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Integrated Solid Waste Management Plan
for
Montego Bay, Jamaica

FINAL REPORT

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USAID/RHUDO/Caribbean
Kingston, Jamaica

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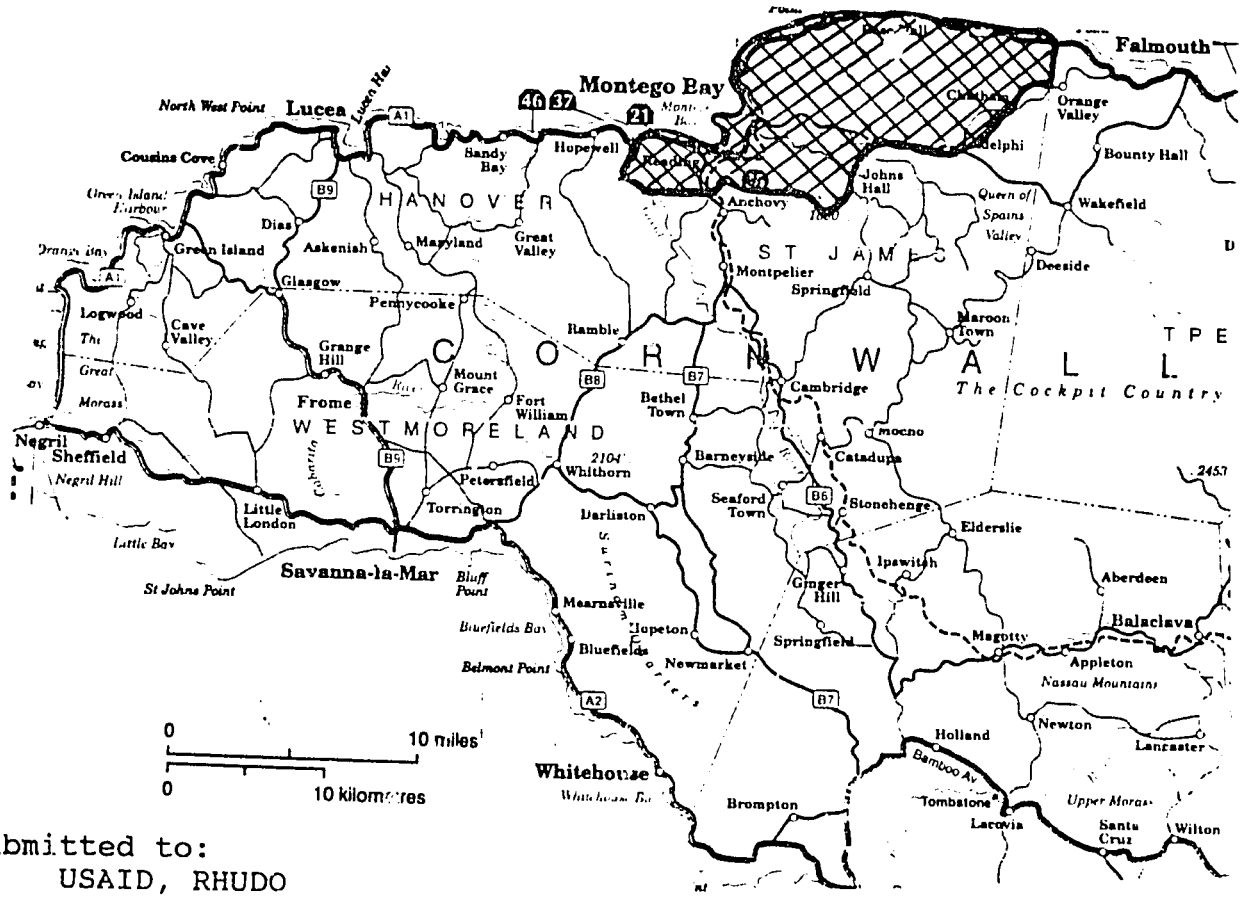
JAMAICA

GREATER MONTEGO BAY SOLID WASTE MANAGEMENT STUDY

FINAL REPORT



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Rate of Exchange:

Rate of Exchange Used for Economic Analysis: $JA 30 per $US 1

Abbreviations:

Ministry of Local Government, Youth and Sports -- MOLGYS
Underground Water Authority -- UWA
Natural Resources Conservation Authority -- NRCAA
Parks and Markets Companies -- P&M's
Western Parks and Markets Company -- WP&M
Parish Councils -- PC's
Greater Montego Bay Metropolitan Area -- GMB
Government of Jamaica -- GOJ
Jamaican Dollars -- $JA
US Dollars -- $US
Gross National Product -- GNP
Gross National Product/capita/year -- GNP/cap/yr
metric tonnes/day -- m.t./day
US Dollars/metric tonne -- $/m.t.
US Dollars/capita/year -- $/cap/yr
Refuse lower heating value in kilocalories/kilogram -- kcal/kg
Refuse density in kilograms/cubic meter -- kg/c.m.

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GREATER MONTEGO BAY SOLID WASTE MANAGEMENT STUDY

EXECUTIVE SUMMARY

a Background. The solid waste management study for Greater Montego Bay (GMB) was sponsored by the United States Agency for International Development (USAID) and involved a study team of 4 consultants, 2 from Jamaica and 2 from the USA. Their combined level of effort involved about 10 weeks of field work and 5 weeks of back-to-office work. Field work was completed between November 1993 and January 1994. A draft final report was submitted in April 1994. Review meetings were conducted in June 1994. Comments from Local Reviewers were obtained in September 1994.

b. Refuse Quantity. Municipal refuse, including residential, commercial, port, and institutional solid waste, amounts to 31,800 tonnes/year for 1994, and is expected to grow to 44,400 tonnes/year in 2000. See Para. 11 to 13, and Annex A.

c. Refuse Character. There is no data on the composition, moisture content, Carbon to Nitrogen ration, calorific value, or density of refuse in GMB. For more definitive examination of the potential for recycling, or the economics of composting or incineration, sampling and analysis of refuse is needed. Such work was outside of the scope of work of this study. Sampling and analysis are included in the IDB study expected to be conducted in 1995 throughout Jamaica. For purposes of this USAID study, analysis of technologies which was conducted was based on visual observation of the wastes at various collection and disposal points within GMB, as well as data from countries of comparable economic development and climate. See Box 8 following Para 127.

d. Legal Framework. Municipal refuse collection and disposal is conducted in a four-parish region including GMB by a private enterprise established by the Ministry of Local Government (MOLGYS), called Western Parks and Markets (WP&M). The WP&M has been fully supported financially by the MOLGYS, with annual budgetary allocations to support recurrent expenditures, and periodic capital investments. The MOLGYS is involved in an active program of local government reform, wherein authority and financial autonomy for services such as solid waste management will be decentralized to the Parish Councils (PC's). The legal framework for the WP&M is discussed in detail in Para. 31 to 46, and points to the need for revisions.

e. Institutional Arrangement. From an institutional and organizational view, the WP&M and its guiding central government agency, the MOLGYS, are weakly staffed for the job which they are supposed to conduct. The issues of weakness are discussed in Para.

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50 to 55. Before specific recommendations can be made to address these issues, the legal framework of WP&M discussed above would first need to be resolved. There are few significant reasons to have solid waste management services provided by regional entities versus PC's. Even where the disposal system's economies-of-scale warrant a regional facility, there is little justification for regional solid waste managment entities. Issues of economies-of-scale are discussed in Para. 48.

f. Financial Arrangement. Until local government reform, all local financial resources to cover solid waste management investment and recurrent expenditures have been provided by the Ministry of Finance (MOF), channeled through the MOLGYS. About 19% of cost of local infrastructure services were covered in 1992/93 by revenues from property taxes. In 1993/94, property taxes were substantially increased and are expected to continue to increase until they cover the cost of local infrastructure services.

g. There are services for which residents would be willing to pay directly a user charge, and measures to begin implementing direct cost recovery have also begun. At least a portion of the costs for solid waste management can be covered through such user charges, as discussed in Para. 60 to 69, Para. 100, and Para. 110 to 112. License fees paid by private haulers would also contribute to covering costs. Tipping fees charged at the disposal site are recommended, coupled with strong sanctions and heavy fines for clandestine dumping. For sanctions to be implemented, legal hearings should be conducted in a community court system rather than through the magistrate court system which is focused on major criminal cases. For details on the full owning, operating, and maintenance costs of collection service, see Para. 93 to 99, and Annex B. Costs for disposal are discussed in Para 104, and Annex C.

h. Collection Service Delivery. Collection service in GMB is relatively complete, in that most residents have access to service. In neighborhoods where collection problems exist, there is a need for greater community cooperation with the collection system, which suggests that public education, vigilance, enforcement, and community pilot projects need to be developed. Also, use of open communal depots instead of closed containers for storing waste while it awaits collection results in the appearance of poor collection, even if the depots are cleaned one or more times daily. While service is believed to be nearly complete, based on the field observations and interviews conducted during this study, there is potential to improve the efficiency of collection through better equipment specification, improved containment, optimized staffing, rationalized routing, and competent privatization in several zones, as discussed in Para. 71 to 88.

i. Disposal. The current disposal system involves open dumping and open burning at the official disposal site. This disposal operation is not sanitary and needs to be upgraded, as discussed in Para. 101 to 109. It would be acceptable and cost-effective to

continue use of the existing disposal site for the next 5 to 10 years, provided that the current operations are upgraded to a cut and cover sanitary landfill in the immediate term. Details for improving the landfill are provided in Annex C. Additional work to develop an operating plan is recommended. Monitoring of groundwater is recommended to safeguard the environment, especially in light of karstic geology reported in the vicinity of the site.

j. Recycling. Recycling is limited in the GMB area because there is not local industrialization activity creating a market demand and costs to transport recyclables to industrial areas, such as Kingston, make it difficult for local recyclables to compete with less costly and higher quality imported recyclables. To address the issue of recycling, markets would need to be developed by focused incentive programs conducted by central government. Until markets are developed, efforts to encourage source segregation and separate collection of recyclables are not recommended. See Para. 119 to 124.

k. Composting. Composting is technically viable for GMB, given the high content of vegetable putrescible material in municipal refuse and the very low level of industrialization which might introduce phyto-toxic constituents, such as heavy metals and pesticides. Unfortunately, there is very little market demand for compost within a 50 km radius of GMB or any significant potential that a market demand could be developed which would enable composting costs to be covered. See Para. 129 to 136.

l. Incineration. Municipal refuse in GMB does not have an adequate calorific value to support self-sustaining combustion. Therefore, the costs of incineration would be prohibitively expensive compared to the costs of environmentally comparable disposal alternatives such as sanitary landfill. See Para. 137 to 138, and Para. 141 to 144. Ship vessel wastes are probably able to support combustion; the quantities are very low and economies-of-scale would not be available, but port authorities and ship owners may consider the investment negligble relative to the priorities of meeting requirements for safe disposal. See Para. 139 to 140.

m. Incineration of medical wastes from hospitals and clinics is recommended because of the high level of hazard associated with them. Ideally, on-site incineration at each major hospital is recommended because of the potential to eliminate hazards of extra handling and transport. However, regional incinerators for medical wastes may capture economies-of-scale and enable optimum operation with skilled staff. A program of source segregation to separately store and collect medical wastes of a pathogenic/hazardous nature is an essential ingredient of a this recommendation. See Para. 155 to 166.

n. Recommendations. Recommendations are summarized in Para. 167 to 179. Recommendations for GMB are not necessarily relevant for other cities in Jamaica. The evaluation of composting and recycling, for example, are highly dependent on the potential for

market development within the local area. Also, while there is no recommendation for a near-term hazardous waste management program in GMB, that does not negate that a national program with at least one national hazardous waste treatment facility is definitely needed; nor does it negate the potential need for cities with greater industrialization than GMB to have a local program.

