (filling)	✓	✓	✓					
	Earth work (cutting)	✓	✓	✓					
	Earth work (cutting trees)		✓	✓					
	Excavation for foundation	✓		✓					
	Piling			✓					
	Construction of access road							✓	
	Construction of Buildings (Maintenance Quarters)							✓	
	Site (special occupancy and topographical change)					✓	✓	✓	
Dumping	Transport of Waste	✓		✓	✓				
	Dumping work	✓		✓					
	Decomposition and existence of waste	Liquid		✓					
		Volatile				✓			
		Decay				✓			
		Floating/ scattering	✓						✓
Food for animals							✓		
Existence	Decomposition of waste	Liquid		✓			✓	✓	
		Volatile				✓			
		Decay	✓			✓			

Source: Note: "✓" shows environmental impacts



Source: Environmental Guideline-SWM, JICA and JICA Study Team

Figure 7.10.2 Impact Prediction Flow of SWM

7.10.2 Screening and Scoping of the New Inter-municipal Disposal Site

The purposes of screening and scoping are to identify the potentials of significant impacts caused by project implementation and to formulate the essentials of the further environmental impact study.

(1) Screening Results

The following table shows the results of the screening in each environmental factors and it is concluded that further environmental examination is required.

Table 7.10.2 Screening of New Inter-municipal Disposal Site

No.	Environmental Items	Description	Evaluation	Remarks (reason)	
Social Environment	1.	Resettlement	Resettlement by occupancy of proposed project	No	No resident in the site. There are some farmer near by
	2.	Economic Activities	Loss of productive opportunity such as land and change of economic structure	No	Agriculture exist in adjacent area
	3.	Traffic and Public Facilities	Increasing traffic congestion and accident, and influence on hospital and school	No	No public facility in the site
	4.	Split of Communities	Split of Communities by obstruction of traffic	No	The site is single lot.
	5.	Cultural Property	Loss of cultural property and decreasing of the values	No	No cultural heritage exists in the sites
	6.	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, and common rights of forest	Unknown	Wells for agriculture exists near by
	7.	Public Health Condition	Generation of vectors and pests, deterioration of hygiene conditions	Unknown	Waste may attract vectors and pests
	8.	Waste	Occurrence of construction waste, ash, etc	Unknown	
	9.	Hazards (Risk)	Increase of possibility of danger of landslide and accident	No	Low possibility
Natural Environment	10.	Topography and Geology	Change of valuable topography and geology by excavation or filling works	Unknown	No large scale structure or earth work
	11.	Soil Erosion	Surface soil erosion by rainwater after land development (vegetation removal)	Unknown	Subjected area is developed already
	12.	Ground Water	Degradation by polluted discharge water from the site	Unknown	Main work is Filling
	13.	Hydrological Situation	Change of river flow and riverbed condition due to landfill and drainage	Unknown	No structure will be built on the rivers
	14.	Coastal Zone	Changes of topographical conditions in coastal area and coastal vegetation	Unknown	The site is located on the coastal area
	15.	Flora and Fauna	Obstruction of breeding and extinction of species due to change of habitat condition	No	There is no primary vegetation
	16.	Meteorology	Change of temperature, precipitation, wind, etc., due to large-scale development.	No	There are no large scale development
17.	Landscape	Change of topography and vegetation by land development and harmonious obstruction by structural objects	Yes	Visual amenity will be changed by SWM facilities	
Pollution	18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	Unknown	Impact by exhaust gas from
	19.	Water Pollution	Pollution by inflow of soil and discharge waster from facilities into rivers and ground waster	Unknown	Less impact by road facilities
	20.	Soil Contamination	Soil contamination by incinerated ash, non-combustion waste and those escapes and diffusion	Unknown	May have discharge waster
	21.	Noise and Vibration	Noise and vibration generated by collection vehicles and disposal site	No	During construction and operation
	22.	Land Subsidence	Deformation of land and land subsidence due to the lowering of ground water	No	Sensitive lands do not exist in the subject area
	23.	Offensive Odor	Generation of exhaust gas and offensive odor from disposal facilities	Unknown	No factor
	Overall evaluation	Environmental Impact Assessment (EIA) is required or not		From the results of the evaluation, EIA is required.	

The geological conditions there are especially unknown so that there may be an affect on surface and ground waster quality. Wells are seen in adjacent area and theses are used for mainly agriculture. It is therefore vital that detailed environmental survey be carried out in the design stage.

(2) Scoping Results

Following to the screening procedure discussed in the previous section, scoping for further examination was carried out and the results were as follows.

Table 7.10.3 Scoping of the New Inter-municipal Disposal Site

No.	Environmental Items	Evaluation	Remarks (reason)	
Social Environment	1.	Resettlement	D	Resettlement will not occur. The site is located in special land use.
	2.	Economic Activities	C	Agriculture in adjacent areas may have impacts by change of ground water level and amount
	3.	Traffic and Public Facilities	C	Access road to the site is insufficient conditions for heavy collection vehicle
	4.	Split of Communities	D	Non-access controlled roads will not create split
	5.	Cultural Property	D	There is no cultural properties identified
	6.	Water Rights and Rights of Common	C	Farmer in adjacent area uses water resources. Change of the resources may affect on the rights
	7.	Public Health Condition	C	There is a community adjacent to the site
	8.	Waste	C	Scattering of waste form the site may occur.
	9.	Hazards (Risk)	C	Low possibility for natural disasters to occur
Natural Environment	10.	Topography and Geology	B	Large land development is not included
	11.	Soil Erosion	C	Large scale of soil erosion has not been identified
	12.	Ground Water	B	There is no large scale underground structure planned
	13.	Hydrological Situation	B	No large scale excavation will be included
	14.	Coastal Zone	D	Project area is inland
	15.	Flora and Fauna	C	It is secondary vegetation area and there is no valuable flora and fauna identified.
	16.	Meteorology	D	Large scale felling and construction of high building is not planned
Pollution	17.	Landscape	B	The site may have impacts on adjacent hilly arable landscape.
	18.	Air Pollution	C	Scattering of ash dust may cause air pollution depend on wind direction to adjacent community during the construction and operation stage
	19.	Water Pollution	B	Existence of the waste and the leachate may cause degradation of water quality in lower river basin.
	20.	Soil Contamination	C	Existence of waste may cause soil contamination through the leachate
	21.	Noise and Vibration	C	There is impact on noise and vibration by increasing traffic volume during operation stage
	22.	Land Subsidence	D	No sensitive lands exist in the project area
23.	Offensive Odor	C	Decomposition of waste may cause offensive odor depend on wind direction	

Note 1: Evaluation categories:

A: Significant impact is predicted

B: Some impact is predicted

C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses)

D: No impact is predicted. EIA is not necessary

Note 2: The evaluation should be made with reference to the Explanation of Item.

Environmental factors that Special attention has to be paid are following subjects.

- Topography and Geology
- Ground Water
- Hydrological Situation
- Landscape
- Water Pollution

Moreover, viewpoints from different angle of the environmental impacts, which is project cycle, were considered for overall evaluation of scoping. The following table shows predicted impacts before operation and operation phase.

Table 7.10.4 Matrix for Scoping Results Classified by the Project Cycle

Major facilities, activities Which may cause impacts		Project Activities					
		Overall Evaluation	Before Operation		Operation		
			Reclamation and spatial occupancy	Operation of construction equipment	Occupancy of land	Operation of vehicle	Operation of facilities	Corpus of people and goods
Social Environment	1. Resettlement						
	2. Economic Activities	✓			✓		
	3. Traffic and Public Facilities	✓			✓		
	4. Split of Communities						
	5. Cultural Property						
	6. Water Rights and Rights of Common	✓	✓				
	7. Public Health Condition	✓				✓	
	8. Waste						
	9. Hazards (Risk)	✓					
Natural Environment	10. Topography and Geology	✓	✓				
	11. Soil Erosion	✓					
	12. Ground Water	✓✓	✓✓			✓✓	
	13. Hydrological Situation	✓✓	✓✓			✓✓	
	14. Coastal Zone						
	15. Flora and Fauna	✓	✓				
	16. Meteorology						
	17. Landscape	✓	✓		✓		
Pollution	18. Air Pollution	✓					
	19. Water Pollution	✓✓	✓			✓✓	
	20. Soil Contamination	✓				✓	
	21. Noise and Vibration	✓		✓		✓	
	22. Land Subsidence						
	23. Offensive Odor	✓✓					✓

Note: ✓✓ The environmental items to which special attention has to be paid. They might be serious impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.

✓: The environmental items that may have a significant impact depending on the scale of the project and site condition

No mark: The environmental items requiring no impact assessment since the anticipated impacts are, in general, not significant.

7.10.3 Overall Evaluation and Environmental Considerations

In conclusion, it is anticipated that implementation of the master plan will contribute to mitigating environmental impacts compared to current disposal management. However, further environmental study shall be carried out for detail evaluation and formulation of countermeasures. Remarkable aspects are explained as follows:

(1) From Al-Bassa to Qasia Inter-municipal disposal site

It is proposed that existing Al-Bassa disposal site will be closed in 1997, and then a new inter-municipal disposal site in Qasia will be opened. Viewpoint from environmental burden in the areas, environmental impacts will be decelerated. The location of Al-Bassa is located in fragile coastal area while the inter-municipal disposal site is located in isolated inland where is 17km from Lattakia centre. In addition to this, sanitary landfill is proposed there while Al-Bassa site is presently dumping the waste with soil cover method partially.

(2) Groundwater and hydrological condition in Qasia

The site forms a small valley and there is a small seasonable river. Construction of disposal site in upper basin, groundwater quality and flow may be affected. It is necessary to have detail survey on this matter in design phase.

(3) Water Rights in Qasia Site

Wells are seen in the community and adjacent farms. When the plan changes topographical and geological conditions there, the ground water condition may be affected. It is necessary to survey these conditions in design stage.

(4) Resettlement may cause in Inter-municipal Disposal Site

Depend on the scale and works of the plan, resettlement may cause in adjacent community. Based on observation of the site, some farmers' housings are seen and they have used ground water for their farms. Once topographical condition changes, the ground waster condition might be affected so that they discontinue to work there.

(5) Al-Bassa Site

As it is explained in previous section, existing dumping site is proposed as master plan site especially up to third quarter of the Plan duration. The plan contains rehabilitation of existing SWM facilities such as disposal site and composting plant. In general there is no significant impact on the plan however miner impacts are identified as follows:

a. Proper treatment of leachate from the disposal site

The leachate from the site may cause ground water pollution and may affect on ecosystem. So far this relation is unknown, though it is necessary to have detail survey further.

b. Haulage of waste from cities

The site will be used till third quarter of the planning period. Current road condition there is insufficient and heavy compactors transport municipal waste every day. The degraded access roads condition may cause spreading wastes on the routes.

In addition, surrounding area of collection bins in the city is insufficient management and this condition generates offensive odour and attracts vectors and pests. Promotion and prevalence of the proper management should also be introduced on the public awareness activities in the plan.

