CHAPTER 7
COST ESTIMATES

Summary

This section presents preliminary cost estimates for the theoretical, 300-ton-per-day, New York City Research and Development Pilot Materials-Recovery and Composting Facility ("pilot MRC facility" or "pilot facility"), described in Chapter 5. The costs presented below include capital development and facility financing costs, as well as annual operation and maintenance costs, which are summarized into projected per-ton processing costs. All of the costs assume that the facility would be publicly owned and developed, but privately constructed and run (i.e., run by a private contractor). Appendix J to this report presents the full 30-year, life cycle financial analysis for the pilot facility.

These costs estimates are included here to help inform the overall discussion as to what it would cost to build and operate such a facility in New York City. Actual costs for the construction and operation of a pilot facility would be determined through a competitive procurement process.

Cost per Ton

The goal of the financial analysis was to determine estimates of the approximate per-ton cost for processing waste at the type of pilot MRC facility described in Chapter 5. The Department accomplished this by supplying assumptions about the theoretical facility to a financial analyst with long-standing experience in the waste-management industry, especially in the field of facility financing. The analyst took these assumptions (such as equipment costs, building costs, electricity requirements, etc.), added others pertaining to facility financing, and then calculated the per-ton costs for the projected life cycle of the facility (30 years). Appendix J contains this full life-cycle analysis for the facility.

Table 7-1 provides the estimated costs per ton to process MSW and biosolids at the theoretical pilot facility for the first year of operations.

The biosolids processing cost is an important number to understand as it is intimately tied to the ultimate MSW-processing cost. For this initial presentation, the objective was to derive a fee structure that would provide a disposal alternative to the Department of Sanitation that was competitive with export cost projections, while still offering a savings for biosolids management to the Department of Environmental Protection. (The DEP currently pays $112 per wet ton to export

Table 7-1
Cost per Ton of Material Processed at Theoretical Pilot MRC Facility

Material	Tons per Year	Cost per Ton
Municipal Solid Waste	90,600	$75
Biosolids	60,400	$100

biosolids, whereas DSNY pays $70 per ton on average to export solid waste.) If both DSNY and DEP shared evenly the cost of developing, operating, and maintaining a pilot facility, then the cost per ton of material processed (regardless of whether it was solid waste or biosolids) would be approximately $85 per ton. However, under the scenario presented here, DSNY would be financially responsible for developing and operating the facility and would "charge" the DEP a competitive tip fee for biosolids. Another way of looking at these figures is that for every dollar "less" the DEP would pay for processing biosolids at the pilot MRC facility, DSNY would pay 67 cents "more" for processing solid waste.

Financial Analysis

Table 7-2 is a reproduction of the summary page from the life-cycle financial analysis (attached as Appendix J). The following sections break out and review the various assumptions contained in each of the subsections of the financial analysis:

- Capital costs
- Operating costs
- Fees per ton

Capital Costs

The capital costs associated with developing a pilot facility generally include the cost of design, engineering, permitting, materials-recovery and composting equipment, facility financing costs, as well as building costs. The following section explains the rationale and background for the capital-cost estimates, cited in Table 7-2.

Engineering and Permitting
The engineering and permitting costs associated with designing and developing a facility of this size (and relative complexity) are as a rule between eight and 12 percent of the total capital costs. However, the assumption behind the financial analysis shown in Table 7-2 is that while the majority of the permitting costs would be borne by the City, part of the total engineering costs would be borne by the private company/companies who would be providing the composting and other equipment. Therefore, the total engineering and permitting costs in this case come to a little more than five percent (three million) of the total capital costs (58 million).

Equipment
Table 7-3 shows a breakdown of the equipment costs, which includes all of the machinery to run the pilot MRC facility, described in Chapter 5. The cost estimates come from the respective manufacturers, including the composting digester drums and the technologies envisioned for the first- and second-phase composting processes. The category for materials-recovery equipment includes all of the cranes, conveyor belts, magnets, screens, cages, containers, and sort-line housing, described in Chapter 5. The engineering consultant who developed the preliminary design for the materials-recovery component of the pilot facility provided these cost estimates. Appendix I contains the consultant's cost estimates, including a breakout of all the proposed equipment, and a description of the individual components.