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GREATER MONTEGO BAY SOLID WASTE MANAGEMENT STUDY

FINAL REPORT

October 1994

INTRODUCTION

1. This report provides a review and assessment of solid waste management issues and needs for the Greater Montego Bay Area. The types of wastes included in the definition of solid waste are shown in Box 1.

2. Because Greater Montego Bay is one of Jamaica's major ports of entry and activity for tourists, wastes from ships and hotels have been given special attention in this study.

3. The findings and views expressed in this final draft report are those of the consultants engaged as the USAID study team and do not necessarily reflect those of USAID.

4. The USAID study team included two foreign consultants, Sandra Cointreau-Levine (study team leader and independent solid waste management engineering consultant) and Robert Donovan (solid waste management specialist and manager of Glendale, Arizona's solid waste department), and two local consultants, Paul Carroll (environmental scientist and impact assessment consultant) and Keith Miller (institutional consultant on local government reform).

WHAT IS SOLID WASTE?

Most practitioners in the field define solid wastes as all non-hazardous solid and semi-solid materials discharged from household, commercial, industrial, and institutional establishments, as well as from public streets, drains and open spaces. Street sweepings and construction/demolition debris are included within the broad definition of solid wastes. However, hazardous wastes from medical and industrial sources are usually excluded and referred to as special wastes.

BOX 1

5. Most of the data gathering was conducted between November 22 to December 15, 1993. The field work focused on collection of site-specific planning data from the Greater Montego Bay (GMB) area, as defined by the Greater Montego Bay Redevelopment Plan, and on collection of legal, institutional, financial, and privatization information from the central government agencies in Kingston. A briefing paper was provided for purposes of presenting findings to

local and central government representatives on December 16 and 17, 1993. Additional field work was conducted by the local consultants between December 28 and January 12 for purposes of addressing needs for additional data identified during the briefings. A draft final report was submitted in April 1994. Review meetings were conducted in June 1994 with Local Reviewers in Kingston and Montego Bay. Comments from Local Reviewers were obtained in September 1994.

6. This final draft report includes detailed cost estimates of alternative collection techniques, improved methods of operating the existing landfill, recommended changes to the fleet and personnel deployed for GMB solid waste services, estimated cost recovery targets and methods, and near-term interventions which collectively could upgrade the state-of-knowledge and provide practical replicable methods for solid waste service improvements.

7. This USAID study is expected to be followed in 1995 by a country-wide solid waste planning effort sponsored by the Inter-American Development Bank (IDB). This USAID study will serve as input to the IDB study, and will provide direction on important issues which the IDB study could pursue in depth. Coordination between this study and the IDB larger study is expected to be an on-going continuous effort.

STUDY AREA.

8. The study area is the Greater Montego Bay Metropolitan Area as defined in the Greater Montego Bay Development Area Plan, prepared under the auspices of the Greater Montego Bay Redevelopment Company. The map on the cover of this report shows the study area in cross-hatching.

9. Greater Montego Bay (GMB) is the main stopover arrival point for cruise ship tourists to Jamaica. In 1992, GMB earned about 35% of the total foreign exchange spent by tourists in Jamaica and received about 30% of Jamaica's cruise ship arrivals and had 39% of Jamaica's tourist bed night sales. The tourism foreign exchange earnings for GMB in 1992 were approximately $US 273.4 million.

10. According to the Greater Montego Bay Development Area Plan, population is growing at about 2% per year. Currently, there are about 104,000 people in GMB and population is expected to reach 124,000 by 2000. The Central Business District is a relatively small area with a small resident population of only about 5,500; however, the number of people in this area during business hours is estimated to be over 76,000. Gross Domestic Product in GMB is growing at a 6.7% rate, adjusted to exclude inflation which is about 20% per year.

11. Most of GMB's residents are considered low income. An estimated 67% of the GMB households makes less than $JA 60,000/year. Of the remaining 33% of the households, 22% makes $JA 60,000-120,000/year and is considered low middle income, 3% makes $JA 120-250,000/year and is considered middle income, and 8% makes over $JA 250,000/year and is considered high income. Within the five main squatter settlements of GMB (Lilliput, Long Acres, Canterbury, Norwood, and Flankers), an estimated 92% of the households have incomes of less than $JA 12,000/year, which is very poor by Jamaican standards.

12. The labor force in GMB is about 47,100, of which about 39,100 are employed, suggesting an unemployment rate of about 17%. Unemployment within the squatter settlements is estimated as 30%.

13. Data on the nonresident population, the number of cruise ship day visitors, and hotel bed nights is provided in Annex A. Current refuse quantities being generated are estimated in Annex A with results as follows:

Table 1
Solid Waste Quantities
Greater Montego Bay
(Metric Tonnes/Year)

Type of Waste	1993	2000
Residents' General Refuse	22,862	32,804
Non-Resident Workers' General Refuse	2,738	4,489
Hotels	4,160	4,659
Ships	2,040	2,448
TOTAL	31,800	44,400

BOX 2

HISTORICAL CONTEXT.

14. Solid Waste Management under Local Authorities. In Jamaica, as in most countries, solid waste management was traditionally the responsibility of the Local Government or Municipal Authorities. The activities conducted as a part of solid waste management are outlined in Box 3. Public Cleansing was included with other functions of the Parish Councils (such as public health, fire protection, public markets, street lighting) in the last quarter of the nineteenth century, when the responsibilities of these Councils were dramatically expanded beyond the original functions of relief to the poor and road maintenance.

WHAT ARE THE SOLID WASTE ACTIVITIES?

Solid waste management typically is defined as the broad range of activities to collect, transport, recycle, process, and dispose of solid wastes.

BOX 3

15. In the early days of the service, until the early 1950's, solid waste was collected using mule-drawn carts. This clearly imposed a limit on the distances over which garbage could be hauled and hence, all of the early dumps were cited within or on the near outskirts of the town or City, including within wetland areas adjacent to the coastal cities.

16. Centralization of Solid Waste Management. Until 1985 the solid waste management function was performed directly by Public Cleansing Departments of the Parish Councils (PC's). In 1986 and 1987, the Government divested these Authorities of this responsibility, along with all of the other major functions of Local Government. Statutory responsibility was given to the Permanent Secretary of the Ministry of Local Government, Youth and Sports (MOLGYS) who was designated to represent the Local Board of Health for all Parishes in the island.

17. At this same time, the Parks and Markets Companies (P&M's) were created country-wide as private enterprises to perform solid waste management services. The P&M's, under MOLGYS direction, are operating exclusively in separate regions. Relative to the MOLGYS's assessment of needs for the region which each P&M services, the P&M's are given trucks, staffing, and budgetary support from the MOLGYS and authorized to provide and contract for services of collection, transport, and disposal of solid wastes.

18. The main arguments advanced in support of the decision to divest the Local Authorities of the solid waste management function were:

a. The poor performance of the Councils in the delivery of the service.

b. The claim that significant economies-of-scale would be realized by regionalizing the function.

19. These arguments have been countered by pointing to the fact that the PC's were severely starved of resources, i.e., finances, management and equipment, while resources were amply provided to the P&M's when they took over.

20. Decentralization of Solid Waste Management. In 1989 the new administration of central government reversed the policy of the previous government in regard to local government and instituted a policy of restoration and reformation of the local government system. This included reinstating the PC's as the Local Boards of Health and giving them statutory responsibility for solid waste.

21. While the trend is in the direction of decentralization, no substantive change in the solid waste system has yet occurred. The legal arrangements by which the P&M's have been authorized to be responsible for solid waste management have been unchanged (as discussed in substantial detail within the next section). The P&M's continue to receive their equipment allocations and recurrent budgets from the MOLGYS, and still report to a Board of Directors appointed by the MOLGYS.

22. Based upon newly established management contracts developed in 1992 by the MOLGYS, the P&M's are now being "hired" by the PC's to provide service. Every PC has been requested by the MOLGYS to sign a management contract with its P&M. The management contract does not obligate the PC to pay the P&M anything for service. However, the contract does require the PC to "secure such funds from the Ministry as indicated by the Annual Budget prepared by the P&M and approved by the Minister". According to interviews with MOLGYS budgetary staff, this involves the PC's merely being a pass-through, wherein the P&M budgets were sent to the MOLGYS via the PC's, but the PC's did not participate in the negotiation meetings between the P&M's and the MOLGYS. While the concept of a management contract between P&M's and PC's is theoretically a change toward including the PC's in solid waste management decision-making -- wherein the P&M's are now supposed to be accountable to PC's they serve -- in reality the P&M's still take their marching orders from the MOLGYS and the PC's still have no real ability to take charge of their own affairs.

23. Because they have no independent revenues, essentially all of the PC's are cooperating with the MOLGYS's request to sign the management contract with their local P&M, thus granting the local P&M a parish-wide franchise (i.e., a zonal monopoly) to provide solid waste management services and recover costs (and profit) through a fee collection system. Under the MOLGYS's decentralization program, a major objective is the development of a local revenue base for the PC's. Once the PC's have their own income from local sources of taxation, there is nothing preventing

them from contracting with any private company for service or even providing the service themselves. Over time, the MOLGYS would need to discontinue subsidizing the P&M's operations in order to enable other private companies to effectively compete with the P&M's.

24. This study team is in full support of the government's ongoing program of local government reform and the move toward cost-effective privatization. Only when the linkages between local governments and the constituents they serve are restored, can we expect to see full accountability and efficiency possible within the system. It is anticipated that the local government reform program will have completed its actions by early 1996, and that local governments will have developed into relatively self-sustaining financially viable units by early 1999. At that time (i.e., 1999), it is recommended that each PC have the option of reaching a fixed-term service management agreement with it's respective P&M, after rechartering to make it more accountable to government, or establishing service directly under its own control.

LEGAL FRAMEWORK.

25. Solid Waste Management Legal Framework. Jamaica's legal framework for solid waste management has the nation's Public Health Act as its traditional cornerstone. Under the Act, each Parish Council is designated to function as the Local Board of Health for the parish. The Local Board of Health is empowered to divide the parish into sanitary districts for purposes of providing solid waste management (and other sanitation) services, and conduct all activities which appear necessary, advantageous, or convenient in the interest of public health.

26. The legal framework of the Public Health Act has been strengthened on the national level by The Litter Act of 1986, which prohibits littering and clandestine dumping. The Litter Act broadly defines refuse to include any refuse, debris, offensive liquid or solid substance, or animal remains which cause a nuisance in a public place. Penalties within The Litter Act include fines of up to $JA 2,000 and imprisonment of up to 6 months. Enforcement authority for The Litter Act is granted to local authorities, and requires summary conviction through a Resident Magistrate's Court. Local authorities are empowered to designate suitable people to perform vigilance and enforcement activities with the "same privileges and immunities as a Constable". In GMB, the WP&M is thus authorized to have selected staff inspectors responsible for enforcing the Act.