Many of existing collection vehicles have insufficient maintenance in terms of safety driving. It is seen that some collection vehicles that tail lamps had gone at night and one of headlight also had gone. Proper maintenance of these vehicles should be considered.

c. Improving visual amenity in Al-Bassa Site

The site is located in one of the most scenery dune along the Mediterranean Sea coast in the region. While the scene of dumping site including coastal area is terrible; for example, scattering of the waste, dispersion of the smoke, awful offensive odour, disordered dumping and spreading the waste in the area, etc. The proposed rehabilitation includes countermeasures against to such negative aspect of the site, though visual amenity and ecosystem there should be considered on the rehabilitation plan.

7.11 IMPLEMENTATION SCHEDULE

The master plan implementation schedule has been prepared based on the scheduling for the introduction of SWM facilities and procurement of equipment.

The time period for the master plan will be divided into two phases.

- Phase I Up to 2006
- Phase II 2007 to 2010

The projects to be implemented in each phase are described below.

(1) Phase I

Phase I shall be the period to establish the basic system of SWM in Lattakia, Jableh, Al-Haffeh, and Qurdaha. Phase I also include the introduction of recycling with separate collection and establishment of new organization. Therefore, the priority project package shall be formed of the following projects and shall be implemented in this period as shown in Figure 7.11.1.

- a. Improvement of collection system (Phase I)
- b. Rehabilitation of Al-Bassa disposal site
- c. Establishment of recycling center in Al-Bassa
 - Introduction of separate collection (Phase I)

- Rehabilitation of existing compost plant in Al-Bassa
 - Construction of sorting center
- d. Introduction of medical waste collection
- e. Establishment of new organization

(2) Phase II

Phase II shall be the period to establish the inter-municipal disposal system in Lattakia and surrounding three cities, in full-scale. Phase II also includes the expansion of waste reduction and recycling, which introduced in Phase I.

- a. Improvement of collection system (Phase II)
- b. Construction of Qasia new inter-municipal disposal site
- c. Establishment of recycling center in Qasia
- Introduction of separate collection (Phase II)
 - Construction of compost plant
 - Construction of sorting center
- d. Construction of transfer stations in Jableh and Qurdaha
- e. Introduction of medical waste treatment

Table 7.11.1 shows the scheduling required for the construction of facilities and for equipment procurement. The investment schedule has been prepared based on this schedule. The priority projects shall be selected from the first phase of the master plan period up to the year 2006.

Table 7.11.1 Implementation Schedule of the Master Plan

Item	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1 Collection										
(1) Collection Improvement - Phase I										
(2) Collection Improvement - Phase II										
2 Rehabilitation of Al-Bassa Disposal Site										
3 Construction of Qasia New Inter-municipal Disposal Site										
4 Recycling Center in Al-Bassa										
(1) Introduction of Separate Collection										
(2) Rehabilitation of Existing Compost Plant										
(3) Construction of Sorting Center										
5 Recycling Center in Qasia										
(1) Introduction of Separate Collection										
(2) Construction of Compost Plant										
(3) Construction of Sorting Center										
6 Transfer Station										
(1) Construction of Transfer Stations (Jableh and Qurdaha)										
(2) Procurement of Transportation Vehicles										
7 Medical Waste Management										
(1) Procurement of Collection Vehicles										
(2) Construction of Treatment Facility										

7.12 MASTER PLAN COST

(1) Condition of Cost Estimation

Master plan cost has been calculated based on the following exchange rate.

Exchange rate: US\$1.00 = SP 49 (as of June 2001)
US\$1.00 = Yen 121 (as of June 2001)

Price: Price of June 2001

(2) Investment Cost

Investment cost of the master plan is shown in Table 7.12.1.

Table 7.12.1 Master Plan Investment Cost

(Unit: Thousand SP)

Item	2001—2006	2006—2010	Total
1. Collection Improvement	155,557	110,888	266,445
2. Construction of Recycling Center			
(1) Compost Plant	199,000	534,000	733,000
(2) Sorting Center	33,260	33,260	66,520
3. Construction of Transfer Station	—	95,420	95,420
4. Improvement of Disposal Site			
(1) Al-Bassa Disposal Site	119,050		119,050
(2) Qasia Inter-municipal Disposal Site		153,860	153,860
5. Improvement of Medical Waste Management	7,200	—	7,200
6. Improvement of Public Awareness	8,965	6,724	15,689
Sub-total	523,032	934,152	1,457,184
7. Engineering Service	36,612	65,391	102,003
Total	560,230	999,782	1,559,187

(3) Operation and Maintenance Cost

Operation and maintenance cost of the master plan (year 2006 and 2010) is shown in Table 7.12.2.

Table 7.12.2 Operation and Maintenance Cost

(Unit: Thousand SP/year)

Item	2006	2010
1. Collection Improvement	88,172	84,260
2. Construction of Recycling Center		
(1) Compost Plant	3,553	13,415
(2) Sorting Center	2,955	5,911
3. Construction of Transfer Station	—	7,387
4. Improvement of Disposal Site		
(1) Al-Bassa Disposal Site	8,966	—
(2) Qasia Inter-municipal Disposal Site	—	12,490
5. Improvement of Medical Waste Management	1,924	1,924
6. Others	1,097	1,097
Sub-total	106,667	126,484
7. Income by selling compost & recyclables	-4,771	-18,848
Total	101,896	107,636

Note: Depreciation is not included.

7.13 FINANCIAL PLAN

(1) Policy of the Financial Plan

In order to ensure the appropriate operation of the solid waste management, it is necessary to secure investment funds for purchasing and renewing the necessary equipment and facilities and a source of revenue for covering operation and maintenance costs. Currently, subsidies from the central government are relied on in order to carry out equipment and facilities renewal. Meanwhile, collected service fees and the general budget of Lattakia Governorate cover operation and maintenance costs. Revenue from fees currently covers no more than 30% of overall operation and maintenance cost (however, depreciation of equipment is not taken into account here).

Taking into consideration the tight financial situation in each municipality, in order to secure sound finances in the solid waste management, revenue from service fees should be regarded as the main component of revenue that covers all costs including depreciation expenses as well as the current operation and maintenance costs.

Considering the present financial state of municipalities, there is no choice but to rely on funds other than those from the municipality own budget in order to finance investment up to 2005. However, concerning investment after that, a funding plan for covering costs by autonomous sources and borrowing in each municipality shall be compiled.

(2) Sources of Finance

Concerning investment funds, there is no choice but to rely on funds other than those from the municipality own budget for the immediate future. However, from 2006 onwards, loans shall be used to secure investment funds.

Two sources of revenue to cover operation and maintenance costs are municipal subsidies and waste treatment fees. Considering that costs in future will increase in

line with the additional burden of depreciation costs (to pay for equipment renewal) and disposal site improvement costs, it will be necessary to expand fund sources. For this purpose, it will be necessary to expand either subsidies or revenue from fees. However, since it is difficult to expand subsidies, it will be necessary to examine the second alternative of expanding revenue from fees.

(3) Cleansing Fees

Cleansing fees are collected in Lattakia, Jableh and Al-Haffeh. Total revenue from fees in 2000 was SP 3.6 million from households and SP 20 million from business establishments. Uniform cleansing fees are prescribed throughout the whole country in Syria (Finance Act No. 1, 1994) and these range from SP 75-500/hh/year in Lattakia and SP 75-200/hh/year in other cities. In Lattakia, cleansing fees of SP 200/year for households and SP 250/month for business establishments are established. Fee collection rate in total is about 50%, however, the rate from households is extremely low (around 20%).

- a. Assuming the current level of fees, if the collection rate can be raised to 80%, it will be possible to raise SP 17.6 million from households and SP 36.4 million from business establishments in 2010.
- b. If household fees are set at the upper legal limit and the collection rate is 80%, it will be possible to collect revenue of SP 42.3 million in 2010.
- c. If even higher revenue is to be sought via service fees, it will be necessary to carry out revision of national legislation.

The upper limit of service fees for households is generally put at 1-2% of household income. Judging from the results of citizens awareness surveys, average household income is SP 140,000/year (5.3 household members). If the service fee is set at SP 1,500/year and the collection rate is raised to 80%, revenue of SP 155.5 million can be obtained. In this case, in consideration of fairly spreading the burden, it will be necessary to raise the fee for business establishments to SP 500/month.

(4) Case Studies

In 2010, it will be necessary to carry the burden of operation and maintenance costs also taking the depreciation cost of facilities and equipment into account, and this comes to a total of approximately SP 230 million. The only available sources of funds for this are municipal government subsidies and revenue from fees. The results of examining different combinations for covering this burden are as indicated in Table 7.13.1.

- Case 1: Improvement of fee collection rate and provision of subsidies
- Case 2: Revision of fees (raising of upper legal limit) and provision of subsidies
- Case 3: Maintenance of existing subsidies and revision of fees
- Case 4: Zero subsidies and revision of fees

Table 7.13.1 Financial Plan Alternatives

Item	Unit	Case 1	Case 2	Case 3	Case 4
Fee on domestic waste	SP/year	200 (100)	500 (200)	1,000 (400)	1,500 (1500)
Fee on commercial waste	SP/month	250 (100)	250 (100)	500 (500)	500 (500)
Subsidy (from municipality)	--	Apply a shortage	Twice of current	Same w/current	No subsidy
Income: Households	Million SP/year	17.6	42.3	84.6	155.6
Income: Commercial entities	Million SP/year	36.4	36.4	79.5	79.5
Income: Subsidy	Million SP/year	Approx. 180	Approx. 150	72.8	0.0
Total	Million SP/year	234.0	228.7	236.9	235.1

Note: () shows the collection fee of surrounding three cities.

As is indicated in Table 7.13.1, even in Case 2 where the upper legal limit of fees is revised, subsidies from the municipal government equivalent to roughly two times the present level are necessary. Therefore, over the long term, as is indicated in Case 3 and Case 4, it is necessary to lighten the burden placed on the municipal government by revising the law and raising fees. Since service fees only account for around 1% of income even in Case 4, this burden can be handled by citizens. Fees in Case 4 are higher than in Case 2 and Case 3, however, in accordance with the principle of polluters must pay, and Case 4 should be aimed for.

(5) Financial Plan

The financial plan for the period up until 2010 based on the above examination is indicated in Table 7.13.2. The following measures need to be implemented in order to realize this plan.

- a. Concerning investment up until 2005, utilize funds other than those from the municipality own budget.
- b. Immediately embark on improving the service fee collection rate based on the present law; also establish service fee collection ordinances in each city and revise fees in line with project implementation (upper legal limit).
- c. Prior to construction of Qasia disposal site, carry out revision of Syrian law and fees in each city so that the level of fees is SP1,500/year for households and SP 500/month for business establishments.
- d. Continue to provide general municipal budget until realization of the new fee system.
- e. Concerning project works from 2006 onwards, establish a system whereby investment funds that cannot be covered by autonomous sources are procured via loans. Concerning the borrowing conditions, loan period of 10 years and interest rate of 8% are envisaged.