Table 7-2
Summary Data: Life-Cycle Financial Analysis for a Theoretical NYC Pilot MRC

Capital Costs:	Project Development (000)	Development Equity: Upon Project Finish (000)	Depreciation Per (Years)
Design & Engineering Cost	$1,000		28
Permitting & Project Development	$2,000		28
Equipment (Including Digester Drums)		$20,000	10
Biofilter		$1,000	10
249,200 Square Feet of Buildings @ $115 per Square Foot		$28,658	28
15-Acre Site @ $250,000 per Acre		NA	
Performance Guarantee		NA	28
Interest During Construction		NA	28
Borrower's Counsel		NA	28
Contingency & Spare Parts @ 10%		$4,966	28
Debt Reserve Fund		NA	
Financing:[1]			
Underwriting Fee @ 1% Assumes General Obligation Debt		$586	28
Underwriter's Counsel		$50	28
Issuer's Fee @ 1%, if required		NA	28
Bond Counsel		$50	28
Feasibility Opinion		NA	28
Trustee		$25	28
Cusip, Printing & Other		$25	28
Financial Advisor		$25	28
Miscellaneous		$250	28
SUBTOTAL	$3,000	$55,635	
TOTAL		$58,635	

Operating Costs:	Cost (000)	Annual Escalation Rate	Per Ton of MSW
Salaries & Benefits	$3,799	2.00%	$41.93
OTPS	$825	2.00%	$9.11
Repair & Replace	$1,000	2.00%	$11.04
Electricity (8,000,000 kwh/yr @ $0.08)	$640	2.00%	$7.06
Residue Disposal (29.1% of MSW @ $75/ton)	$1,977	2.00%	$21.83
TOTAL	$8,241		$91[2]

Fees per Ton:		CPI
MSW Tip Fee (w/Residue Disposal)	$0[3]	2.00%
Biosolids Tip Fee (per Wet Ton)	$100	2.00%
Aluminum Revenue (.75% MSW)	$0	2.00%
Ferrous Metal Revenue (2.3% MSW)	$0	2.00%
Sold Compost Revenue (Freight On Board at Facility)	$0	2.00%
Unsold Compost Cost (Freight On Board at Facility)	$0	2.00%

FINANCIAL RESULTS:	Cost per MSW Ton
YEAR 1	**$75.00**

NA = Not Applicable to a publicly financed facility, but would be relevant if the facility were privately financed.

1. The assumptions that inform the analysis are that the total capital cost of the facility ($58,635,000) will be publicly financed through a 20-year General Obligation Bond at the current debt rate of 4.72%.
2. This figure is derived by dividing the annual operating costs by the annual tons of MSW processed. It differs from the Year 1 cost ($75) in that it does not take into account revenues (from biosolids) or debt service.
3. The proposed pilot facility would not charge DSNY a tip fee for processing MSW. The cost for processing MSW is derived by dividing the total annual facility costs (including debt service) by the annual tons of material processed.

Table 7-3
Estimated Equipment Costs

Equipment	Cost
Three digester drums (14' x 200')	$7,000,000
Materials-Recovery Equipment	$4,200,000
First-Phase Composting[1]	$4,500,000
Second-Phase Composting and Curing	$1,300,000
Biofilter	$1,000,000
Post-Drum Screens and De-stoner	$500,000
Biosolids storage and pumping	$500,000
Miscellaneous Equipment[2]	$2,000,000
SUBTOTAL	**$21,000,000**

1. Includes air-handling equipment.
2. All other equipment not specified in other categories, such as front-end loaders, balers, forklift and dump trucks, tub grinder, etc.

The Miscellaneous Equipment category represents the cost of all the required equipment not specified in another category, such as front-end loaders, forklift and dump trucks, baling equipment, and tub grinders for shredding wood.

Buildings

Building costs greatly influence the total capital cost of any facility and, through the debt service that a municipality must pay over time, bear directly on the per-ton processing cost. For example, for every five-dollar increase in per-square-foot building costs, the cost per ton to process MSW in Year 1 increases $1.19.

Building costs are difficult to estimate, especially as there are a number of local and site-related conditions that are impossible to predict in a generic model. These include:

- Site condition and the degree of site preparation required
- Need for pilings to provide structural support
- Amount of concrete needed for foundations

Therefore, the approach presented here uses estimated dimensions (square feet) for each of the various buildings envisioned for a pilot MRC facility and then, for clarity and consistency,

Table 7-4
Estimated Building Costs

Buildings	Square Feet
Materials Recovery (including tipping floor)	80,000
Materials-Recovery Staging Area (including loading ramps and docks)	20,000
Digester Tipping Floor	12,800
Post-Drum, Primary Screening	19,200
First-Phase Composting (includes air-handling–equipment housing)	48,000
Second-Phase Composting & Curing	38,400
De-Stoning	10,800
Management Office	4,000
Final Screening & Compost Load-Out	16,000
TOTAL SQUARE FEET	**249,200**
SUBTOTAL (@ $115 per square foot)	**$28,658,000**

applies a constant square foot price for construction (including electrical work, fire systems, etc.). Table 7-4 presents the building dimensions and the total cost by square footage.