27. The National Resources Conservation Authority Act of 1991 provides for environmental and natural resource protection and establishes the National Resources Conservation Authority (NRCA). The NRCA is specifically authorized to develop measures and perform functions to implement, study, and monitor environmental and natural resource protection. As one of its activities, under Section 38 of the Act, the NRCA may develop design and operating standards for existing and new disposal sites and environmental impact assessment requirements for new disposal sites. To this end, the NRCA and Underground Water Authority (UWA) have been working on guidelines for the selection and siting of disposal facilities, as well as procedures and requirements for permitting and operating disposal facilities. These documents are now in draft form and are being used to provide technical guidance to Local Authorities. Under Section 17 of the Act, the NRCA has clearly designated powers to regulate the performance and discharges from solid waste disposal sites. The Act carries enforcement powers which allow penalties of up to $JA 20,000 and imprisonment of up to 2 years for noncompliance with NRCA requirements, liable on summary conviction before a Resident Magistrate.

28. Regulatory Oversight for Solid Waste Disposal. For approval of any new solid waste disposal site, the NRCA should be the lead agency to establish design and operating codes and

standards, determine environmental monitoring requirements, and approve the environmental impact assessment, prior to granting permission to Local Authorities to proceed with implementation. Because Jamaica is an island country, dependent on limited groundwater reserves, the UWA charged with protecting hydrogeological resources which are potentially viable for water supply. The UWA has veto authority over any potentially polluting activity which is proposed.

29. Inspectors under the Ministry of Health (MOH) are responsible for vigilance of public health offenses, including public nuisances created by inappropriate or clandestine disposal of wastes. Litter Wardens under the Parish Council's (PC's) are responsible for vigilance of littering and clandestine dumping offenses related to a very broad spectrum of wastes. Field staff under the NRCA are responsible for vigilance of waste spills and clandestine disposal offenses which appear to be environmental damaging. The areas of responsibility for oversight appear to overlap and can lead to confusion over which agency or authority is accountable for thorough monitoring of specific types of offenses. This could be especially important when it comes to the management of potentially hazardous wastes, including medical wastes.

30. Operational Responsibility for Solid Waste Management. Responsibility for solid waste collection and disposal service provision is designated to the Ministry of Local Government (MOLGYS), as the constitutional entity legally representative of local government. Unlike most countries, Jamaica does not have a legal framework which provides clear designation of responsibility and power directly to local governments for the provision of service. Because the legal framework is confusing on this point, each central government administration has been able to vary on the extent to which it assigns or does not assign responsibility and power to local government for this service. For example, during the administration working between 1986 to 1989, all authority and responsibility for solid waste service delivery was stripped from local government. Whereas, the current administration is pro-decentralization and is reestablishing local government's role in local service delivery.

31. Legal framework of the Western Parks and Markets Company. In 1986 and 1987, the solid waste collection and disposal service function was commercialized throughout Jamaica. Commercialization is a form of government privatization wherein government ownership and activity in service delivery is reduced and the new service entity is provided with some of the management flexibility of a corporate enterprise. In Jamaica, limited liability companies called Parks and Markets companies (P&M's) were established for provide solid waste management services to multi-parish regions.

32. Western Parks and Markets (WP&M), the P&M serving the four-parish region which includes GMB, was established as a

registered limited liability company in January 1987. In the process of conducting this study, it appears that there are flaws in the legal framework of the WP&M. The MOLGYS and Jamaica's Attorney General are now investigating these flaws in an effort to resolve them. The following discussion outlines the issues which need to be addressed in amending the WP&M's charter.

33. The objectives for which the WP&M was established included general sanitation responsibility for public areas, removal of residential refuse, management of public parks, markets and cemetaries, disposal of wastes, and litter prevention. The company is given complete freedom to work as a corporate entity without government intervention, and is freely allowed to make a profit in any manner it chooses. As clearly stated in the corporate memorandum of association, the company is allowed to "acquire or establish and carry on any business or undertaking (and either separately or in conjunction with others) in Jamaica and elsewhere as the Directors may in their absolute discretion from time to time determine whether agricultural, manufacturing, industrial, mining, commercial or otherwise". Not only is the company entirely free to work anywhere in Jamaica which it chooses, it is not required to provide service exclusively (or even at all) within the four-parish region wherein the WP&M currently works.

34. Despite the freedom given to the WP&M to enter any business, until late in 1993 the WP&M confined its activities to the charter-specifed removal of residential waste, and left commercial waste removal to be conducted by private hauler operating without license and without oversight by the WP&M or the PC's. Most contractors to the WP&M serviced the commercial establishments located along their routes for residential collection. Not only was this a missed opportunity for the WP&M to generate revenues through service of commercial enterprises, but it allowed private haulers to serve commercial establishments without regulation. There is some possibility that clandestine dumping in some of the gullies and open lots around GMB may have been done by private haulers. To implement control, licensing would include use of a "truckers' book" which records each stop made, enabling a copy of each transaction to be provided to the customer, truck owner, and oversight agency.

35. In the memorandum of association and related articles of the company, ownership and control were given to seven individuals who were then officials within the MOLGYS, including the Permanent Secretary at the time. Each of these individuals signed the incorporation papers above their typewritten name and the title and address of their position within the MOLGYS, and thus became the seven shareholders of the WP&M. The signatures of the seven shareholders were not designated as "on behalf of" the MOLGYS. There are no references within the incorporation papers suggesting any role, responsibility, or authority for the MOLGYS. Furthermore, this team's review of the background files from the

time of incorporation has not discovered any documents which would qualify or counter the apparent omission of the MOLGYS.

36. Within the incorporation papers, there is no requirement that the shareholders involve the MOLGYS in decision-making or designation of board directors. The articles of association clearly state that "the name of the first Directors shall be determined by an instrument in writing under the hands of the subscribers (shareholders)". Complete ownership and autonomy is granted to the shareholders. While the shareholders are allowed to be directors, the directors need not be shareholders. Reportedly, none of the individuals has exercised the powers granted to them as the WP&M's sole shareholders, they have not participated in making appointments of directors, nor have they obtained any profit from being the sole shareholders.

37. Some of the seven shareholders are still employed by the MOLGYS, but others are no longer with the MOLGYS or within this central government's administration. The shareholders own the assets of the company and could step into fully exercising the authority granted to them by the incorporation papers at any time. As stated in the charter, the company may "exchange, let on lease or otherwise, mortgage, charge, sell, dispose of....all or any part of the property and rights of the Company". This issue of ownership is particularly important at this time, because a major procurement of 45 new solid waste collection trucks (costing about $US 5.9 million) has been conducted by the MOLGYS for all of the P&M's in Jamaica and 8 new trucks are expected to be provided to the WP&M for its use. Based on our interviews, trucks currently used by the WP&M are officially owned by the PC's. Whether the new trucks procured by the MOLGYS will also be given to the PC's, or instead will be given to the WP&M, has yet to be decided.

38. Since WP&M's incorporation in 1987, the MOLGYS has consistently behaved as though it had ownership of the WP&M. Although not legally authorized in the corporate charter or its supportive documents to have any role in the WP&M, the MOLGYS has always appointed the Directors to the Board, regularly provided the WP&M with budget and equipment, and has been involved with key staffing decisions. The designation of all authority to the seven shareholders may have been done in error. Nevertheless, at any time, the shareholders, and only the shareholders, have had the authority to appoint, remove and replace any, and all, directors.

39. The WP&M has a number of freedoms articulated in its charter which raise questions about the ethical framework of the corporation. The company is authorized to engage in "complimentary businesses", and is empowered to undertake a variety of activities in furtherance of its interests, including the acquisition of other companies, property and equipment. Other activities enumerated in the Memorandum of Association seem unrelated to the company's mission. Examples of such activities include: (1) trade in

intellectual property and marketing rights; (2) lending money; (3) scholarships; (4) donations to persons designated by the Directors. Although the unwritten freedom granted to a company for such activities is not inappropriate, it is unusual for it to be so clearly articulated and creates a concern that such activities might be undertaken for other than ordinary charitable and business reasons. Significantly, the directors of the company are allowed to contract with the company in virtually any capacity. Normally, where directors are allowed to contract with the company they serve, the interested director is disqualified from voting on the award of his contract. The corporate charter for Western Parks and Markets specifically empowers an interested director to vote on such contracts.

40. It appears that solid waste management, formerly a public function of the government, was mistakenly placed in under the ownership of individuals. In order to change the situation and create an entity which is accountable to government, permission of the shareholders would be necessary so that the MOLGYS could redraft the company's charter and recast ownership. The change would probably require the shareholders' super-majority approval, in accordance with local corporate law. The MOLGYS has begun to take the necessary steps to secure cooperation of the shareholders in transforming the company to one which is legally accountable to government.

41. If the shareholders had not been supportive of redrafting the charter, the MOLGYS would have had to abandon the WP&M organization and start an entirely new organization. In this latter case, the WP&M shareholders could have retained ownership of any assets to which the WP&M holds legal title and could continue under its existing charter to function as a private company established for private service. According to the memorandum of association, only in the event that the shareholders wish to dissolve the WP&M, are they required to transfer assets to "some other institution or institutions having objects similar to the objects of the Company". The shareholders have stated that they fully intend to cooperate with the MOLGYS activities to redraft the company charter and transfer ownership to government.

42. The corporation was clearly not established as a transitional private enterprise to be replaced by a semi-private enterprise or public enterprise. The shareholders are not required to offer the company to private interests for subscription and the corporate charter prohibits a public offering.

43. Based on the above findings, and discussions of this study team with the MOLGYS, the current Permanent Secretary has taken steps to have the shares of the WP&M transferred to the Accountant General, which is the agency normally authorized to hold the GOJ's interest in any privatized arrangement. The overall legal framework of the WP&M is now being examined by the Attorney

General for resolution of the WP&M's charter. The shareholders are cooperating fully with MOLGYS's efforts to transform the company to be fully accountable to government.

44. WP&M Service Agreement with Local Authorities. As a limited liability company, the WP&M is expected to be accountable to its board of directors directly, and to its paying customers indirectly. Because the MOLGYS appoints the general manager and board members of these companies and provides essentially all financing to meet their annual capital and recurrent expenditure requirements, WP&M behaved in an manner accountable to the MOLGYS. On the other hand, there has been no direct link between the populace requiring solid waste collection and disposal service and the WP&M. In accordance with democratic theory, a local populace in Jamaica is represented by its local council and mayor. However, these local government representatives are not included in the WP&M's board of directors and do not have any definitive say in how much money is appropriated to the solid waste service or how well it is conducted.

45. While WP&M was established by the MOLGYS to carry out the business of sanitation services, without a service agreement from the MOLGYS or PC it has no legal responsibility to provide service. In fact, the WP&M's charter is so open that it could engage in a wide variety of activities using the monies provided by MOLGYS. GMB has little choice in being served by WP&M because it has no financial resources which would enable it to establish its own service entity or arrange for any changes in how it is served by WP&M. The monthly meetings which each parish separately holds with the WP&M allow each parish to separately lobby for its share of WP&M's scarce service resources and for readjustment of priorities in how their specific allocation of parish related resources are spent.