Table 7.13.2 Annual Investment Cost and Financial Plan

Items	(1) Investment and O/M Cost																	Total			
	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017		2,018	2,019	2,020
1. Construction																					
Disposal site	0	730	81,505	36,815		76,490	77,370	0	0	0			29,840			76,490	77,370				
Transfer station						23,360	72,060										48,700				
Compost plant					0	0	347,000	187,000						21,776					187,412		
Sortin center							14,000	19,260						5,260					21,110		
Collection							155,557							110,888			0	110,888			
Medical							7,200							7,200							
Public awareness							1,494	1,868						1,494							
Engineering	0	156	26,364	9,857	131	7,094	18,353	25,375	14,589	105											
Sub total	0	2,380	402,894	150,673	1,999	1,08,438	280,538	387,868	222,697	1,599	0	49,096	192,597	27,036	0	76,490	236,958	0	209,522	0	2,349,886
2. Operation																					
Disposal site	8,195	16,390	16,390	8,310	8,946	8,966	8,996	12,620	12,640	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	12,490	
Transfer station								7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	7,387	
Compost plant								3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	3,553	
Sortin center	110,981	110,981	88,172	88,172	88,172	88,172	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	84,260	
Collection							1,924	1,924	1,924	1,924	1,924	1,924	1,924	1,924	1,924	1,924	1,924	1,924	1,924	1,924	
Medical																					
other																					
Sub total	119,176	128,468	105,659	99,503	106,847	106,667	102,785	113,796	115,780	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	
Total	119,176	130,848	508,653	250,176	1,08,646	1,215,105	383,324	501,665	338,477	1,28,083	1,26,484	1,75,580	319,081	153,520	1,26,484	202,974	369,442	1,26,484	335,006	1,26,484	4,739,891

Items	(2) Cash Flow																	Total			
	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017		2,018	2,019	2,020
1. Revenue																					
Remaining	7,600	14,205	14,587	36,095	37,066	38,063	143,631	147,495	151,462	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	155,537	
Fee from HH	30,000	36,426	36,426	36,426	36,426	36,426	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	79,466	
Sub sidy	89,461	77,837	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	72,800	
Sales of compost							678	678	678	678	678	678	678	678	678	678	678	678	678	678	
Sales of reusable							4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	4,093	
Sub total	127,061	128,468	123,813	145,321	151,063	152,060	227,868	231,792	237,291	253,851	253,851	253,851	253,851	253,851	253,851	253,851	253,851	253,851	253,851	253,851	
Grant (100%)	0	2,380	402,894	150,673																	
Loan (70%)																					
Total	127,061	130,847	526,807	295,994	152,462	227,867	424,245	503,240	393,179	254,970	253,851	288,218	388,669	272,776	263,851	318,867	455,265	253,851	431,084	253,851	
2. Expense																					
Capital Invest	7,885	2,380	402,894	150,673	1,999	1,08,438	280,539	387,869	222,697	1,599	0	49,096	192,597	27,036	0	76,490	236,958	0	209,522	0	
Operation	119,176	128,468	105,659	99,503	106,647	106,667	102,785	113,796	115,780	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	126,484	
Loan repayment							0	140	7,731	27,368	54,519	70,108	70,220	73,657	87,138	89,031	88,891	87,802	88,306	61,155	
Loan interest(%)							0	112	61,73	21,255	40,796	49,906	43,387	37,789	34,901	39,794	34,337	27,214	25,304	34,393	
Total	127,061	130,848	508,653	250,176	1,08,646	1,215,105	383,324	501,665	338,477	1,28,083	1,26,484	1,75,580	319,081	153,520	1,26,484	202,974	369,442	1,26,484	335,006	1,26,484	
Balance	0	-0	18,154	45,818	43,816	12,610	37,228	550,298	433,792	247,096	240,090	283,569	427,638	280,452	249,851	319,079	479,548	249,183	423,490	226,390	
Accumulation	0	-0	18,153	63,971	107,768	120,987	147,415	100,357	59,743	67,617	81,377	86,026	47,057	39,390	43,380	43,168	21,884	26,552	34,157	61,618	
Remaining loan	0	0	0	0	1,399	77,166	265,813	509,952	611,321	542,332	472,112	436,260	497,421	429,208	340,177	316,303	429,915	341,610	457,699	394,408	
Total debt	0	-0	18,153	63,971	106,388	43,231	-118,398	-409,596	-551,578	-474,715	-390,735	-350,233	-450,365	-389,828	-296,798	-273,135	-408,031	-315,057	-423,541	-332,791	
Debt ratio	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	6.1%	21.0%	40.2%	44.8%	46.9%	42.5%	42.9%	50.0%	48.6%	45.7%	44.6%	48.3%	34.9%	39.4%	

CHAPTER 8 EFFECTIVENESS OF THE MASTER PLAN

8.1 TECHNICAL ASPECT

The master plan comprises the following technical systems. The effectiveness of each system of SWM flow from the technical viewpoint is briefly confirmed as follows.

Table 8.1.1 Effectiveness of Technical System

Item	Technical system applied	Verification of effectiveness
Collection	Medium size compactor vehicle Container & plastic bag collection Separate collection	<ul style="list-style-type: none"> • Raising the collection ratio to 95% by 2010 • Efficient collection by a combination of compactor & container • Sufficient collection capacity • Improvement of collection works, existing night will be discontinued shift. • Reduction of O/M cost • Types of vehicles are standardized.
Source Separation	Citizen's participation	<ul style="list-style-type: none"> • Enhancement of citizen's awareness on SWM • Recycling of organic waste • Recycling of reusable materials
Waste Transportation	Transfer stations in Jableh and Qurdaha	<ul style="list-style-type: none"> • Efficient transportation of the waste over long distances to disposal site • Each municipality is responsible for the collection works of their own area
Composting	Compost plant	<ul style="list-style-type: none"> • Recycling of organic waste • Reduction of waste amount leads to the reduction of the burden on disposal site • Encourage citizen participation in SWM in source separation • Contribution to agricultural sector by providing compost product
Recycling	Sorting center	<ul style="list-style-type: none"> • Recycling of reusable materials • Encourage citizen participation in SWM in source separation • Introduction of recycling society
Disposal	Sanitary landfill - Control facilities & equipment - Liner, periodical cover soil - Leachate collection & treatment	<ul style="list-style-type: none"> • Environmental protection measures are applied to prevent waste scattering, self-burning, offensive odor, vectors, leachate effect on water bodies etc. • Proper landfill operation is applied with cover soil and cell method

(1) Improvement of Collection

In the study area, since the decline in collection services resulting from deterioration of collection equipment has been extreme, renewal of equipment is an issue requiring urgent attention. When introducing new collection equipment, considering topographical conditions in the collection districts, vehicles shall basically consist of

medium size compactors rather than the present large size vehicles. Also, equipment required for source separate collection and street sweeping shall be provided. Existing collection systems shall be respected so that container collection as a rule is carried out in Lattakia, Jableh and Qurdaha and collection in plastic bags is carried out in Al-Haffeh. Implementation of these measures will raise the collection rate to 95% (2010) and is judged to be very feasible.

(2) Source Separation

Source separate collection shall be introduced in phases in line with the commissioning timing of related facilities (composting facilities and sorting centers). The target amount of source separate collection as a ratio of generated domestic waste shall be 26% in 2006 and 48% in 2010. Source separate collection was carried out in the Pilot Study, and active participation of citizens was obtained at this time. Therefore, it is judged that source separate collection is very possible if carried out in tandem with campaigns to enhance citizen awareness.

(3) Transfer System

The Master Plan proposes a transfer station transport system for the cities of Jableh and Qurdaha, which are located between 35-40 km away from the new disposal site. By separating collection and transport, it is possible to realize efficient collection. Direct reloading has been set as the reloading method at transfer stations since this is a simple method in technical terms and also from the viewpoint of operation and management. Therefore, the transfer station transport system is judged to be technically valid.

(4) Composting

The compost plant that was constructed in Lattakia some 20 years ago was operating until recently. However, since mixed waste was carried into this plant and the plant systems were not appropriate, problems were found to exist in the quality of the compost product and operation of the plant was suspended in March 2001. In the Master Plan, composting of separated domestic organic waste and market waste is proposed, and it has already been proven in the Pilot Study that good quality compost can be produced using this method. Therefore, composting is judged to be very feasible.

(5) Sorting of Reusable Materials

The Master Plan proposes construction of a reusable materials sorting center for handling inorganic waste that is separated at the source. Simple and sure manual screening is assumed for the reusable materials recovery process, and this proposal is judged to be very feasible in technical terms.

(6) Sanitary Landfill

The existing dumping site conducts open dumping that entails no special treatment. The Master Plan proposes introduction of a sanitary landfill and minimizing of impact on the surrounding environment. By installing control facilities such as leachate collection and drainage pipes, leachate treatment ponds (circulation treatment facilities) and monitoring wells, etc., and also by introducing the landfill techniques (pushing up/cell method, earth covering) adopted in the Pilot Study and using appropriate landfill

equipment (bulldozers, excavators and dump trucks), disposal that entails low environmental load is proposed. Therefore, sanitary landfill disposal is judged to be technically appropriate.

8.2 ECONOMIC AND FINANCIAL ASPECT

8.2.1 Economic Aspect

In the economic assessment, economic cost and benefit estimation and cost-benefit analysis are conducted, and the economic internal rate of return is computed.

(1) Economic Cost

In carrying out economic assessment, financial costs are directly converted into economic costs.

(2) Economic Benefits

Generally speaking, improving the solid waste management utility has the effects indicated in Table 8.2.1.

Table 8.2.1 Benefits of Solid Waste Management

Item	Benefit	Contents
Preservation of living environment	Reduction of solid waste	Removal of waste from inner cities
Improvement of public sanitation	Reduction of odor and harmful pests Prevention of epidemics Mitigation of human health harms	Removal of waste from inner cities Earth covering at final disposal sites
Environmental preservation effect	Reduction of environmental pollutants Reduction of final disposal quantities Conservation of energy and resources Reduction of global warming-related substances	Environmental preservation around existing disposal sites (leachate treatment, prevention of waste scattering and spontaneous combustion) Reduction of final disposal quantities by composting Reduction of global warming gases
Utility revenue effect	Resource recycling by composting Recovery of reusable materials	Reduction of chemical fertilizer, increase agriculture production, improvement of agriculture production quality, reduction of water consumption, reduction of disposal costs, recovery of reusable materials Recovery of reusable materials
Other effects	Enhancement of citizen awareness Vacant site utilization Promotion of tourism and recreation sectors Other effects	Utilization of vacated site at Al-Bassa Promotion of coastal road construction

Benefits resulting from implementation of the project can be considered as follows.

- a. Elimination of solid waste: protection of the urban living environment, improvement of public sanitation
- b. Introduction of source separate collection: enhancement of citizen awareness
- c. Compost production: recovery of reusable materials, reduction of chemical fertilizer, increase in production, improvement of production quality, reduction of water consumption, reduction of disposal quantities, reduction of global warming gases, recovery of reusable materials
- d. Recovery of reusable materials: recovery of reusable materials, reduction of final disposal quantities
- e. Improvement of existing disposal sites and construction of new disposal site: surrounding environmental protection, promotion of coastal road construction, vacant site use

Out of the above, quantifiable benefits are as follows: 1) benefits resulting from removal of solid waste, 2) benefits of compost production, and 3) benefits of reusable materials recovery. The economic value of these benefits is as follows.