Financing
The cost associated with financing any project is the cost of borrowing the money to develop and build it. Again, the assumption guiding the financial analysis is that the pilot facility would be publicly developed, with the City retaining a private contractor to operate it. Therefore, the analysis assumes public financing, through a 20-year, General Obligation bond. This is the typical mechanism through which the City finances large-scale capital projects. The costs to the City associated with this type of financing are listed in Table 7-2 in the Capital Costs category under Financing.

These costs (such as the services of a financial advisor, the bond underwriter's fee and counsel, etc.) are important to include as they are borne by the City as a whole, and excluding them from the analysis would not accurately reflect the true cost of such a project.

Operating Costs

Operation costs, generally referred to as operation and maintenance costs, represent what is involved with the daily running of a facility. These costs are summarized in Table 7-2 as follows:

- Salaries and benefits
- Other than personnel services (OTPS)
- Repair and replacement
- Electricity
- Residue disposal

Unlike the capital costs, these costs are recurring over time, so an annual escalation rate (two percent) is built into the financial analysis to reflect rising costs over time.[1]

Salaries and Benefits
The workers' locations and positions listed in Table 7-5 are described in more detail in Chapter 5. Again, the assumption is that while the facility would be publicly owned and developed, operations would be contracted with a private company. The theoretical pilot facility would operate six days a week, with Saturday overtime costs broken out as a separate item below.

Table 7-6 provides a breakdown of anticipated management expenses. The total *Salary & Benefits* figure cited in Table 7-2 equals the sum of the totals listed in Tables 7-5 and 7-6.

Other Than Personnel Services
The OTPS figure in the financial summary is comprised of the items listed in Table 7-7. Compost-testing costs are for the laboratory analysis required by the State, as well as for additional testing to ensure that the compost meets the consistent quality standards outlined

Table 7-5
Estimated Annual Labor Expenses, Including the Estimated Cost of Fringe Benefits

Location within Facility and Position	First Shift (8am - 4pm)	Second Shift (4pm - 12am)	Third Shift (12am - 8pm)
Tipping Floor			
1 Grapple Crane Operator	$50,000	$50,000	-
1 Loader Operator	$50,000	$50,000	-
Primary, Pre-Drum Sort Line			
1 Supervisor	$50,000	$50,000	-
2 Sort Line Workers (Bag Handlers) @ $40,000	$80,000	$80,000	-
4 Sort Line Workers @ $35,000	$140,000	$140,000	-
Secondary, Pre-Drum Sort Lines			
2 Sort Line Workers (Bag Handlers) @ $40,000	$80,000	$80,000	-
4 Sort Line Workers @ $35,000	$140,000	$140,000	-
De-bagged Surge Piles			
2 Grapple Crane Operators @ $50,000	$100,000	$100,000	-
Final, Pre-Drum Sort Lines			
1 Sort Line Supervisor	$50,000	$50,000	-
6 Sort Line Workers @ $35,000	$210,000	$210,000	-
General			
1 Equipment Operator	$50,000	$50,000	-
Materials-Recovery Staging Area			
1 Supervisor	$50,000	-	-
3 Workers @ $40,000	$120,000	-	-
1 Equipment Operator	$50,000	-	-
Digester Drum Tipping Floor			
1 Equipment Operator	$50,000	-	-
Post-Drum Primary Screening[1]			
2 Equipment Operators @ $50,000	$100,000	-	-
First-Phase Composting			
2 Equipment Operators @ $50,000	$100,000	-	-
Second-Phase Composting			
1 Equipment Operator	$50,000	-	-
Night Clean-Up Crew			
1 Supervisor	-	-	$50,000
4 Workers @ $40,000	-	-	$160,000
SUBTOTAL LABOR	**$1,520,000**	**$1,000,000**	**$210,000**
Saturday Overtime[2]	$456,000	$300,000	$63,000
TOTAL LABOR	**$1,976,000**	**$1,300,000**	**$273,000**

1. One of the operators from the post-drum primary screening process will swing to also de-stone the unders from the designated digester (see Chapter 5 for a description of this operation).
2. The Saturday rate is derived by dividing the subtotal labor cost by five to arrive at a daily rate and then multiplying that by one-and-a-half to arrive at overtime costs. It should be noted that fewer people might actually be required as waste collection is generally light on Saturdays.

Table 7-6
Estimated Annual Management Expenses, Including the Estimated Cost of Fringe Benefits

Position	First Shift (8am - 4pm)	Second Shift (4pm - 12am)
Plant Manager	$75,000	-
Assistant Plant Manager/Maintenance Supervisor	$65,000	$75,000
Clerk	$35,000	-
TOTAL MANAGEMENT	**$175,000**	**$75,000**

in Chapter 4. Once a facility establishes a record of quality, then free, off-site deliveries of material could be made annually to new, potential end-users so they can sample the material.