46. Since 1992, the MOLGYS has requested each PC to sign a service agreement between the PC and its assigned P&M. The service agreement creates a false impression that each PC signing the agreement is a "customer" of the P&M -- presumably with specified rights for service, responsibilities for securing P&M budgets, and freedom of choice in selection of its service provider. The service agreement also creates an impression that the P&M is accountable to the PC. However, only 3 of the 4 PC's within WP&M's jurisdiction had signed the agreement last year, and yet nothing was altered in service provided to the 4 PC's. The PC which had not signed the agreement was St. James, wherein the GMB is located.

INSTITUTIONAL ARRANGEMENTS.

47. Local Government Institutions. Because of its technical complexity, which requires continuous data collection, economic analysis, financial management, and operational rationalization, solid waste management service is an excellent window into the competence of local government. Because local governments in lesser developed countries (LDC's) have limited resources to enable independent technical action, it is also ar excellent window into the adequacy of support being provided by central government.

48. Part of the justification for establishing the P&M's with multi-parish jurisdiction for solid waste management was a presumption that economies-of-scale could not be captured at the parish level. While it is true that some components of the solid waste system have economies-of-scale which suggest that handling of 200,000 or more residents would allow cost optimization, the combined components of collection, transfer, disposal, and/or treatment do not require such service areas with this many residents. Based on our analysis, for Jamaica economies-of-scale arguments do not justify creating institutional arrangements for solid waste management which extend beyond parish boundaries, as discussed below:

a. Collection activities require the majority of a city's solid waste budget, as indicated in Table 1, Box 4. For collection of solid waste, there are no economies-of-scale beyond 15 tonnes/day, which is roughly equivalent to the amount of waste which two medium-sized compaction trucks can collect and a population of about 20,000 residents. There is no parish in Jamaica with under 65,000 residents, and most parishes have over 100,000 residents.

GLOBAL PERSPECTIVE ON
SOLID WASTE MANAGEMENT COSTS VERSUS INCOME

	LOW INCOME DEVELOPING COUNTRY	MIDDLE INCOME DEVELOPING COUNTRY	HIGH INCOME INDUSTRIAL COUNTRY
WASTE GENERATION	0.2 m.t./cap/yr	0.3 m.t./cap/yr	0.6 m.t./cap/yr
AVE. INCOME FROM GNP	370 $/cap/yr	2,400 $/cap/yr	22,000 $/cap/yr
COLLECTION COST	10-30 $/m.t.	30-70 $/m.t.	70-120 $/m.t.
TRANSFER COST	3-5 $/m.t.	5-15 $/m.t.	15-20 $/m.t.
SANITARY LANDFILL COST	1-5 $/m.t.	3-10 $/m.t.	20-50 $/m.t.
TOTAL COST	14-40 $/m.t.	38-95 $/m.t.	105-190 $/m.t.
COST AS % OF INCOME	0.8 - 2.2%	0.5 - 1.2%	0.3 - 0.5%

Note:

1. Income based on 1992 Gross National Product data from the World Development Report 1994 published by the World Bank.

2. Costs are for owning, operation, maintenance, and debt service in 1992, assuming no equipment provision through grants.

3. If sanitary landfill can be located with an economic haul distance allowing direct haul in collection vehicles, the cost of transfer can be avoided. An economic haul time for a truck carrying 2 to 6 tonnes is typically 30 minutes one-way from the collection area to the unloading point. Depending on traffic conditions, 30 minute one-way would be 15 to 20 kilometers one-way.

4. $/m.t. means US Dollars per metric tonne, and $/cap/yr means US Dollars per capita per year.

BOX 4

b. While economies-of-scale indicate regional disposal facilities should be carefully analyzed, it needs to be noted that the added cost of longer distance travel and the potential need for adding the cost for transfer stations may over-ride such economies-of-scale. Beyond a distance one way of about 15 miles, or a travel time one way of about 45 minutes, is would not generally be economically viable to directly haul refuse in a collection vehicle and implementation of transfer stations would need to be considered. Transfer facilities have economies-of-scale. For the simplest facilities employing one small unloading platform and one transfer truck making at least four trips daily, at 20 tonnes/trip, the economies-of-scale would be 80 tonnes/shift, which translates to about 125,000 residents. If a parish has less than this number of residents, it would not be advisable to enlarge the area of service because economies within the collection system would favor serving an area which has no greater than a 20 km radius around the transfer station.

c. Disposal and treatment facilities have economies-of scale. For example, sanitary landfills rely on bulldozers to spread, grade, and cover the refuse. A small bulldozer (140 horsepower) can handle about 200 tonnes/shift and thus accommodate a population of about 300,000 residents. Similarly, a small incineration system would handle about 240 tonnes/day, in two parallel continuous process trains of 120 tonnes/day each, and serve about 370,000 residents. Even if multi-parish participation in a regional disposal facility were assessed to be economic, the institutional arrangements typically would best be handled by developing intergovernmental agreements for the specific facility under consideration.

49. Another part of the justification for establishing P&M's to handle a multi-parish jurisdiction was that technical and management resources were severely limited at the parish level and government pay scales were considered too low to attract adequate management professionals. It is clear that there is a healthy pool of individuals with excellent management capability and experience in Jamaica if appropriate salaries and working conditions are offered. To meet staffing needs, parishes may need to consider contracts for management services. Also, strong support from a central government unit established to give technical assistance on solid waste management would lessen the need for professional expertise at the local level. While local professionals clearly

need training on how to properly establish and run an efficient and effective solid waste management service, a shortage of professionally competent candidates is not adequate justification for multi-parish jurisdictions.

50. By creating the WP&M for management of solid waste and informally designating the four parish region including the GMB area as their exclusive zone, the MOLGYS changed from conducting the service by public monopolies (i.e., Parishes) to private monopolies (i.e., P&M's). While the incorporation papers allow the WP&M complete autonomy to act with management flexibility in staffing, operations control, contracting, and revenue generation, the WP&M acts like a department of government rather than limited liability company. The WP&M is understaffed, undertrained, and underfinanced to do its job. By relying on the MOLGYS as its only source of revenues, the WP&M has not exercised its charter-granted freedom to develop its own contracting instruments, generate revenues, or make independent changes to the way in which the zones and the services are structured.

51. The study team strongly recommends that the WP&M, after being properly rechartered so that it is a semi-private enterprise which is accountable to government, be strengthened in its ability to manage solid waste and administer contracts. The WP&M should have a zone of service so that it can manage contractors from a position of practical experience in operations and realistic knowledge of costs. The WP&M should have some staff dedicated to collection of performance data and analysis of costs, so that planning and rationalization can be an on-going process. While the current staffing with public health professionals is laudatory, there must be supplemental expertise in engineering if economic systems are to be developed and maintained. Also, training in development and operation of cost-effective systems is needed. For proper oversight and direction, every effort to supplement the Board of Directors with professionals having business management and engineering expertise should be made.

52. <u>Central Government Institutions</u>. It is a major flaw in the system that the MOLGYS does not have a single staff person dedicated to providing technical guidance and performance oversight to the P&M's. The role of the MOLGYS until now has been limited to control of P&M budget allocations, audit of P&M accounts, appointments to the P&M boards and staff, political manipulation of contract awards, and control over contracting terms. The need for technical aspects to be addressed has been short-shrifted, largely because this sector has suffered in Jamaica from having a false image as being simple technically and a low status as being unworthy of professional attention. Provision of solid waste service is extraordinarily costly in every low-income country and, even when done efficiently, will consume 1-3% of GNP should be cause enough to encourage attention. Return to Table 1, Box 4 for

a global view of costs as they relate to Gross National Product (GNP).

53. Costs analyzed for the GMB and presented in Annex B indicate that collection service alone costs about $JA 1,200/tonne (including depreciation, debt service, and contractor profit of 10%), which equates to about $JA 280/capita/year, or about $US 9.3/capita/year. Disposal by controlled landfill procedures at the Retirement Dump would roughly bring total costs to about $US 10/capita/year. With GNP in Jamaica in 1990 estimated at $US 1,500/capita/year, solid waste service would consume about 0.7% of GNP. Implementation of new sanitary landfill facilities could raise this to about 1% of GNP, provided siting could be within a viable direct haul distance of less than 15 miles so that transfer facilities would not be required.

54. Based on the above, the study team recommends that a dedicated unit of staff for solid waste purposes should be established at the MOLGYS to provide technical guidance and performance oversight. The unit should be staffed with civil/sanitary engineers, urban planners, and economists which could work toward rationalization of Jamaica's solid waste system. One of the development agencies working with the MOLGYS on institutional strengthening should be requested to provide technical support to this unit, with short term advisors provided over a period of several years.

55. In keeping with the above comments about staffing at the MOLGYS, environmental guidance on disposal of solid waste is also not getting adequate attention. Based on our cursory site reconnaissance, recent siting activities performed for nearby Negril suggest that too little attention may have been paid to selecting the most economically and environmentally suitable site. See Annex D for more detail.[] It may have been well worth the while to pay for land having more soil base and soil cover, rather than to take a "free" government site which appears to have rock outcroppings which could limit the site's capacity and safety. Funds had been appropriated for construction of site access, even though borings had yet to be conducted to confirm the sites viability. Based on the above, the study team recommends that a dedicated unit of staff be established at the NRCA for purposes of establishing realistic modified landfilling guidance procedures for existing sites, providing technical guidance to P&M's and Local Authorities attempting to select new disposal sites or upgrade existing ones, monitoring pollutant discharges and environmental consequences at solid waste facilities, and providing regulatory oversight.

FINANCIAL ARRANGEMENTS.

56. Under the present arrangement, financing of solid waste management comes almost exclusively from the central Government of Jamaica (GOJ). The MOLGYS assumes responsibility for the allocation of budgetary and other resources to solid waste management operations, within the overall allocation to Local Government by the Ministry of Finance (MOF). While an exercise is conducted annually to develop a detailed budget, in reality every solid waste management budget is essentially a copy of last year's budget altered by the percentage increase (or decrease) suggested by the MOF guidelines for pending fiscal year.

57. There has been an increasingly acute inability of the GOJ to adequately fund solid waste management operations. The causes for this inability lie largely in the following context:

a. Prior to 1974 Local Authorities, which then had direct responsibility for solid waste, funded these operations by the imposition of local rates, and a direct relationship existed between the cost of the service and the amount raised by way of the rates.

b. In 1974 local rates were abolished and rolled into Property Taxes which were collected by GOJ, who in turn paid a grant to the Local Authorities in lieu of the abolished rates. This served to disconnect the cost of local services from the amounts raised from property taxes.

c. In subsequent years a growing gap developed between revenue collected from property tax and the cost of major local services, to the point where in 1992/93 the cost of these services amounted to $JA 379 million, whereas the collections from property tax was only $JA 73 million. The consequence is that Central Government has been called on to subsidize these services from other revenue sources.

58. At the same time, GOJ been faced with severe restrictions on its recurrent budget, caused by among other things:

a. up to 40% of the national budget is being preempted for debt service;

b. IMF conditionalities which demanded an elimination of the budget deficit and imposed a cap on public sector spending.