- Concerning the solid waste elimination effect, the amount beneficiaries are willing to pay shall be the benefit. Judging from the findings of the citizen awareness survey, the average amount beneficiaries are willing to pay is SP 132/month in Lattakia. It is assumed that stores have similar willingness to pay according to the amount of waste. Taking this willingness to pay, the number of households and the waste collection rate into account, the estimated benefit will be SP 196.2 million in 2006 and SP 243.8 million in 2010. Incidentally, this amount beneficiaries are willing to pay roughly works out at 1% of income and is a fair level.
- Effect of compost production: The project intends to introduce a 200-tons/day compost plant by 2010 which produce 50 tons of compost per day. The effects of composting can be divided into the fertilizer reduction effect, agricultural production increased income effect, and water consumption reduction effect. In economic terms, these effects work out as SP 580, SP 1,500 and SP 500 per ton of compost respectively. It is estimated that this benefit will be SP 40.0 million in 2010.
- Reusable materials recovery effect: In the project, it is planned to recover 10 tons/day of reusable materials at both the compost plant and the sorting center. It is estimated that this benefit will be SP 13.4 million in 2010.

(3) Economic Internal Rate of Return

Calculating from the above estimates of cost and benefit, the economic internal rate of return works out as 6.7% as indicated in Table 8.2.2.

This is a low figure for the economic internal rate of return when compared to other projects. However, in addition to the above quantifiable effects, when non-quantifiable effects such as reduction of final disposal quantities (150 tons/day in compost treatment, 10 tons/day at sorting facilities), environmental improvement of disposal sites, utilization of the vacated site at Al-Bassa, and promotion of tourism, etc.

are taken into account, it is possible to view the project as a viable undertaking. Moreover, the fact that project implementation will enable waste disposal to be carried out over the long term at Qasia in Lattakia Governorate is extremely important.

Table 8.2.2 Economic Analysis on the Master Plan

(Unit: SP million)

Year	Balance	Coat			Benefit			
		Total	Invest	Operation	Total	Willingness	Compost	Reusable
2001	0.0	0.0	0.0		0.0			
2002	-2.4	2.4	2.4		0.0			
2003	-327.6	508.8	403.1	105.7	181.2	181.2		
2004	-64.2	250.2	150.7	99.5	186.0	186.0		
2005	91.5	108.6	2.0	106.6	200.1	191.0	5.0	4.1
2006	-9.9	215.2	108.5	106.7	205.3	196.2	5.0	4.1
2007	-149.3	383.5	280.7	102.8	234.2	225.1	5.0	4.1
2008	-261.4	501.7	387.9	113.8	240.3	231.2	5.0	4.1
2009	-91.2	338.6	222.8	115.8	247.4	237.4	5.0	5.0
2010	169.1	128.1	1.6	126.5	297.2	243.8	40.0	13.4
2011	170.7	126.5	0.0	126.5	297.2	243.8	40.0	13.4
2012	121.6	175.6	49.1	126.5	297.2	243.8	40.0	13.4
2013	-21.9	319.1	192.6	126.5	297.2	243.8	40.0	13.4
2014	143.6	153.6	27.1	126.5	297.2	243.8	40.0	13.4
2015	170.7	126.5	0.0	126.5	297.2	243.8	40.0	13.4
2016	94.2	203.0	76.5	126.5	297.2	243.8	40.0	13.4
2017	-66.3	363.5	237.0	126.5	297.2	243.8	40.0	13.4
2018	170.7	126.5	0.0	126.5	297.2	243.8	40.0	13.4
2019	-37.8	335.0	208.5	126.5	297.2	243.8	40.0	13.4
2020	181.2	126.5	0.0	126.5	307.7	254.3	40.0	13.4
2021	471.5	-471.5	-471.5					
Total	752.7	4,021.5	1,879.1	2,142.4	4,774.2	4,140.5	464.9	168.8
EIRR	6.7%							

8.2.2 Financial Aspect

The results of the economic analysis indicate that the project is a viable undertaking. In the financial plan of the project, it is necessary to raise central government subsidies for investment made up until 2005 and to raise cleansing fees until 2010. However, since the ratio of cleansing fees following the price increases will still only be around 1% of household income, this will not prove to be a major burden. Moreover, if investment until 2005 can be subsidized, it will be possible to sustain the solid waste management utility by financing investment from 2006 onwards using 30% own funds and 70% loans. It can thus be concluded that the project is financially viable.

Furthermore, the compost plant and sorting center can cover operation and maintenance costs except for personnel expenses by means of revenue from the sale of compost and reusable materials.

8.3 ENVIRONMENTAL ASPECT

Environmental Effectiveness is defined as the positive environmental aspects by the implementation of the proposed Master Plan when compared to current waste disposal management. Consistent implementation of the Plan and its proper operation will contribute to a variety of environmental practices and the environmental effectiveness on this plan is summarized by four points 1) global environment, 2) regional environmental effectiveness, 3) improvement of the existing disposal site and 4) recycling effectiveness as described as follows:

1) Global Environmental Issues:

- **Promotes environmentally sound practices, such as reduced methane generation**

The emission of landfill gases produced by the anaerobic and aerobic decomposition of organic matters is major source of green house gases, which is responsible for global warming and ozone depletion. It is assumed that one million tones of unsorted municipal waste contain approximately 0.3 ton of carbon in various forms. Experimental research and process modeling demonstrate that about 0.2 ton would be converted to landfill gases consisting of 0.09 ton carbon dioxide and 0.09 ton methane. Landfill gases from landfills account nearly half of the anthropogenic source of methane. Landfills have proven to be only partially successful since up to 60% of the methane generated escapes through leakage. It is clear to prevent land filling of organic waste is a measure and composting is one of the simplest ways to prevent emission of methane because the organic fraction of the waste stream is diverted from landfill².

2) Regional Environmental Issues:

- **Creation of Environmentally Sound Cities**

The solid waste management proposed in the master plan brings wide range of environmental effectiveness in the cities. Waste separation at source will increase enlightenment of municipal waste disposal manner, and improvements of collection and haulage system with sufficient collection vehicles and equipments will be sufficient for keeping clean the cities. In addition, recycling activity may effect reducing the waste amount. Rehabilitation and rearrangement of Al-Bassa Disposal site and construction of Recycling Centre are the other hand of the management body. Sufficient capacity and appropriate operation will be essential, then, as results, the plan will contribute to create sound cities in terms of hygiene and living environment.

3) Environmental Issues on the site:

- **Minimize environmental damage from indiscriminate dumping at existing disposal site**

Presently waste disposal management is under insufficient management condition and lack of equipment and inappropriate engineered measures are frequently seen.

¹ Composting and Its Application in Developing Countries, World Bank

² Composting and Its Applicability in Developing Countries, World Bank

Proposed the rehabilitation and introduction of sanitary landfill method are suitable for maintaining the environment and the project will contribute to enhance positive aspects.

- **Improve coastal landscape and environmental conditions along the Mediterranean Sea Coast which is one of the most scenery area in this area**

The existing disposal site is located on dune area, which is one of the most attractive scenes in this area. The proposed rehabilitation and the arrangement of the site are in order and effective for recovering coastal landscape and environment, which are presently degraded by the existing disposal activity.

- **Improve the quality of landfill leachate**

Landfill leachate is created when water percolates through the waste and biological and chemical constituents from the waste are brought in to solution. Depending on the landfill design and prevailing weather condition, composting may not significantly reduce the quantity of landfill leachate, however it will improve quality of the leachate.

4) Recycling Issues:

- **Improves recycling by removing organic matter from the waste stream**

Recycling organic matter from the waste in the study area is suitable idea that 78% of the total collected municipal waste is organic and almost of all market waste is also dominated by organics. In addition to this, climate condition helps to introduce composting system as recycle of the waste.

The composting process reduces the waste amount, and enhances recycling the waste. 5% of the total waste amount is sorted and 20 % will be fine compost, 25% will be residue and 16% will be recycle compost. As a result, total amount of the organic waste will be 63.5%. In addition, another recyclable wastes such as plastics, glasses and metals are sorted and are used as supplement materials for new productions. Moreover the activity is also effective for enlightenment of waste disposal management at source.

- **Produces a valuable soil additive – integral to sustainable agriculture**

Utilization of compost product is an essential for agriculture in order for intergrading physiochemical soil structure. An organic component will introduce well-balanced nourishment in addition to the chemical fertilizers.

- **Enhances the effectiveness of fertilizer application**

Organic manure namely the compost will improve nourishment of the soil and will enhance applicability of fertilizer. Chemical fertilizers are generally preferred over compost because they are easy to handle, store and apply, and a synergistic relationship exists between compost and chemical fertilizers, and greater fertilizer efficiency can be established through the use of compost in conjunction with chemical fertilizers (World Bank 1997a).

- **Can integrate existing informal sectors involved in collection, separation and recycling**

There is an opportunity to involve informal sectors working on waste separation into integrated system. Presently waste-pickers are sorting valuable wastes, which are sellable metals, plastics and glasses. In order for proceed recycling and keeping safety on the site, waste-pickers can be involved in the system. It is therefore social impact may be minimized.

CHAPTER 9 PRIORITY PROJECT

The priority project consists of four (4) components as listed below. The outline of first three components are described in the following sections.

- a. Improvement of collection system (Phase I)
- b. Rehabilitation of Al-Bassa disposal site
- c. Establishment of recycling center in Al-Bassa
 - Introduction of separate collection (Phase I)
 - Rehabilitation of existing compost plant in Al-Bassa
 - Construction of sorting center
- d. Establishment of the inter-municipal treatment setup
- e. Campaigns for raising citizens' awareness
- f. Securing of sources of funds for solid waste management

9.1 IMPROVEMENT OF COLLECTION SYSTEM (PHASE I)

Waste collection coverage ration in 2006 targeted in the master plan is 85% (398 ton/day). Waste types to be collected are domestic waste, commercial waste, road & part waste, seasonal waste in summer, non-infectious medical waste, and small-scale industrial waste. In the year 2005, separate collection for the domestic waste will be introduced. Collection equipment that must be procured for the priority project is shown in Table 9.1.1.

Table 9.1.1 Procurement of Collection Vehicles

Item	Lattakia	Jableh	Qurdaha	Al Haffeh	Total
1. Collection					
Compactor (8m3)	15	7	--	--	22
Compactor (4m3)	7	3	1	3	14
Dump truck (6m3)	2	2	1	1	6
Wheel loader	1	1	--	--	2
Wash container	1	--	--	--	1
Sub total	26	13	2	4	45
2. Sweeping					
Mechanical sweeper	--	--	--	--	--
Waster tank	2	--	--	--	2
Sub total	2	--	--	--	2
G. Total	28	13	2	4	47

Source: JICA Study Team

9.2 REHABILITATION OF AL-BASSA DISPOSAL SITE

Rehabilitation of Al-Bassa disposal site will be carried out in the following two stages. Stage-1 shall be implemented by the municipality as an urgent measure and stage-2 will be carried out by the priority project.