Repair and Replacement
An important part of the daily operations of any facility is keeping all of the machinery and equipment in good working order. This category in the financial analysis provides the estimated annual expense the facility will incur through maintaining, repairing, and replacing broken equipment ($1,000,000 per year). As with any endeavor, purchasing quality equipment from reputable vendors, combined with a system of routine maintenance, helps to keep replacement costs down. Almost all of the equipment recommended for the theoretical pilot facility also comes with an extended service warranty.

Electricity
The electricity (kilowatt) requirements of the pilot MRC facility are fairly straightforward and are based on the usage of the actual equipment specified. The $.08 per kilowatt is a discounted rate provided to the Department as a bulk consumer of electricity. The assumption that served as an input to the life-cycle financial analysis is that the Department (and ultimately the City) as the owner of the facility would receive this rate. The electricity requirements for each facility component are listed in Table 7-8. In each case, the estimate came from the manufacturer and was then rounded up, to be conservative.

Residue Disposal
Incoming material that the pilot MRC facility does not recover for

Table 7-7
Estimated Annual Operating Expenses: Other Than Personnel Services (OTPS)

Category	Cost ($)
Heating	$225,000
Diesel Fuel	$100,000
Compost Testing & Off-Site Deliveries	$500,000
TOTAL	**$825,000**

Table 7-8
Estimated Annual Operating Expenses: Electricity

Facility Component	Electricity Requirement (kwH)
Composting Digester Drums	3,500,000
First-Phase Composting[1]	2,300,000
Materials Recovery	1,200,000
Second-Phase Composting	300,000
Other (screens, lighting, fans, etc.)	700,000
TOTAL	**8,000,000**

1. Includes air-handling equipment.

Table 7-9
Estimated Annual Tonnage: Waste Received & Processed

Throughput	Tons per Day	Days per Year	Tons per Year
MSW	300	302	90,600
Biosolids	200	302	60,400
Total	500		151,000

recycling or composting will require disposal. As Chapter 6 described, the pilot MRC facility would recover an estimated 71 percent of the incoming solid waste, meaning that approximately 29 percent would require disposal (see Table 6-1). The assumption is that residue disposal will cost $75 per ton in the first year of facility operation. Again, the financial analysis applies a two-percent annual escalation factor to residue disposal costs.

Fees per Ton

In order to determine a per-ton processing cost for a pilot MRC facility, it was necessary to apply all of the above costs to the number of tons that the theoretical facility would process. Table 7-9 presents the number of operating days and the amount of MSW and biosolids that the facility would receive. As described in Chapter 5, the facility would receive and process material on two, eight-hour shifts, six days a week. Using the DSNY operational calendar, this translates into 302 operating days (including Saturdays).

The Fees per Ton section of the financial analysis summary page (Table 7-2) describes the revenue that the facility would derive from its operation. The financial analysis assumes that DSNY would bear the costs of developing, operating, and maintaining the pilot facility, and would then "charge" the DEP a competitive tip fee of $100 per wet ton for biosolids. (As stated earlier, the DEP currently pays $112 per wet ton to export this material.)

The per-ton cost for MSW ($75, shown for Year 1 in Table 7-2) is the total cost of the theoretical pilot MRC facility operation (including debt service) divided by the total number of tons that the facility would process.

The financial analyst provided lines in the model for revenue from aluminum and ferrous metal recovered from the waste stream, as these two commodities have established and known value. However, as Chapter 6 explained, DSNY has chosen to set this revenue to zero, in order to conservatively assess the costs of a pilot facility.

The analyst also provided the ability in the model to assume revenue from selling compost. As noted, the assumption is that the compost would generate no revenue. If the facility is able, like many currently operating MSW-composting facilities (see Chapter 3 for more information), to generate a consistent, quality product, then this assumption is extremely conservative.

To balance these conservative assumptions, the cost for unsold compost is also zero. This is unlikely to be true, but without knowing the location of the facility and the proximity to outlets and modes of transportation, it is very difficult to assign a cost to unsold compost.

For example, if a pilot facility were located near a closed landfill, then a major distribution outlet would be readily available.

As described in the Other Than Personnel Services section above, money is allocated in the annual operating expense of the facility to provide free distribution of the material to potential end users, once the New York State Department of Environmental Conservation has approved its use. Ensuring that the compost is an asset and not a liability for a pilot facility will be critical to its success. The market demand and viable end uses of the compost is one of the important learning objectives of any pilot facility, as outlined in Chapter 5.

The findings of this report demonstrate that it is possible to make a compost that meets DEC pollutant-limit and product-use standards from samples of New York City MSW. Given the possibility of potentially recycling 70 percent of the municipal solid-waste stream at a price that is competitive with waste export costs, it would seem well worth the effort to build a pilot MRC facility to see if these goals can be met.