59. The GOJ has recently decided to initiate changes to the way in which local services such as solid waste management will be

financed in the future. First, all property taxes have been significantly increased and the intention is that the revenue yield from this source should reflect the costs of providing the relevant services. Second, property tax is to be allocated to the Local Authorities which will then be responsible for using these funds to finance the services. Third, a review is to be carried out to determine the desirability of returning to the situation where specific rates are charged for services such as solid waste management. Table 2 shows the historical pattern of revenues collected by central government, and highlights the anticipated revenue base expected in fiscal year 1993/4 from increased property taxes.

60. Near-Term Cost Recovery Measures. Beyond these measures being considered by central government for increasing general revenues at the local government level, local authorities could readily generate revenues by charging a license fee for private haulers of solid waste. Also, local authorities could collect tipping fees at the disposal sites from all entities dumping their wastes, including the local port authorities, hotels, private haulers, and the P&M's and their contractors. The hotels and ports might be especially be willing to pay tipping fees for land disposal when they realize the high costs of incineration if they consider building their own combustion facility. The cost details of combustion are discussed later in this report.

61. A weighbridge would allow exact monitoring of collection productivity, provide a basis for continuous planning and rationalization of collection operations, as well as enable collection of tipping fees on a measurable basis.

62. There is some concern that implementation of tipping fees would lead to clandestine dumping. To avoid this problem, several steps are necessary. The tipping fees need to support an advanced system of vigilance and enforcement of the licensed and contracted private firms which are collecting wastes. The licenses and contracts need to have specifications which state that they can be revoked after illegal and unacceptable activities are identified. The customers of private service need to be held accountable if they are found to hire unlicensed firms. Use of a "truckers' book" would facilitate oversight. In this system, each collection load is recorded in the truckers' book and copies are distributed to the customer at the time of collection, and then to the truck owner and oversight agency. Also, use of a gate house with continuous record-keeping of incoming loads at the disposal site provides a means of calibrating the records from the trucker' book system. Good vigilance, speedy enforcement and stiff penalties are essential.

63. Retirement Disposal Site is utilized for open dumping of all refuse collected from the GMB area. The property was originally part of a 1,000 acre parcel purchased by the GOJ for

COMPARISON OF SELECTED TAX TYPES AS A % OF TOTAL TAX REVENUE

FOR THE FISCAL YEARS 1970/71 TO 1993/94

(JA$ MILLION)

FINANCIAL YEAR	TOTAL TAX PEVENUE	PROPERTY TAXES		M/V LICENSES		STAMP DUTIES		CUSTOMS DUTIES		INCOME TAX		GCT/SCT/EXCISE/		TRAVEL TAX		EDUCATION TAX	
		AMT	% OF TOT	AMT	% OF TOT	AMT	% OF TOT	AMT	% OF TOT	AMT	% OF TOT	AMT	% OF TOT	AMT	% OF TOT	AMT	% OF TOT
1970/71	189.16	1.50	0.79	5.21	2.75	4.24	2.24	43.28	22.88	83.56	44.17	45.94	24.29	0.93	0.49	0.00	0.00
1971/72	233.37	1.57	0.67	5.83	2.50	7.69	3.30	51.76	22.18	109.12	46.76	51.66	22.14	1.08	0.46	0.00	0.00
1972/73	259.68	1.51	0.58	6.20	2.39	11.68	4.50	54.13	20.84	119.67	46.08	60.34	23.24	1.21	0.47	0.00	0.00
1973/74	324.40	10.90	3.36	6.50	2.00	15.50	4.78	54.62	16.84	147.70	45.53	74.70	23.03	1.25	0.39	0.00	0.00
1974/75	394.42	12.04	3.05	6.81	1.73	16.48	4.18	57.86	14.67	185.00	46.90	101.39	25.71	1.29	0.33	0.00	0.00
1975/76	477.46	22.60	4.73	9.36	1.96	16.89	3.54	83.94	17.58	194.80	40.80	128.07	26.82	1.78	0.37	0.00	0.00
1976/77	488.29	22.80	4.67	10.72	2.20	14.92	3.06	39.38	8.06	214.31	43.89	170.45	34.91	1.59	0.33	0.00	0.00
1977/78	487.39	25.00	5.13	13.50	2.77	16.10	3.30	30.34	6.22	193.90	39.78	182.30	37.40	1.55	0.32	0.00	0.00
1978/79	734.90	25.00	3.40	15.50	2.11	49.00	6.67	50.30	6.84	263.90	35.91	286.99	39.05	3.87	0.53	0.00	0.00
1779/80	838.90	24.80	2.96	16.50	1.97	59.10	7.04	66.69	7.95	329.63	39.29	303.36	36.16	4.77	0.57	0.00	0.00
1980/81	880.87	23.34	2.65	15.71	1.78	44.03	5.00	43.64	4.95	412.17	46.79	309.13	35.09	5.10	0.58	0.00	0.00
1981/82	1130.76	27.09	2.40	17.00	1.50	72.72	6.43	89.67	7.93	523.27	46.28	353.51	31.26	5.72	0.51	0.00	0.00
1982/83	1362.15	31.22	2.29	17.30	1.27	99.47	7.30	117.66	8.64	639.66	46.96	393.80	28.91	7.76	0.57	0.00	0.00
1983/84	1668.10	26.35	1.58	18.00	1.08	128.10	7.68	136.03	8.15	670.76	40.21	364.76	21.87	7.83	0.47	10.07	0.60
1984/85	2008.98	24.45	1.22	30.83	1.53	179.25	8.92	167.92	8.36	898.85	44.74	552.31	27.49	21.81	1.09	39.28	1.96
1985/86	2735.80	23.40	0.86	44.68	1.63	443.03	16.19	217.09	7.94	1161.41	42.45	637.92	23.32	15.47	0.57	46.47	1.70
1986/87	3758.30	33.50	0.89	47.90	1.27	564.40	15.02	255.91	6.81	1555.52	41.39	1056.42	28.11	30.88	0.82	55.18	1.47
1987/88	4306.90	65.50	1.52	38.70	0.90	702.30	16.31	350.11	8.13	1726.58	40.09	1118.47	25.97	40.83	0.95	65.74	1.53
1988/89	4901.60	58.20	1.19	39.00	0.80	619.40	12.64	549.00	11.20	2067.50	42.18	1211.36	24.71	45.93	0.94	65.38	1.33
1989/90	6364.10	70.30	1.10	40.60	0.64	771.10	12.12	761.20	11.96	2663.00	41.84	1390.22	21.84	72.80	1.14	218.10	3.43
1990/91	7809.00	68.00	0.87	49.10	0.63	890.40	11.40	787.10	10.08	3787.10	48.50	1449.82	18.57	86.20	1.10	304.74	3.90
1991/92	11273.70	69.20	0.61	65.90	0.58	1025.20	9.09	1529.60	13.57	4746.40	42.10	2879.33	25.54	166.80	1.48	428.20	3.80
1992/93	18786.10	88.20	0.47	67.90	0.36	1179.50	6.28	2631.00	14.01	7801.50	41.53	6018.19	32.04	341.40	1.82	664.60	3.54
1993/94	27012.20	450.00	1.67	281.20	1.04	1417.40	5.25	3247.10	12.02	10080.50	37.32	9793.40	36.26	485.60	1.80	952.60	3.53

Table 2

agriculture and assigned to the Ministry of Agriculture for management. Of the original 1,000 acres, an area of 100 acres has been assigned to St. James Parish for multiple uses, including the establishment of the Retirement Disposal Site. Ownership title papers, however, have not been officially transferred to the St. James Parish. Because of the question over ownership, it is not clear whether the PC has the legal authority to collect tipping fees at the site.

64. Currently the charter of the WP&M allows it to generate revenues in any manner it legally is able to do. Also, the MOLGYS has recently encouraged the WP&M to take over priority zones of collection service and collect fees from residents and commercial establishments within these zones. However, given that the WP&M had been granted, via its charter, by MOLGYS a private monopoly in the GMB and was not truly accountable to local authorities, and given that its charter needs to be revised to make it accountable to both local and central government, it is recommended that WP&M be discouraged by MOLGYS from extending its revenue generation activities until resolution of its legal framework.

65. Long-Term Cost Recovery Targets. In 1992/93, the total GOJ budget for recurrent expenditures was $JA 15.00 billion and for capital expenditures was $JA 11.25 billion, and totaled $JA 26.25 billion. The total MOLGYS budget was $JA 0.45 billion for recurrent expenditures and 0.21 for capital expenditures, totalling $JA 0.66 billion. The recurrent expenditure funding to all P&M's in that same year totaled $JA 117.9 million, and included some monies for market management and beautification, especially in Kingston's P&M. The amount of recurrent expenditure funding provided by MOLGYS to the WP&M for solid waste management was $JA 10.9 million. Therefore, WP&M's share of the MOLGYS's solid waste budget was only 9% ($JA 10.960 million out of $JA 117.423 million), even though WP&M's four-parish population accounts for about 13% of the nation's total population. See Table 3.

66. Based on the MOLGYS budget provided, the expenditure per resident in the WP&M area was only $JA 34, which is about 12-15% of what is needed to cover total owning and operating costs for complete collection service and moderately safe disposal practices. Annex B provides analysis of alternative refuse collection trucks. If new and appropriate equipment were purchased by the MOLGYS (at a subsidized interest rate on capital) to provide sanitary and complete refuse collection, the total owning and operating costs, including debt service, would average about $JA 950/tonne for an average one way haul distance of 15 km. The total cost per person would average about $JA 230/capita/year. For the private sector to provide comparable service at nonsubsidized costs and including a 10% profit, the total cost per person would average about $JA 280/capita/year.

Table 3

22A

BREAKDOWN OF PARKS AND MARKETS COMPANIES EXPENDITURE

REVISED EXPENDITURE FOR 1992/93
(000 Ja$)

P&M COM	ADMIN EXPENSES		SWM EXPENSES		OTHER EXPENSES		TOTAL EXPENSES	PM EXP AS % OF TOTAL
MPM	20866	22.66	51346	55.76	19880	21.59	92092	66.56
CPM	2222	10.25	18558	85.58	806	3.72	21686	15.67
SPM	1523	30.10	3438	67.96		.00	5059	3.66
WPM	2303	21.01	8558	78.08		.00	10960	7.92
NEPM	1115	13.03	7098	82.95	245	2.86	8557	6.18
TOTAL	28029	20.26	88998	64.33	20931	15.13	138354	

BREAKDOWN OF PARKS AND MARKETS COMPANIES EXPENDITURE

REVISED EXPENDITURE FOR 1993/94
(000 Ja$)

P&M COM	ADMIN EXPENSES		SWM EXPENSES		OTHER EXPENSES		TOTAL EXPENSES	PM EXP AS % OF TOTAL
MPM	35916	34.42	62418	59.83	6000	5.75	104334	58.26
CPM	2222	6.92	29286	91.21	500	1.56	0 32108	17.93
SPM	2216	28.83	5371	69.88		.00	7686	4.29
WPM	3560	16.62	17460	81.51	300	1.40	21420	11.96
NEPM	2706	19.98	10635	78.54	100	.74	13540	7.56
TOTAL	46620	26.03	125170	69.89	6900	3.85	179087	

67. For solid waste management to be conducted efficiently and effectively, the managing entity needs an adequate budget and reliable cash flow. When budget provisions are lacking, there is a tendency to cut back on investment in proper equipment, maintenance of the fleet of collection vehicles and payment of fair wages to operational personnel. The system in GMB illustrates this tendency -- the fleet of collection trucks has depreciated to well beyond its economic life, maintenance performance is poor, the dump site is inadequately operated, and the operational personnel are being severely underpaid.