Stage-1: As an urgent measure, Zone I and II (total 25.7ha) shall be rehabilitated same manner with the pilot study on the improvement of Al-Bassa disposal site carried out by

the *JICA Study Team*. Firstly, surrounding embankment will be constructed by using the existing accumulated waste, and then incoming waste will be received in the rehabilitated area. Covering soil shall be installed periodically. Rehabilitated area in Zone I and II will receive the waste until the year 2003 (about two years operation; receiving waste amount is estimated to 260,000 ton). Lattakia municipality shall rent the equipment for the rehabilitation and landfill works of Zone I and II.

Stage-2: As a medium term measure, Zone III (16.4ha) shall be rehabilitated as the same manner with the pilot study, and then the medium term disposal site will be constructed as a priority project. Facilities to be installed are; control house, fence & gate, clay soil liner, leachate collection pipe, gas removal pipe, re-circulation pond, etc. Landfill equipment such as bulldozer, excavator, dump truck, etc. shall be procured in this stage. Zone III will start its operation in the year 2004 and continued until 2007 (about 4 years operation; receiving waste amount is estimated to be 550,000 tons).

9.3 ESTABLISHMENT OF RECYCLING CENTER IN AL-BASSA

(1) Introduction of Separate Collection (Phase I)

In order to introduce an affordable recycling system in the study area, waste separation at source is to be introduced in Lattakia, Jableh, Al Haffeh, and Qurdaha. Target ratio of the source separation at households in the year 2006 is 26% (equivalent to 88 ton/day). Citizen's awareness campaign shall be carried out in the proper time for the successful introduction of it, in accordance with the same manner with the pilot study on campaign carried out by the *JICA Study Team*. Proper collection system shall also be introduced.

(2) Rehabilitation of Existing Compost Plant in Al-Bassa

Rehabilitation of existing compost plant in Al-Bassa will be implemented based on the following considerations. The plant will be rehabilitated in 2003 and 2004, and start its operation in 2005.

- All equipment shall be renewed, because the existing equipment is too old and the system itself is not suitable for composting
- Existing building structures will be used as much as possible
- Rehabilitation of the compost plant in Al-Bassa is considered to be the pilot plant for the introduction of large-scale plant in the future (150ton/day plant in Qasia)
- Capacity of the plant is 25 ton/day for one shift operation and 50 ton/day for two shifts. (After verifying the compost quality and demand, the plant will be operated by two shifts.)
- Market waste and the source separated organic waste will be received.
- Waste mass balance in the compost plant assumed to be; 25% compost product, 5% recyclables, and 25% residue of receiving waste in weight ratio

(3) Construction of Sorting Center

Sorting center in Al-Bassa will be constructed in 2003 and 2004, and will start operation in 2005. Source separated non-organic waste from Lattakia, Jableh, Al-Haffeh, and Qurdaha will be received. Plant capacity is 20 ton/day and the main facilities to be equipped at the sorting center are; stockyard, receiving hopper, feeding conveyor, hand-sorting conveyor, container/handcart, wheel loader, etc. Manual sorting system is to be introduced.

Recyclables to be collected at the sorting center are; paper, plastic, textile, metal, and glass. It is estimated that about 25% of receiving waste (equivalent to 5 ton/day) will be collected and sold to middlemen.

PART II

***FEASIBILITY STUDY ON THE
PRIORITY PROJECT AT LATTAKIA
AND THE THREE SURROUNDING CITIES***

PART II FEASIBILITY STUDY ON THE PRIORITY PROJECT AT LATTAKIA AND THE THREE SURROUNDING CITIES

CHAPTER 1 INTRODUCTION

The Lattakia Governorate is located on the coast of the Mediterranean Sea and a tourist area in Syria. It has four cities, namely, Lattakia, Jableh, Qurdaha and Al Haffeh. The total population of these cities is 541,000 as of 2001 and is expected to become 687,000 in the year 2010. Solid waste generated in these cities is estimated to be 385 ton/day in 2001 but only 70 % of waste generated is collected. Solid waste collected in Lattakia and Qurdaha is disposed of at Al Bassa disposal site. Jableh and Al-Haffeh cities dispose their waste at their own disposal sites. However, all of these disposal sites are open dumping sites and solid waste is just dumped without covering soil. These open dumping sites are polluting the surrounding environment and damaging potential tourism.

These four cities except Qurdaha city are facing a severe shortage of effective equipment and most of equipment used for solid waste collection and street sweeping are very old. Expansion of collection services is necessary to maintain living environment and cleanliness of the cities, especially in low-income areas. However, solid waste collection and sweeping services cannot be maintained at present levels without proper replacement of old equipment in near future.

As mentioned above, it is quite urgent to improve solid waste management in Lattakia and the three surrounding cities.

To cope with these problems, the Master Plan has targeted the year 2010 for proposing the introduction of sanitary landfills and solid waste recycling systems together with improvement on solid waste collection. Also it proposes to create a new department to cope with inter-municipal solid waste management and a sustainable financial base adopting the user pays principal.

Among these proposals, the master plan proposes a priority project consisting of the following components.

- a. Improvement of solid waste collection and street sweeping and introduction of separate collection for organic and non-organic waste.
- b. Construction of a recycle center at Al Bassa by rehabilitation of old compost plant and construction of a sorting center.
- c. Rehabilitation of Al Bassa disposal site and improvement of operation of final disposal.
- d. Promotion of public awareness on solid waste and environment
- e. Establishment of a new department for inter-municipal management

A feasibility study was conducted on above priority project.

CHAPTER 2 FRAMEWORK OF THE PRIORITY PROJECT

2.1 TARGET YEAR

According to the Master Plan, Qasia new disposal site is planned to start operation in 2008. Until that time, solid waste shall continue to be disposed at the Al-Bassa disposal site. Therefore, the priority project shall be planned assuming the year 2006, the mid-year of the Master Plan, to be the target year.

2.2 IMPLEMENTATION SCHEDULE

Lattakia city and the surrounding three cities are facing severe shortage of equipment. It is desirable to implement the priority project as soon as possible. However, it is necessary to consider the time required to secure the budget and to make the detailed design, procurement and construction. Actual schedule will be set that the detailed design will be in year 2002, procurement and construction will be in year 2003 and 2004.

The rehabilitation of Zone I and II of Al Bassa and improved operation of final disposal shall be continued as same as the pilot study conducted in this Study. Lattakia city shall prepare the budget and rent heavy equipment to continue rehabilitation and operation until new equipment will be procured.

2.3 INSTITUTION AND ORGANIZATION SET-UP

Solid waste collection and disposal is conducted by each municipality then collected waste is open dumped. No effective measures to prevent open dumping are taken although the surrounding areas of the existing disposal sites of Lattakia and Jableh city are polluted. To introduce sanitary landfill, it is necessary to create inter-municipal disposal systems because there will be only one sanitary landfill site in the Lattakia Governorate. In addition, proper management of medical waste also requires inter-municipal treatment. Therefore, a new institution and organization shall be set up together with the implementation of priority project.

2.4 ENHANCEMENT OF PUBLIC AWARENESS

Resident cooperation is essential to introduce separate collection. Therefore, it is necessary to increase public awareness on solid waste and environment through several campaign and advertisement.

CHAPTER 3 IMPROVEMENT OF SOLID WASTE COLLECTION AND INTRODUCTION OF SEPARATE COLLECTION

3.1 RENEWAL OF EXISTING VEHICLES

The primary issue facing collection and transport is development of a setup to enable the necessary equipment to be procured and renewed. If the current situation in currently served central urban areas is left unchanged, it is obvious that collection services will decline as a result of equipment deterioration like that currently seen in Jableh. The second issue concerns expansion of waste collection services in outlying areas. In particular, this is a matter of urgent importance in Lattakia City and Jableh.

On the other hand, the current trend is to construct a society that generates as little environmental pollution as possible, and for this purpose the introduction of source separation as well as the promotion of recycling waste are necessary. In consideration of these facts, source separation of waste shall be introduced to coincide with construction of the recycling center. Source separation shall be introduced not only in Lattakia City but also in the three cities surrounding Lattakia.

Moreover, since it is planned for final disposal to be carried out at Al-Bassa disposal site until 2007, waste collected in each city shall be directly transported to Al-Bassa disposal site.

3.2 TARGETS AND DESIGN CONDITIONS OF WASTE COLLECTION IMPROVEMENT

- a. The target waste collection rate shall be 85% in 2006, and domestic waste, commercial waste (including market waste), park and street waste, non-infectious medical waste and small-scale factory waste shall be collected.
- b. Source separate collection shall be introduced from high and middle-income residential regions. Under this program, the separation shall be done for organic and inorganic waste. It is planned to collect 20 tons/day of inorganic waste in line with the scale of the reusable materials sorting center. Market waste shall be collected as organic waste and treated at composting facilities. In the rest of cities, mixed collection shall be continued as it is currently being done.
- c. The forecast for waste collection amount is as shown in Table 3.2.1. This shows that the amount in 2006 will be 390 tons/day.

Table 3.2.1 Collection Amount Target by Waste Type in 2006

Waste Type	2006 (ton/day)	
	Generation	Collection
Domestic waste	351.2	298.5
Separated organic	-	71.2
Separated in-organic	-	20.1
Mixed	-	207.2
Commercial waste	81.8	69.6
Market waste (organic)	-	25.0
Others (mixed)	-	44.6
Road & park waste	16.1	15.3
Medial waste (non-infectious)	2.8	2.8
Industrial waste (small-scale)	10.4	9.3
Total	462.3	389.5

The collection amount target by each city in 2006 is shown in Table 3.2.2.

Table 3.2.2 Collection Amount Target by City in 2006

Waste Type	(Unit: ton/day)				
	Lattakia	Jableh	Qurdaha	Al-Haffeh	Total
Mixed waste	201.3	45.3	21.3	11.2	279.1
Separated organic waste	74.4	12.2	6.5	3.1	96.2
Separated in-organic waste	14.0	3.4	1.8	0.9	20.1
Total	289.7	60.9	29.6	15.2	395.4

3.3 COLLECTION SYSTEM

As for the collection system, the current system of using containers shall be continued in principle at Lattakia, Jableh and Qurdaha. And at Al-Haffeh collection shall be done by use of plastic bags. In addition, large compactor trucks are currently used for container collection. However, in consideration of existing conditions in the collection region, medium size compactor trucks shall be introduced.

For mixed collection and separated organic waste collection, the current container collection shall be adopted and daily collection shall be implemented, except at Al-Haffeh where plastic bag collection shall be continued. Separated inorganic collection and plastic bag collection shall be done twice per week because small amounts are generated and there are no storage problems at each household.

3.4 STREET SWEEPING

At Lattakia, Jableh and Qurdaha, street sweeping is mainly being carried out with mechanical equipment, and in future the same sweeping practice shall also be continued. For other streets, manual sweeping in combination with waste collection shall be carried out as it is currently being done. Furthermore, at the smallest city of Al-Haffeh, all street sweeping shall be carried out manually. The total length of streets to be swept is shown in Table 3.4.1.