68. The solid waste management budgeting process for GMB is not based on planning data and economic analysis of alternative systems. There is no economic or technical justification required by MOLGYS or conducted by WP&M. Only accounting records of the current year are used to project budgets for the pending year. While audits annually are conducted by MOLGYS, this information is not an integral part of the budget determination process. No data on performance is generated by WP&M and no monitoring of performance is conducted by MOLGYS. Records are not even kept on the number of solid waste truck loads being delivered daily to the disposal site by WP&M and its contractors. Furthermore, there is no data available that would enable correlating truck load data (if it existed) to volume and weight of solid waste being collected. This inadequacy in quantitative basis for determining budgetary allocations is probably not unique to the solid waste service, and it can not be resolved only for the solid waste service. Nevertheless, it needs to be addressed over the long-term.

69. Based roughly on population projections, waste generation projections, service levels, disposal improvements, and estimated costs, the budgeting requirements outlined in Table 4, Box 5 below are suggested. Through a steady increase in taxes, user charges to households and establishments receiving collection service, license fees for private haulers, and tipping fees for use of the Retirement Dump, it is envisioned that full cost recovery could be implemented over a 5 year period.

Budgetary Requirements -- Preliminary Estimates and Potential Sources

	1993/4	1994/5	1995/6	1996/7	1997/8
Population (number)	104,393	107,525	110,750	114,073	117,495
Municipal Solid Waste (tonnes/year)	31,800	33,600	35,400	37,200	39,000
Collection Cost ($JA/capita/yr)	33 recurrent only	280	280	280	280
Disposal Cost ($JA/capita/yr)	1 dumping only	25	25	25	25
Total Cost ($JA/capita/yr)	34	305	305	305	305
Total Cost ($JA/year)	10.9 M	32.8	33.8	34.8	35.8
Budget ($JA/year)	10.9 M	15.0	20.0	26.0	35.8
Property Taxes	1.67%	3%	5%	8%	10%
License Fees	0%	1%	2%	3%	5%
User Fees	0%	91%	83%	74%	65%
Tipping Fees	0%	5%	10%	15%	20%

Note:

1. Total costs for 1993/94 are based on recurrent costs for operation and maintenance of fully depreciated equipment, recognizing that the contractors are supplementing their income by their service of commercial establishments.

2. Total costs for other years are based on full capital and debt service costs, as well as operating and maintenance costs, even though current equipment is fully depreciated and no provisions for a renewal fund have been made. Budget allocations are expected to gradually increase until depreciation and debt service (or renewal) requirements are met.

COLLECTION SERVICE.

70. Existing Service Delivery. Collection service provided in the GMB area is relatively complete. Even within slum and squatter areas which are inaccessible to trucks, service at the perimeters is being provided. Residents either bring their refuse to a truck (after it arrives and rings its bell to announce its arrival) or they bring it to a communal depot (usually an on-ground loading point). There are, however, some semi-urban or rural areas which do not have service. In these areas, if residents are relatively well educated, they bury or burn their refuse in a remote area of their property.

71. There are two problem areas of collection in the GMB area. There are squatter settlements between Princess Street and Perry Street and slum areas in the Green Pond area. These areas without service result in clandestine dumping by residents into the North Gully and South Gully which drain into the eastern portion of Montego Bay. Some of the neighborhoods near these gullies receive service, but residents who are undisciplined and uneducated do not cooperate with the service. During and after storms, some of the waste placed in the gullies is washed into the Bay. While creating a negative visual impact on the Bay, the water quality reportedly is not being significantly affected by the refuse coming from the gullies. Nevertheless, greater service delivery, public education, and vigilance and enforcement of the Litter Law are needed to resolve the problem.

72. Community Participation. Implementation of a neighborhood pilot project to develop a demand-driven method of appropriate collection and community participation is recommended. With this approach, meetings and interviews with community residents would seek to determine the type of service which they would prefer and be willing to pay for, commensurate with type type of participation they would provide. Alternative costs and participation levels for alternative refuse collection systems (such as door-to-door collection by hand cart, scheduled block collection by truck along the main access routes, or communal container collection at the neighborhood peripheries) would need to be presented to residents for consideration. Pilot testing and continuous adjusting of the resident-chosen alternative would be conducted, followed by replication in other neighborhoods of comparable conditions.

73. Vehicle Productivity. Over the past decade, economic analysis has not been conducted to determine which vehicle types, vehicle capacities, vehicle crew sizes, and route sizes would lead to rationalization of collection service. The current collection system is not efficient, as it is characterized by equipment of inappropriate vehicle design and crew sizes. For example, in the case of the large open tipper trucks used in GMB, the standard crew

of only three sidemen labors is undersized -- leading to poor vehicle productivity. In another example, the poor design inherent in the side-to-side roto-packer style rear end loading compaction trucks (high loading height, slow packing, regular jamming) slows down the loading efforts of even the standard crew of only two sidemen -- leading to poor worker productivity. Also, the current jurisdictions of contractor zones do not take into consideration economies-of-scale, as discussed earlier in paragraph 45 [].

74. While the size and type of truck are critical design issues, it is important to recognize that even the best truck selection can not be efficient when the collection conditions are poor. Even when more appropriately designed rear-to-front push-blade style rear end loading compaction trucks are being used in GMB, spillage and on-ground placement of solid waste seriously slows down the loading process -- leading to poor vehicle productivity. Development of household, communal, and large generator containment systems which are properly sized and easy to empty is essential to obtaining high productivity from workers and vehicles.

75. Problems Faced by Contractors. The contractors providing collection service are clearly not making enough money to provide sanitary, reliable and economic service. When contracting, government must recognize that the private sector bears many costs which public service does not directly bear. In taking the decision to privatize service, government must pay these additional costs, or find some way to provide the same hidden subsidies to contractors. To illustrate, the following findings came out of the Montego Bay study effort:

a. Contractors, because they are operating without any cash reserves, admit to having to pay high interest rates (i.e., about 80%-90 on the overdraft amount) on monthly overdrafts once each month because the MOLGYS is 1 to 2 weeks late in the second payment of each month. Their statements were verified through interviews with a key local commercial bank.

b. Contractors have to pay high interest rates (i.e., about 60% of capital cost) to finance equipment and typically have to pay back their note over the life of their contracts (i.e., 2 years), rather than the economic life of the equipment (i.e., 5 years).

c. Contractors borrowing from commercial banks for purchase of vehicles have to take out comprehensive vehicle insurance (i.e., about 20% of capital costs) plus personal life insurance, whereas the government does not specifically pay insurance but

instead bears the hidden cost for damages caused by accidents or replacements necessitated by thefts.

d. Contractors also have to pay customs duties (i.e., about 45% on truck value), whereas government receives an exemption from paying customs duties.

e. Contractors also may have hidden costs related to political manipulation and/or marketing (i.e., about 5% of total cost) and are surely entitled to a reasonable profit (i.e., about 10% of total cost).

PRIVATIZATION ARRANGEMENTS.

76. There are various methods for involving the private sector, as described in Box 6. For solid waste collection from urban areas, the two most commonly used methods are contracts and franchises. Contracts are used when government is considered a reliable customer for the private sector, i.e., with revenues able to cover the costs and a history of reliability of payment. Franchises are used for specific customers which are considered low-risk with regard to payment, such as large commercial and industrial establishments. Franchises are also used to serve residential customers when government is not considered reliable or able to make scheduled payments.

REDUCING GOVERNMENT ACTIVITY

Contracting
Government awards a finite-term contract to a private firm to provide a solid waste management service and government pays the firm for the services delivered.

Franchise
Government grants a private firm an exclusive monopoly to provide a specific type of solid waste service within a specific zone and the firm generates its own revenues from customers within the zone.

Concession
Government allows the private sector to utilize one of its resources, in this case solid waste, for profit-making purposes. Government may pay a tipping fee or service charge to defray part of the costs of processing the solid waste, but sale of the concession's product covers the remaining costs and profits.

Open Competition
Government licenses private firms to freely compete with each other in providing solid waste management services. No firm has monopoly within a zone and price regulation is not required. Each firm generates its own revenues from the subscribers to its services.

BOX 6

77. There are two objectives for involving the private sector in provision of solid waste service: (a) obtaining investment from the private sector, and (b) obtaining improved efficiency, and thus lower costs, for service. Contracting with the private sector does not automatically achieve these two objectives. Only if the contracting process and contracting agreements are properly conducted will these objectives be fulfilled. While it is a positive step that the WP&M has involved the private sector in collection of solid waste, the terms for contracting and methods of monitoring have not been conducted in a manner which realizes the objectives of investment and efficiency.

78. Existing Contract Terms for Refuse Collection. The WP&M has contract service agreements with private contractors for public cleansing services including cleaning of all streets and median strips, cleaning of open storm drains, emptying of all street litter bins, and collection of all non-commercial refuse within their designated zones. There are no quantitative performance

measures in the contracts, and the contractors are not paid on the basis of the weight of waste collected or the area of street, garden or drain cleaned. Therefore, performance evaluation is qualitative and arbitrary.

79. The term length of the WP&M contract has been too short (i.e., two years) to enable the contractors to obtain capital financing at economic terms. Also, payments to contractors have not been adequate to enable them to invest in new or refurbished vehicles, thus requiring them to operate fully depreciated and typically dilapidated vehicles (many of which are more than 15 years old). MOLGYS sets the salary payment structure which WP&M can pay to its contractors and WP&M dictates the number of vehicles and workers to be assigned to a zone. Irregular payments from government have been eating away at any potential for profit (because of the high overdraft charges from the banks).

80. Under original contracts, some of the contractors were allowed to use equipment owned by the MOLGYS. This represented a hidden subsidy to some of the contractors, and created inequitabile competition among contractors. The contractors receiving equipment were not required to enter a lease contract whereby rental payments would be made and periodic specific preventative maintenence and repairs would be required. As a result, after every accident or break-down, the MOLGYS was required to either solve the problem or resolve to not having the vehicle in service. For new equipment now on order, the MOLGYS has developed lease agreements which are expected to address the problems of the past.

81. The last contracts awarded by WP&M were in 1989. These contracts had a 2 year term, over in 1991. MOLGYS has been in the process of developing new contracts for several years and there have been no new contracts awarded by WP&M since the 1989 contracts expired in 1991. Nevertheless, work continues by the contractors on an informal "extension" basis. Contract prices have not been renegotiated and only very modest price adjustments in salary scales have been periodically announced -- lagging far behind inflation and typically provided only at the last minute to stay a major labor strike. Even when the contracts were in effect, they did not have any cost indexing included within them.

82. To make ends meet, the private sector's work force is seriously underpaid for the arduous and hazardous work they perform. Most contractors' crews work 10 to 12 hours daily -- without overtime pay, protective boots or gloves, medical benefits, or disability/sick pay.

83. To supplement their income, contractors have had little recourse but to supplement their contract-specified work by seeking private subscription agreements for waste collection with commercial establishments in their zones. Recently, the MOLGYS has begun to take that opportunity away from contractors working in the

most lucrative zones though an action to give the most downtown "corridor" areas to the P&M's for service and cost recovery.

84. Equitable and Competitive Contracting. For contracting to be viable, there should be a competitive tender process which recognizes that each zone is unique and allows contractors to bid according to the zonal conditions. Every attempt must be made at making the zones equitable, so that each zone has a comparable level of difficulty to service and a comparable opportunity for generating income -- in other words the problems and the goodies should be equitably shared. At the moment, the zones appear to be highly inequitable, with some contractors having a large number of ghetto (squatter) neighborhoods, while others have mostly laid-out upper income neighborhoods. See Table 5, Box 7 which indicates different haul distances and service populations for each contracted zone.

Population and Travel Distance
by Contractor Zone

CONTRACTOR ZONE	1993 Population	Travel One-Way (km)
Contractor 1C+2B	25,048	12.9
Contractor 1A	21,952	11.3
Contractor 1B	7,215	8.1
Contractor 2A	11,669	14.5
Contractor 3	18,325	24.2
Contractor 4	15,076	12.9
Contractor 5+5A	5,108	12.9

BOX 7

85. Given the high costs of commercial borrowing, a contract should have a minimum length of 5 year in refurbished vehicles are being purchased, and a minimum length of 7 years if new vehicles are being purchased, so that the investment payback period can be rationalized to enable a low cost/tonne of refuse collected. Contract performance terms need to be carefully specified, with adequate provision made for vigilance and sanction commensurate with performance failures. Current contracts simply specify "cleaning" the zone -- a performance measure which is essentially unmeasurable.

86. Commercial Borrowing Terms for Contractors. Because the interest rates from commercial banks are high, the government may wish to consider setting up a project credit line for "solid waste management development" with the National Development Bank (NDB). NDB project credit lines are lent through the commercial banks in accordance with the NDB terms. The NDB can lend only to companies which are not majority-owned by government, therefore WP&M would not be able to borrow under the credit line and government would need to continue procurement of the WP&M vehicles. Under NDB terms, borrowing for trucks could be set up with a 6 year payback period, including 6 months of grace. January 1994 NDB interest rates were 11% on $US (about 14% from the commercial banks) and 37% on $JA (about 43% from the commercial banks). With donor country financing interest rates can be about 2% lower.

87. Applications under the NDB project financing system take about 1.5 months to process by the commercial bank together with NDB. Like the commercial banks, NDB would require the length of contract to be as long as the period of payback and would accept the contract a collateral (with payments being made directly to the to the commercial bank from the WP&M). Because of the history of delayed payments to contractors by the WP&M, the loan to contractors would need to include 2-3 months of working capital.

88. Banks may require loan guarantees beyond the collateral available from local companies. To this end, consideration should be given to use of the USAID housing loan guarantee program, which is being used in this regard to encourage privatization of solid waste systems in Indonesia.

PUBLIC VERSUS PRIVATE COST ANALYSIS:

89. In the study area, there is no accurate view of what solid waste collection service would cost if all hidden costs within government were considered (i.e., opportunity cost of capital, economically determined renewal periods for equipment, exemption from customs duties, guarantees on borrowing and on equipment which allow avoidance of insurance costs, hidden administrative and benefit costs for personnel) and all legitimate costs for the private sector were considered (i.e., commercial borrowing interest rates, insurance costs, profit, economically determined depreciation and renewal periods, marketing).

90. It is essential to recognize that this analysis is preliminary and provided to indicate actual costs. Also, the analysis provides a format for future updated analysis as part of an annual continuous planning exercise which the study team recommends be conducted. In Montego Bay, there are no records kept at the disposal site or in the field to indicate the daily performance by the Western Parks and Markets and its contractors. Also, there have not been any time and motion studies performed over a significant time frame to determine how crews of various sizes on collection trucks of various types perform within the range of physical conditions existing in the area's various neighborhoods. And finally, there is no data on truck load weights to enable densities of loads to be definitively estimated.

91. To compensate for the above, interviews with public and private sector representatives were held to obtain an indication of productivity, several days of time and motion observations were conducted, and several days of observing operations at the disposal site were conducted. Much more needs to be done in any follow-on studies planned for the next year.

92. The costing tables provide analysis of the following:

a. productivity per truck type and size for various transport distances from the collection route to the unloading point (e.g., disposal site) -- which indicates the important need for continuous data on load weights and time and motion.
b. cost per tonne per truck type and size for various transport distances -- which indicates the truck systems which are lowest cost for the study area and the specific waste generation sources to be served.
c. percentage breakdown of total cost into personnel costs, consumables costs, and ownership costs -- which enables choices to be made by decision makers between capital intensive or labor intensive systems.

d. cost per capita per truck type and size for various transport distances -- which indicates the tariff requirements for full cost recovery.

93. Results of the Comparative Cost Analysis. If private sector service is established in a way to encourage and enable the private sector to make investment (i.e., there are competitive tenders held for contracts of 5 or more years duration), the private sector costs will reflect no hidden subsidies which are inherent in the public sector costs. Based on the analyses accomplished, for capital intensive systems (i.e., container-lift arm roll, skip, or compaction trucks), private sector service will cost from 10-45% more per tonne than the subsidized public sector costs. For labor intensive systems (i.e., manually loaded open tippers or manually loaded compaction trucks), private sector service will cost from 5-20% more per tonne than the subsidized public sector costs.

94. Non-compaction container-lift systems, such as the arm roll or skip lift trucks, provide the lowest cost method of collection service for Montego Bay. However, they can be used only where there is a large source of waste generation, as the smallest container size would be 5 c.m. and costs go down appreciably when the required container size is higher at the source. Container lift systems should therefore be implemented for all large generators, such as markets, hospitals, inaccessible ghetto neighborhoods, and hotels.

95. Compaction systems which mechanically lift and unload containers at each stop along the route, such as front end loading compaction trucks which lift 5 c.m. containers and rear end loading compaction trucks which lift 1 c.m. containers, are the highest cost method of collection service for Montego Bay. In low-income developing countries, such large volume, capital intensive systems are justifiable only in large metropolitan areas where the distance and time required to travel to the unloading point (e.g., disposal site) are more than 15 km. These systems should not be implemented by government, unless government takes over all hotel and commercial service where the tipping fee would fully cover the cost of this more aesthetic, convenient and enclosed method of collection.

96. Compaction and non-compaction systems which are manually loaded are economic for Montego Bay because of the low cost of labor. However, every effort to get citizens to properly contain their waste in properly sized dustbins or plastic bags would enhance productivity and lower costs from what is currently shown. The roto packer compaction truck is somewhat more costly than the push-blade type of compaction truck; because the smaller opening of the hopper, the higher height of the hopper, and the slower loading movement of the packer collectively limit the ability of the crew to rapidly load the truck.

97. Recommended Collection Fleet Requirements. Annex A provides current and projected population and waste generation data. Presently, the population of GMB is about 104,400. The current amount of municipal solid waste in Greater Montego Bay is estimated to total 25,600 tonnes/year (not including hotel refuse and ship refuse which amount to 4,160 and 2,040 tonnes/year, respectively). Of the metropolitan area's population, roughly 60% is urban, 20% is semi-urban and 20% is suburban. Assuming that 95% service of the urban and suburban area would be a viable service goal, the total amount of refuse to be collected is roughly 19,500 tonnes/year, or 62 tonnes/work day (based on a work week of 6 days/week).

98. Of the 19,500 tonnes/year which need to be collected, physical conditions of the various neighborhoods in GMB would affect which type and size of equipment would be appropriate. The container-lift system, when used in suitable locations, offers the lowest cost/tonne of service, therefore every effort to maximize its use is recommended. Based on field observations, it is assumed that 30% of the waste could be served by the lowest cost container-lift system. The remaining 70% of the waste could be served by the somewhat higher cost manually loaded rear-end loading compaction trucks or open tippers. Assuming that the average distance of travel is 15 km one way from the collection service area to the disposal site, based on continued use of the Retirement Site, the following fleet size appears appropriate:

a. Container Lift System -- 30% of 19,500 tonnes/year -- 5,850 tonnes/year:
   2 Arm Roll trucks of 8 c.m. capacity, averaging 3,700 tonnes/year productivity

b. Manual Load System -- 70% of 19,500 tonnes/year -- 13,650 tonnes/year:
   4 Rear End Loading Compaction trucks of 10 c.m. capacity, averaging 3,700 tonnes/year productivity

99. Costs of Collection. The average cost for the above fleet, for complete debt service, operation and maintenance, would be about 1,075 $JA/tonne if private sector and 952 $JA/tonne if public sector (with hidden subsidies). Addition of profit to the private sector costs would conceivably raise them to about 1,200 $JA/tonne. The breakdown of these costs are roughly 50% capital (including interest) and 50% operating and maintenance costs.

100. Cost Recovery for Collection. Based on the above average costs for solid waste collection, the user charge or tax to be collected from residents for full cost recovery would average 280 $JA/capita/year if private sector service or 230 $JA/capita/year if public sector service. Commercial establishments, industries, and institutions which are large generators should be charged on the

basis of quantity they generate, while households and small commercial/industrial establishments are charged on the size of their property (which is typically an indicator of property value and waste generation). Tariff structures should allow for cross subsidies from large generators and upper income households to small generators and low income households, as necessary to accommodate their ability to pay. Initially, the tariff structure should strive to cover recurrent operating and maintenance costs. In time, the tariff structure should cover the total owning, operating, and maintenance costs, as well as provide for creation of an adequate renewal/expansion fund.

DISPOSAL SERVICE.

101. Current Disposal Conditions. Based on field observation, the composition of the waste stream arriving at the current disposal site is primarily residential and commercial waste such as various types of paper, glass, plastics and metals. There appears to be little if any industrial waste or hospital infectious waste deposited at the site. Separate interviews with the airport and a major medical facility indicate medical and airport waste are handled by incineration at the airports and hospitals. Cruise ship waste, from home-port ships only, is handled at the dump and the issue of legally arranging for the port to pay a tipping fee is discussed in an earlier section on financial arrangements.

102. Currently disposal operations in the GMB area are conducted at the Retirement Dump. Site operations and maintenance are the responsibility of the Western Parks and Markets Organization. The site consists of 8-10 hectares of land which is accessible by a 1 km long road. The working portion of the site consists of 3.3 hectares of the available property. The roughly 33,000 tonnes/year of municipal solid waste generated in GMB in 1993/94 require 33,000 cubic meters of ultimate space within a landfill. Daily, intermediate and final soil cover material would increase the spatial requirement by about 15% to about 38,000 cubic meters. For a site which has a depth of about 10 meters, this means that land disposal requirements begin at 0.38 hectares/year in 1993/94 and are expected to increase by about 5% yearly. Therefore, the existing site has a life of about 10 years.