Table 3.4.1 Road Length for the Road Sweeping

(Unit: km)				
Item	Lattakia	Jableh	Qurdaha	Al-Haffeh
Main road	76.7	54.0	NA	NA
Other road	229.1	52.0	NA	NA
Total	305.8	106.0	14.8	NA

3.5 RENEWAL OF EQUIPMENT

Vehicles procured before 1990 shall be renewed in 2006. The equipment required to raise collection rates to 85% and to introduce source separate collection is as indicated in Table 3.5.1. This shows that 63 collection vehicles are required in total. Of these 45 will need to be newly procured. Moreover, eight (8) street sweeping vehicles will be required, of which two (2) will need to be newly purchased.

Table 3.5.1 Equipment for Collection and Road Sweeping in 2006

(Unit: nos)					
Item	Lattakia	Jableh	Qurdaha	Al-Haffeh	Total
Collection					
Compactor (9 ton)	(9)	(1)	(3)		(13)
Compactor (8m ³)	15	7			22
Compactor (4m ³)	7	3	1	3	14
Dump truck (6m ³)	2 (1)	2	1	1	6 (1)
Tractor	(2)	0	(1)	(1)	(4)
Shovel loader	1	1			2
Wash container	1				1
Sub total	26 (12)	13 (1)	2 (4)	4 (1)	45 (18)
Sweeping					
Mechanical sweeper	(3)	(1)	(1)		(5)
Water tank	2		(1)		2 (1)
Sub total	2 (3)	(1)	(2)	0	2 (6)

Note: () shows the number of existing equipment which can be used in 2006

3.6 OPERATION AND MAINTENANCE PLAN

Waste collection and street sweeping work shall be implemented as shown in Table 3.6.1.

Table 3.6.1 Waste Collection and Street Sweeping Work

Item	Contents
1. Collection day	In principal, daily collection.
2. Collection system	In Lattakia, two (2) shifts operation, day and night, and necessary vehicles and personnel for each shift shall be arranged (8 operation hours). In other cities, one (1) shift operation, daytime, and operation hour shall be 8 hours. Further, in summer time the operation hours shall be extended to cope with increased waste volume.
3. Organization of waste collection crew	One driver for a collection vehicle with 2 workers. One supervisor for every 5 vehicles. One supervisor, one driver and one worker for a wheel loader.

Item		Contents
4.	Organization of street sweeping crew	One operator with one sweeper. For manual sweeping, one handcart for each worker. One team consists of one supervisor and ten workers.
5.	Method of discharging	Daily discharging of mixed collection and separated organic waste to containers. In Al-Haffeh, discharging of waste by use of plastic bags to collection points. Discharging of separated inorganic waste in plastic bags to collection points twice a week.
6.	Maintenance of equipment	Daily maintenance shall be carried out by driver and periodical inspection and repairing shall be contracted out to a specialized private company.

The numbers of personnel required for waste collection and street sweeping are as shown in Table 3.6.2. At this moment, a total of 818 personnel are engaged in waste collection and street sweeping in the four (4) cities. Except for Lattakia City, the numbers of personnel in the other three (3) cities must be increased. However, in Lattakia it is necessary to decrease the number of people doing manual sweeping in accordance with the upgrading of the equipment as well as for the improvement of cooperation in waste issues by residents. It is also necessary to switch over those surplus people to the waste treatment and disposal divisions, for the purpose of cost reduction in waste disposal.

Table 3.6.2 Required Personnel for Collection and Road Sweeping in 2006

(Unit: person)					
Personnel	Lattakia	Jableh	Qurdaha	Al-Haffeh	Total
Collection					
Supervisor	10	4	2	2	18
Driver	42	16	7	6	71
Worker	83	31	14	11	139
Sub total	125	51	23	19	218
Sweeping					
Supervisor	36	1	1	1	
Driver	6 (12)	1	2		
Worker	6 (24)	1	2		
Manual sweeper	374	31	9	6	
Sub total	446	34	14	7	501
Total	571	85	37	26	719

CHAPTER 4 DEVELOPMENT OF LATTAKIA RECYCLING CENTER

4.1 GENERAL

In accordance with the Master Plan, Al-Bassa recycle center shall be constructed on the site of the old compost plant. Project components of the recycle center are rehabilitation of the old compost plant and construction of a sorting center. The layout of Al-Bassa recycle center is shown in Figure 4.1.1.

4.2 REHABILITATION OF OLD COMPOST PLANT

4.2.1 Rehabilitation Policy and Plant Capacity

The old compost plant in Al-Bassa was constructed 20 years ago and the facilities and equipment are deteriorated. Furthermore, the composting system itself is not suited to producing good quality compost. Therefore, the old compost plant shall be rehabilitated on the condition that all equipment is renewed, and the plant building is reused as much as possible with partial repairs.

This facility is viewed as a pilot plant for the new recycle center that will commence operation in 2010, and it will act as a model recycling facility in the area of quality control and sales promotion of compost products and sorted reusable materials.

Plant capacity shall initially be 25 tons/day in single shift operation, however, it is planned to increase this to 50 tons/day over two shift operation as soon as the compost quality and demand are confirmed.

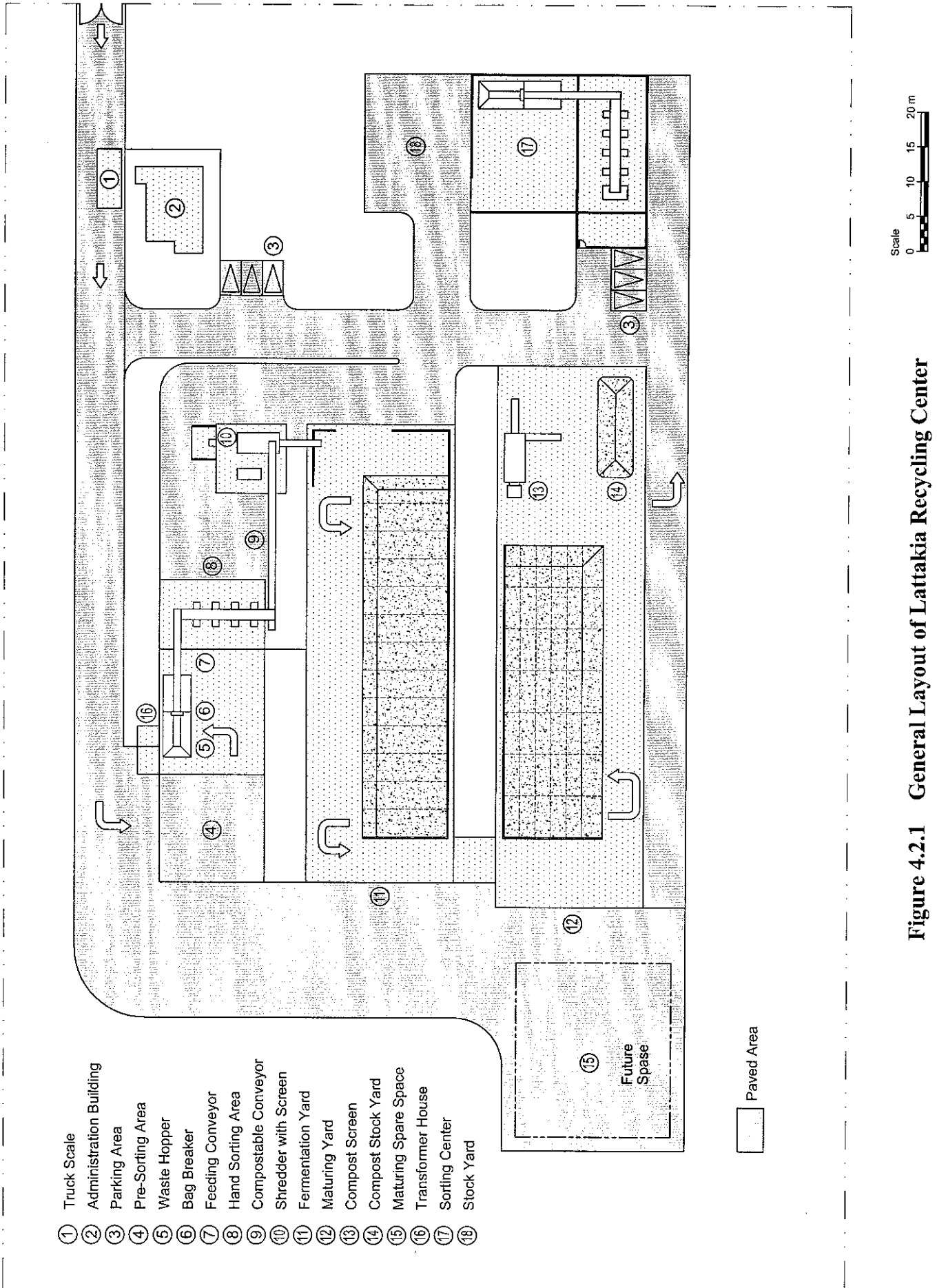


Figure 4.2.1 General Layout of Lattakia Recycling Center

4.2.2 Basic Design Condition

Rehabilitation of the old compost plant is planned according to the following conditions.

(1) Waste Quality

Market waste is targeted because of easy composting. Waste composition is shown in Table 4.2.1.

Table 4.2.1 Market Waste Composition

Waste	Q'ty (ton/day)	(% in wet basis)						Total
		Food	Paper	Plastic	Metal	Glass	Others	
Market	25	83.3	3.6	7.1	0.6	0.5	4.9	100
Domestic	25	83.6	5.8	5.4	1.0	0.8	3.9	100
Design	50	83.5	4.7	6.2	0.8	0.6	4.4	100

(2) Composting system

Composting system consists of the following procedures for better quality compost production referring to the pilot study conducted from June 2001 at the old compost plant in Al-Bassa.

- a. Receiving waste
- b. Removal of non-compostable material by hand sorting
- c. Shredding by pulverizing classifier
- d. Fermentation with turning by wheel loader
- e. Maturing with turning by wheel loader
- f. Refining of coarse compost by screen

System flow diagram is shown in Figure 4.2.2. Detailed explanation of the system is described in 4.2.3 System Description.

(3) Treatment Capacity

A maximum of 50 ton/day is possible considering reuse of the existing compost building and around space.

(4) Equipment Capacity

In consideration of maximum operation capacity of 50 ton/day, equipment will be operated in two-shift operation.

Actual equipment operating time will be 6hour/shift x 2shift =12 hours, and therefore, equipment capacity required will be as 50ton / 12 hour = 4.2 ton/hour.

(5) Operation Organization

At the initial stage the plant will be operated by one shift operation of 26 people and the next stage will be operated by two-shift operations of 38 people by the year 2010 (Target year of master plan).

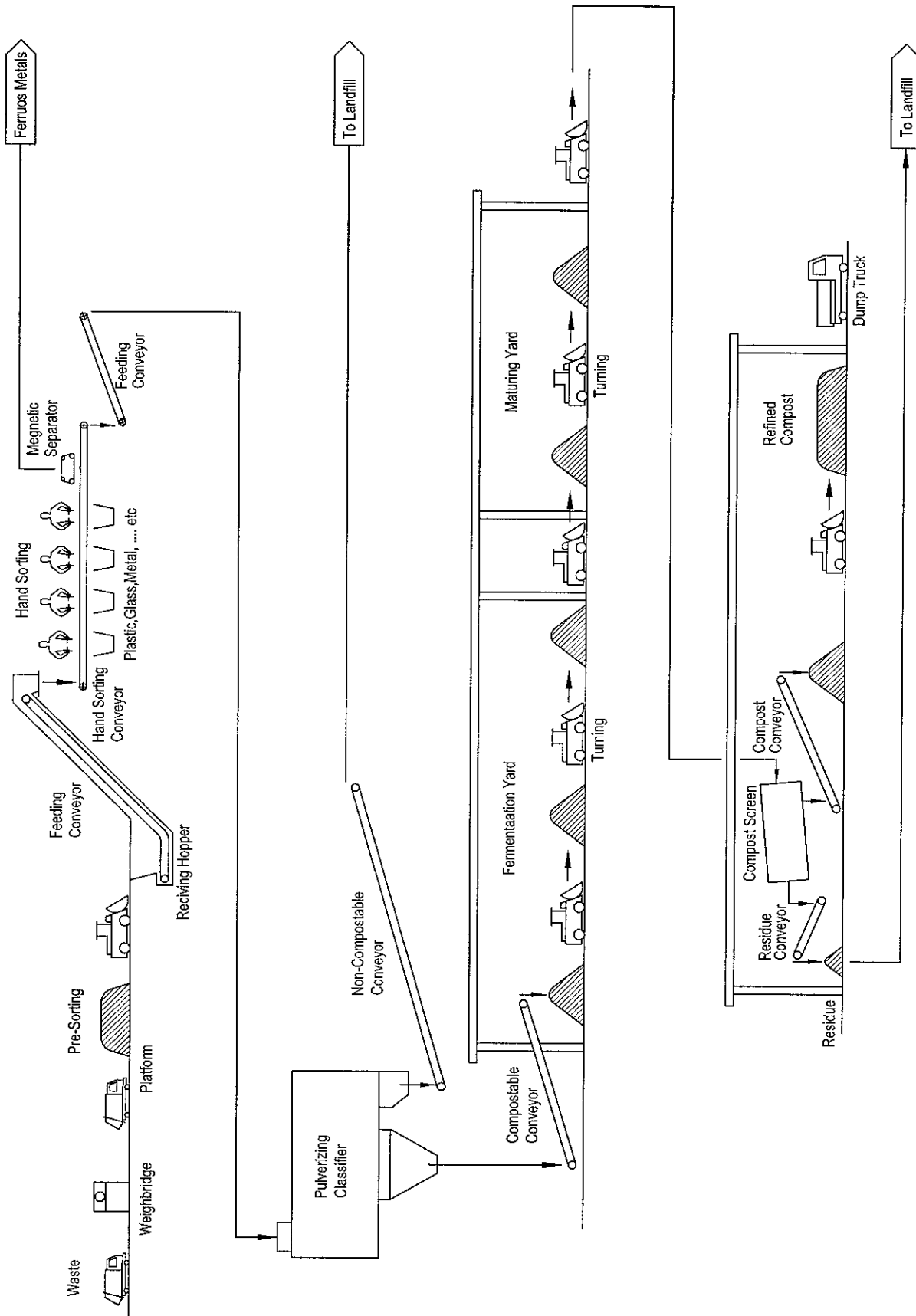


Figure 4.2.2 System Flow Diagram of Compost Plant

(6) Waste Amount to be Treated

At the initial stage waste amount to be treated is estimated at 25 ton/day because of the one shift operation, i.e., 4.2 ton/hour x 6 hour/day = 25 ton/day. In 2010, 50 ton/day will be available through two-shift operations, i.e., 4.2ton/hour x 12 hour/day =50 ton/day.

4.2.3 Material Balance

Material balance at 50 ton/day operation is shown in Figure 4.2.3. From this material balance it is possible to predict the followings:

- Approximately 2.5 ton/day (5% of received waste) of recyclable material such as paper and plastic are recovered.
- Approximately 12.5 ton/day (25% of received waste) of compost is produced.
- Approximately 12.5 ton/day (25% of received waste) of residue is removed to final disposal site.

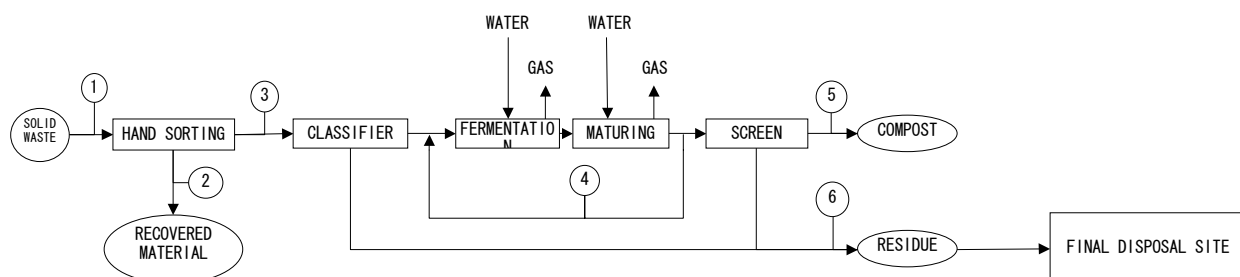
4.2.4 System Description

(1) Reception equipment

Market waste transported by collecting vehicles is weighed by track scale at the entrance of the recycle center and unloaded on the pre-sorting area. The pre-sorting area has one (1) day storing capacity for mitigating the daily fluctuation of waste. Unloaded waste on the pre-sorting area is charged into the waste hopper with feeding conveyor by wheel loader after removal of bulky waste such as tire, timber boxes and so on.

(2) Hand Sorting Equipment

The waste is fed constantly from the waste hopper to the hand-sorting conveyor by feeding conveyor. Before hand sorting, waste bags are broken by the bag breaker located at outlet of the waste hopper. Paper, plastic, metals and glass are recovered by hand sorting workers standing on the both side of the hand sorting conveyor. Recovered materials are stored at ground floors located under the hand sorting conveyor. And the separated waste is fed to a pulverizer by feeding conveyor.



ITEM	①	②	③	④	⑤	⑥
	MSW INPUT	RECOVERD MATERIAL	AFTER HAND SORTING	RECYCLE COMPOST	FINE COMPOST	TOTAL RESIDUE
QUANTITY (t/d)	50.0	2.5	47.5	8.0	12.5	12.5

① MSW	COMPSITION (%)	WEIGHT (t) (t/d)
Food, Vegetable	83.5	41.8
PAPER	4.7	2.4
PLASTIC	6.2	3.1
METAL	0.8	0.4
GLASS	0.6	0.3
Others	4.4	2.2
TOTAL	100	50

RECOVERED MATERIAL	
MATERIAL	② HAND (t/d) SORTING
PAPER	0.6
PLASTIC	1.6
METAL	0.2
GLASS	0.2
TOTAL	2.5

IN PUT (t/d)		OUT PUT (t/d)	
SOLID WASTE	50.0	CONPOST	12.5
WATER	0.3	RESILDUE	2.5
		RECOVERED MATERIAL	12.5
		GAS, VAPOR	22.8
TOTAL	50.3	TOTAL	50.3

Figure 4.2.3 Material Balance Sheet of Al-Bassa Compost Plant (2 shift operation, 50 ton/day)

(3) Pulverizing equipment

In the pulverizer, organic materials such as vegetables in the waste are pulverized to small pieces of less than 50 mm and non-organic materials such as plastics are separated from the waste. Pulverized and separated compostable material is conveyed to the fermentation yard by the compostable material conveyor. Separated residue is conveyed to the residue storage by conveyor.

(4) Fermentation equipment

Compost-able materials are piled and turned by wheel loader while the fermentation process takes place. As the fermenting temperature exceeds 65 deg. C, vermin and harmful microbes are killed and organic material fermentation progresses during about two (2) weeks with moisture content control. Fermented waste is transported to the maturing yard by wheel loader.

(5) Maturing equipment

The fermented compost is piled up by wheel loader in the maturing yard. They are regularly turned also by wheel loader while the maturing process takes place during about six (6) weeks under the control of moisture content. Matured compost is transported to the refining equipment by wheel loader.

(6) Refining equipment

The matured compost is fed to the compost screen, where foreign matter like glass, stone, plastics, etc. is effectively removed and adjusted the grain size.

(7) Vehicle

Four (4) wheel loaders are required as follows:

- For charging waste into the receiving hopper
- For removing compost material from the pulverizer to fermentation yard
- For turning in the fermentation yard and removing waste to maturing yard
- For turning in the maturing yard, removing matured compost to refining equipment and delivery of fine compost.

One (1) dump truck is also required for removing residue to final disposal site.

4.2.5 Main Specification of Equipment

Main specification of equipment is shown in Table 4.2.2.

Table 4.2.2 Main Specification of Equipment

Process	Equipment	Q'ty	Main Specification	Remarks
Reception	Truck Scale	1	Type : Load cell	
			Capacity : 50 ton	
	Pre-sorting Area	1	Space : 220m ²	
	Waste receiving hopper	1	Type : Steel structure	
			Volume : 5 m ³	
	Waste feeding conveyor	1	Type : Apron conveyor	
Capacity : 5 ton/h				
Motor : 5.5 kw				
Hand sorting	Hand sorting conveyor	1	Type : Belt conveyor	
			Capacity : 5 ton/h	
			Motor : 2.2 kw	
	Magnetic separator	1	Capacity : 5 ton/h	
			Motor : 1.5 kw	
	Sorted waste conveyor	1	Type : Belt conveyor	
			Capacity : 5 ton/h	
			Motor : 2.2 kw	
	Pulverizing	Pulverizer	1	Type : Rotary blade type
Capacity : 5 ton/h				
Motor : 110 kw				
Compost material conveyor		1	Type : Belt conveyor	
			Capacity : 3.8ton/h	
			Motor : 1.5 kw	
Reject material conveyor		1	Type : Belt conveyor	
			Capacity : 1.1 ton/h	
			Motor : 1.5 kw	
Fermentation	Fermentation yard	1	Capacity : 14 days	
			Space : 20 mW x 64 mL	
Maturing	Maturing yard	1	Capacity : 42 days	
			Space : 20 mW x 52 mL	
Refining	Screen	1	Type : Trommel type	
			Capacity : 1.3 ton/h	
			Motor : 2.2 kw	
	Fine compost conveyor	1	Type : Belt conveyor	
			Capacity : 1.1ton/h	
			Motor : 1.5 kw	
	Residue conveyor	1	Type : Belt conveyor	
			Capacity : 1.1ton/h	
			Motor : 1.5 kw	
Vehicle	Wheel Loader (small)	3	Capacity : 1.2 m ³	
			Engine : 90 HP	
	Wheel Loader (middle)	1	Capacity : 3.1 m ³	
			Engine : 120 HP	
	Dump truck	1	Capacity : 8 ton	
Engine : 210 HP				

4.2.6 Compost Demand and Sales Plan

As a result of the compost demand survey implemented in the Study, it is estimated that demand for compost in and around Lattakia is approximately 52,500 tons/year.

Table 4.1.2 shows the quantities of compost produced and reusable materials recovered at the composting plant together with the sales revenue from each. It is forecast that sales of compost product and recovered reusable materials could generate annual income of approximately SP 3,300,000/year in the case of two-shift operation.

Table 4.2.3 Amount of Compost Product and Sorted Recyclables

Item	1 shift operation (25 ton/day)		2 shift operation (50 ton/day)	
	Amount (ton/year)	Income (SP/year)	Amount (ton/year)	Income (SP/year)
Compost product	1,938	678,000	3,875	1,356,000
Recyclables	403	1,008,000	806	1,922,000
Total	2,341	1,686,000	4,681	3,278,000

4.2.7 Operation Management Plan

The rehabilitated compost plant will be operated by 26 persons of one shift operation at initial, however, in 2010 will be operated by 38 persons of two-shift operation as shown in Table 4.2.2.

Table 4.2.4 Number of Operational Personnel

(Person)			
Item	Initial stage (2006)	Next stage (2010)	Remarks
Administration	6	4(6*)	*See note.
Operation	Reception area	3	4
	Hand sorting area	4	8
	Shredding area	2	4
	Fermentation area	2	4
	Maturing area	2	4
	Screening area	2	4
	Others	3	4
Maintenance	2	2	
Total	26	38(*40)	

Note) * 2 persons, i.e. compost division manager and secretary are concurrent with new compost plant to be constructed in Quasia in 2010.

4.3 SORTING CENTER

4.3.1 Introduction

According to the master plan prepared in this study, the sorting center in Al Bassa is proposed in the year 2005 in order to introduce an affordable recycling system in Lattakia and surrounding three cities.

At the sorting center, the source separated non-organic waste will be received and collecting the recyclables from them; such as paper, plastic, textile, metal, and glass.

4.3.2 Planning Conditions

Planning conditions of the sorting center in Al Bassa are summarized in Table 4.3.1. Site plan is shown in Figure 4.2.1.

Table 4.3.1 Planning Conditions of Sorting Center in Al Bassa

No	Item	Conditions
1	Location	Adjacent to old compost plant in Al Bassa
2	Area	2.2 hectare (including old compost plant)
3	Service area	Lattakia, Jableh, Qurdaha, and Al Haffeh city
4	Year operation started	2005
5	Type of waste received	Source separated non-organic waste (domestic waste)
6	Receiving waste amount (Plant capacity)	20 ton/day
7	Target amount of sorted recyclables	25% of receiving waste (about 5 ton/day)
8	Estimated amount of residue	75% of received waste (about 15 ton/day)
9	Sorting method	Manual sorting
10	Sorted recyclables	Paper, plastic, textile, metal and glass
11	Handling of sorted recyclables	Sell to middlemen (Sorted recyclables will be collected/ transported by them)
12	Handling of residues	Transported/ disposed by the Recycling Center

4.3.3 Recycling Target

Waste composition of source separated non-organic waste (receiving waste at the sorting center) is shown in Table 4.3.2 (*source: The Pilot Study on the Production of Better Quality Compost carried out by the JICA Study Team*). As shown in the table, potentially 10 ton/day of waste contains the recyclables among 20 ton/day of receiving waste.

In the master plan, at the sorting center, the target for the collection of sorted recyclables from the receiving waste has set as 25%. Therefore, 5 ton/day; i.e. 2.0ton for paper, 1.9ton for plastic, 0.4ton for textile, 0.4ton for metal and 0.3ton for glass, will be the recycling target at the sorting center, as shown in Table 4.3.2.

Table 4.3.2 Receiving Amount and Recycling Target

Item	Composition of Non-organic waste		Target of Sorted Recyclables	
	%	ton/day	%	ton/day
Food, vegetables	32.9	6.6	--	--
Paper	20.6	4.1	50%	2.0
Plastic	19.1	3.8	50%	1.9
Textile	4.5	0.9	50%	0.4
Metal	3.4	0.7	50%	0.4
Glass	2.7	0.5	50%	0.3
Others	16.8	3.4	--	--
Total	100.0	20.0	25%	5.0

Source: JICA Study Team

Table 4.3.3 shows the selling prices of each type of recyclables. Considering the targeted amount of recyclables at the sorting center described in Table 4.3.3, it is estimated that about 3 million Syrian Pond per year will be the selling amount/ income of the sorting center.

Table 4.3.3 Selling Price of Recyclables

Recyclables	Collecting amount		Selling price	
	Ton/day	Ton/year	Unit price ^{*1)}	Total (SP/year) ^{*2)}
Paper	2.0	620	1,500 SP/ton	930,000
Plastic	1.9	589	3,000 SP/ton	1,767,000
Textile	0.4	124	1,000 SP/ton	124,000
Metal	0.4	124	1,000 SP/ton	124,000
Glass	0.3	93	1,500 SP/ton	139,500
Total	5.0	1,550		3,084,500

Source:*1) Field survey result by the JICA Study Team

*2) Working days per year have set for 310 days. In holiday (about 55 days/year), sorting center will not receive the waste.

4.3.4 Facilities and Equipment

(1) Facility Plan

The major facilities introduced at the sorting center are composed of receiving & supply facilities, sorting facilities, and storing & carryout facilities. Details of each facility are described in the following articles.

1) Receiving and Supply Facilities

- **Truck scale**

Truck scale will be equipped at the entrance of the recycling center. Incoming waste (source separated non-organic waste) transported by the collection vehicles shall be weighed here.

- **Stockyard**

Receiving waste shall be kept at the stockyard and hauled in the receiving hopper continuously by the wheel loader. Basically, all of the receiving waste shall be treated in the same day. However, taking into account the breakdown of the plant system, stockyard of the one-day incoming waste shall be prepared. The required area of the stockyard is calculated as follows.

$$\langle 20 \text{ ton/day} / 0.2 \text{ ton/m}^3 \times 1 \text{ day} / 2.0\text{m height} = 50 \text{ m}^2 \rangle$$

- **Receiving hopper and feeding conveyor**

Receiving source separated non-organic waste shall be smoothly/ quantitatively supplied to the feeding conveyor without pilling up. The capacity of the receiving hopper is 5m³ and will be equipped with bag breaking knives.

Waste hauled in the receiving hopper will be transferred to the hand-sorting conveyor through the feeding conveyor. Some equipment to prevent the waste from falling shall be equipped on both sides of the feeding conveyor.

2) Sorting Facilities

• Hand-sorting conveyor

Paper, plastic, textile, metal, and glass will be collected by hand sorting workers standing on both sides of the hand-sorting conveyor. Hand-sorted recyclables are thrown into containers/handcarts set on the ground floor. At the end of the hand-sorting conveyor, residue will automatically put into handcarts installed on the ground floor.

In order to adjust the sorting efficiency, derailer shall be equipped at the hand-sorting conveyor. The width of the conveyor will be 0.75m.

3) Storing and Carryout Facilities

• Container/ handcart

Containers equipped with casters or handcarts will be installed at the ground floor in order to receive the sorted recyclables and/or residue. Their capacity will be 1.0-1.5m³.

• Stockyard for recyclables and residue

Recyclables collected at the sorting center will be sold to the middlemen and/or end-users. Based on the field survey on recycling activities in Lattakia, middlemen collect the recyclables from waste-pickers once a week, in average. Therefore, stockyard for the amount of one-week recyclables shall be prepared (including the recyclables from compost plant: 1ton/day). Stockyard shall be divided into 5 categories; i.e. paper, plastic, textile, metal, and glass. The required area of the stockyard is calculated as follows.

$$\langle (5+1) \text{ ton/day} / 0.2 \text{ ton/m}^3 \times 7 \text{ days} / 2.0 \text{ m height} \times 1.2 = \text{about } 130 \text{ m}^2 \rangle$$

Basically, residue will be transported to the final disposal site by dump truck without storing at the center. Therefore, a stockyard for the amount of one-day residue will be prepared at the site.

$$\langle 15 \text{ ton/day} / 0.2 \text{ ton/m}^3 \times 1 \text{ day} / 2.0 \text{ m height} = \text{about } 40 \text{ m}^2 \rangle$$

(2) Equipment Plan

1) Wheel Loader

One wheel loader shall be equipped for the following purposes.

- Carry the stored incoming waste from the stockyard to the receiving hopper and haled in.
- Loading the recyclables to the trucks owned by the middlemen/ end-users who came to the sorting center to buy them.
- Loading the residue to the dump truck that transports them to the disposal site.

2) Dump Truck

One dump truck shall be equipped for the following purpose. (This dump truck will be used mainly for the operation of the compost plant.)

- Transport the residue to the final disposal site

Table 4.3.4 shows the specification/ dimension of the main facilities and equipment of the sorting center.

Table 4.3.4 Major Facilities of Sorting Center

Process	Facility/ Equipment	Q'ty	Specification/ Dimension
Receiving & Supply	Truck scale ^{*)}	1	50 ton, load-cell type
	Stockyard: Receiving waste	1	50 m ²
	Receiving hopper	1	5 m ³ , steel structure
	Feeding conveyor	1	5 ton/h, 0.75m wide, apron conveyor
Sorting	Hand-sorting conveyor	1	5 ton/h, 0.75m wide, belt conveyor
	Container/ handcart	15	1.0-1.5 m ³ with caster
Storing	Stockyard: Recyclables	5	130 m ²
	Stockyard: Residue	1	40 m ²
Equipment	Wheel loader	1	120 HP, Bucket: 1.5m ³
	Dump truck ^{*)}	1	8 ton
Others	Sorting building	1	200m ²
	Receiving building	1	300m ²
	Control house	1	50m ²

Note: ^{*)} will be implemented by the compost plant (joint operation)

4.3.5 Operation Management Plan

Management of the sorting center, including maintenance of facilities/equipment, selling the collected recyclables, etc. shall be performed by the new organization described in section 4.3.5 of this report under the coordination of *Recycling Center*.

Table 4.3.5 shows the staff and their responsibilities for the operations and maintenance of the sorting center. The total number of staff required is estimated at 20 personnel.

Table 4.3.5 Staff of Sorting Center

Staffing	Number	Responsibilities
Site manager ^{*)}	1	- All the responsibility of management/ operation of recycling center
Secretary (Accountant)	1	- General affairs, register income and outlay daily management
Truck-scale operator ^{*)}	1	- Operates truck scale, data collection and processing, reporting (daily, weekly, monthly and yearly)
Engineer (Mechanical) ^{*)}	1	- Responsible for maintenance of all systems and vehicles
Operator/ Wheel loader	1	- Handling of incoming waste, recyclables, etc.
Driver/ Dump truck ^{*)}	1	- Transport the residue, etc.
Worker (Sorting etc.)	13	- Hand sorting - Handling of containers/ handcarts
Guard man	1	- Keep safety of the sorting center
Total	20	

Note: ^{*)} will be joint work with the compost plant.