103. The operating plan, which appears to have developed on an ad hoc basis, utilizes approximately 8 and 1/2 acres of the existing land for actual operations. No formal operating plan exists and no site preparation has been conducted. The site has not been graded for drainage to minimize standing water which will encourage the formation of leachate (liquid which comes into contact with refuse). There is no being attempt made to cover refuse daily with soil to control vectors, such as flies, or prevent fires. As a result the refuse which is deposited burns continuously and is an active breeding ground for flies. Small animals and birds are also active scavengers at the site and enhance the possibility that bacterial and viral infections will be moved off the site. The fires consume large amounts of plastic and almost certainly contain significant quantities of dioxin, a known carcinogen. It appears unlikely that landfill gas generation (landfill gas is comprised of approximately 50% methane and 50% carbon dioxide with other trace elements) is a problem as it either vents directly into the atmosphere or is consumed in the fire as it is generated.

104. Costs of Disposal. Resources expended on operations, based on discussions with the attendants and the tractor operator, are estimated at approximately $JA 80,000/year. This equates to

about $JA 4/tonne or $US 0.13/tonne for open dumping costs. For comparison, sanitary landfill costs for an approved site and design in a country of Jamaica's income level would range from $US 3-8/tonne. Equivalent costs of $US 15-25/tonne for an USEPA (US Environmental Protection Agency) approved site in the USA are typical.

105. Disposal Plans and Standards. At the national level there is no legislation, currently, that requires any specific controls regarding landfill siting and operation. There are also no controls, at the Parish level, regarding landfill operations. Discussions with WP&M personnel, the nominal operators of the site, indicate they do not have any specific operating criteria for the facility other than to have the bulldozer operator bury the in place refuse every two weeks. As the existing bulldozer utilized at the site is not equipped for excavation the operator has developed a plan whereby trucks dump at the approximate center of the active area of the site, the refuse is burned, and he pushes the ashes and residuals after burning to the edge of the site. Trucks have dumped refuse all along the 1/2 mile road into the site when access was limited by rainy weather conditions.

106. This information is important in light of what is happening at the national level in an effort to regulate solid waste disposal. Discussions with the staff at the NRCA indicate that a document titled "Procedures and Requirements for Permitting and Operation of Waste Disposal Facilities" is being circulated for review and adoption. This documented was prepared by a consultant for the Ministry of Health with funding from the Pan American Health Organization. This document fundamentally follows the wording of the US Environmental Protection Agency's regulatory framework for landfill siting, design, and operation, which is called Subtitle D of the Resource Conservation and Recovery Act. Subtitle D was developed to protect the public from improper siting and management of landfills in an industrialized nation with a relatively high per capita income where technology and trained personnel are relatively readily available, although at a high cost, to allow for compliance.

107. When viewed in the context of Jamaica, neither the technology, the technical personnel or the financial resources are available to make this a workable regulatory framework for the near term. There needs to be an interim regulatory framework which enables disposal practices to gradually be upgraded from the open dumps which exist today to sanitary landfills of suitable developing country design and operation standards. Given the cost of developing and operating a landfill of the type contemplated by Subtitle D and the current level of resources being expended in Jamaica on disposal, a significant financial burden will certainly be experienced if these proposed regulations are adopted. Also, the technical staff and resources are not available to WP&M to comply with the proposed guidelines.

108. Measures to Upgrade Current Disposal. To upgrade the Retirement open dump to a modified sanitary landfill, the following design suggestions are provided:

a. The road to the landfill should be cleared of all illegally dumped material and surfaced and maintained for all weather operation. An aggregate material laid over a properly prepared subgrade should be sufficient if it is properly maintained. A good road is critical to insure that trucks can reach the dump site in inclement weather rather than resorting to dumping material on the sides of the road. Leaving the existing material in place will encourage illegal dumping and continue to foster fires, flies and other scavengers. Trucks and a front end loader will have to be rented to accomplish clearing the existing material from the road and moving it to the disposal area.

b. Obtain a larger bulldozer than the one currently operating at the site equivalent to a Caterpillar D-7, with ripper attachment to enable excavation. A complete breakdown of costs for purchase and operations can be found at Annex C.

c. Move the accumulated refuse along one side of the site to prepare the site for cut and cover sanitary landfill operations to be conducted.

d. A site development plan should be followed utilizing the existing 8 and 1/2 acres for burying existing material and operations for the next 5 to 10 years. For site development details see Annex C.

e. A cut and cover operation will have to be followed on a daily basis to insure proper site operation. The efficiency of this operation will be hampered by the requirement to accommodate the population of waste pickers which is currently deriving part or all of their income from recycling material from the site. With proper utilization of the bulldozer and control of scavenging a reasonable operation can be carried on which accommodates the population in question and minimizes the inefficiencies. For operating details see Annex C.

f. Arrange for gas ventilation by appropriate means, for example through a gravel layer along one wall of the cut, and soil cover stockpiled along the top of the same wall so that trucks can unload along the other wall.

g. Slope the base of trench to encourage drainage of surface runoff from the working face within the upgradient area of the cut.

h. Leave 1 to 1.5 meters of undisturbed soil layer under the cut to protect groundwater.

i. As refuse is placed in cells within the cut, each daily cell area is covered with soil. To minimize soil cover, the working face need not be covered with soil, but can instead be covered with tarps (or even discarded carpets). Also, the cells can be designed to be deep and narrow so that intermediate cover is minimized.

j. Put in upgradient perimeter drains to divert surface runoff away from any refuse receiving area.

k. Drill and develop groundwater monitoring wells and implement regular monitoring, especially in light of the karstic geology within the site vicinity.

l. Curtail any disorganized scavenging from the operational area and prohibit any children from entry to the site.

109. Retirement Dump's inadequacy as a disposal facility results from lack of legislative controls over the disposal process, lack of technically skilled staff, and inadequate financial resources. In the context of an integrated solid waste management strategy for the near term, sanitary landfill provides the most cost effective solution for disposal in the GBM. The clear challenge is to upgrade the existing facility from a dump to a landfill in the next four to five years. Given technical and financial constraints there are no other viable alternatives.

110. Cost Recovery for Disposal. As with most systems a clear limitation to progress relates to the amount of dollars available to "make things happen" in a timely manner. At this point it is worthwhile to note that the Retirement Dump is operated solely from money provided by WP&M through an appropriation from the MOLGYS. Jamaica operates on the same principal as do most third world countries in relation to solid waste management which is that it is funded out of general tax revenues rather than being entirely or partially self supporting. In contrast many industrialized nations and several Central American countries have discovered that people are willing to support quality solid waste management services through a fee for service system. In the U.S. many municipal landfills are operated on a basis of residential disposal costs being supported by a differentially higher rate for the disposal of commercial refuse.

111. No disposal fee for dumping is charged at the Retirement Dump. No real progress can be made without either an increased appropriation from the central government or a disposal fee for dumping. The logical approach would be to start charging a small fee for disposal, which would be raised annually, until a full recovery situation could be achieved with the national government making up the difference in operating cost through an increased appropriation until the full 'recovery situation was achieved. A differential fee is recommended for GMB which charges the commercial refuse generator at a higher rate than the residential. Part of the rational for this differential fee is that commercial/industrial refuse generally tends to contribute more to environmental contamination than household refuse, and thus requires more costly landfill technology than does residential refuse.

112. The exact fee to be charged each type of waste generator will depend on the political considerations regarding a good starting amount which will institute a pay for disposal system and not create an illegal dumping problem as a result. The fee to be charged will also be dependent on the amount of funding the national government is willing to provide towards operations and of course the ultimate operating costs as they are related to the landfill. A large revenue generator would be fees derived from cruise ship waste. Currently the landfilling of this material occurs on an ongoing basis. There has been no effort to legalize disposal of cruise ship waste and charge for the service. The rational for not allowing this is the fear of contamination. It would seem far more effective from both a public health and a financial standpoint to legalize the disposal of this material in a controlled environment and charge for the service. A suggested operating budget for a near term cut and fill operation, to include a full recovery operating fee, is included at Appendix C "Site Development".

113. Disposal Standards. A cut and cover landfill operation is not the ultimate preferred operational methodology for this or any other site on a long term basis. Cut and cover operations do not eliminate leachate formation and do not allow for the recovery and treatment of the leachate that is formed. They are also inherently inefficient in terms of optimizing the space which is available. However, as I pointed out earlier they present a low cost/low technology alternative to operating the open dump which is currently in place. In terms of the future, 5 to 10 years out, WP&M, or whoever is ultimately in charge of disposal in Montego Bay needs to carefully prepare to move the operation both financially and technically to an environmentally sound sanitary landfill operation.

114. Although it was not in our scope of work to review the draft "Procedures and Requirements for Permitting and Operation of Waste Disposal Facilities", it is necessary to comment on it in the

context of the impact it will have on the Montego Bay area. This document does not cover the disposal of hazardous or toxic waste. It also has some shortcomings in the area of design such as the requirement for a final landfill cap. This document allows a 20 mil synthetic cap (.10 E. 1. page 28) which was specified as a cost saving measure. The longevity of such a cap and the technology to put it in place while maintaining cap integrity is questionable. The document also has some administrative shortfalls in terms of the integrity of references between paragraphs etc. It should be reviewed for technical feasibility, enforcement capability and some timeline developed to phase in the requirement to meet these criteria should be developed which are consistent with the available financial resources, technology and management resources available in the Jamaican context as a key consideration.

RECYCLING.

115. Waste Recovery at the Dump. There are normally about 40 waste pickers working at the GMB disposal site, and about 80 on holidays and during peak tourist periods when the recyclable content of the waste is higher. Scavengers working at the site, if allowed, should be registered with the WP&M. Only adults should be allowed on site, and only those adults wearing their registration card. Since many of the scavengers appear to be farmers from surrounding communities, it may be useful to constructively organize their activities. For example, they could be organized into a cooperative and provided with an area of the site on which to work. To this area of the site, organic wastes from markets and restaurants could be diverted for small-scale production of compost and/or processing into pig feed.

116. The Benefits of Recycling. Recycling can provide savings to local manufacturers in feedstock and energy costs. Local manufacturers for tissue paper currently import secondary paper waste material of high grade (computer paper and stationary) as a substantial portion of their feedstock, and are gearing up to increase production with an improved local network of source segregation. Certain types of glass are already recovered under a buy-back type of program and that a market exists for the purchase of green, brown and clear bottle glass of all types. Plastics such as HDPE, PET and LDPE also appear to have a market. The market for scrap metal is small and does not appear to offer many immediate opportunities. High levels of copper wire recovery being reported from the GMB Retirement site.

117. Within any solid waste management system, the addition of a special system to segregate and collect secondary waste materials, i.e., recyclables, adds complexity and cost. While virtuous in nature, recycling is not and activity which any city in any developing country should undertake unless there is clearly a local market demand which will cover the cost of recovering recyclables. Source segregation programs conducted at the household and commercial establishment level tend to increase waste collection cost by roughly 50-100%. Income from sales of recyclables would have to cover this cost differential.

118. The negative side of the resource recovery/recycling picture rests in the lack of national initiatives in this area, a lack of public education and the lack of a cost effective transportation network that would facilitate the transport of material from the Montego Bay area to markets in Kingston and other areas that have end users for the commodities.

119. The Need for a Recycling Program. Another area of research conducted, as a component of the disposal system, in the Montego Bay area was a look at the viability of instituting a recycling program to divert waste from the landfill and save

landfill space. In discussing this issue it is important to note that beneficial recycling programs depend on many variables for success. The first critical issue that must be defined when looking at a recycling program is simply to answer the question "what is a successful recycling program?". This question must be answered in the context of the specific jurisdiction in which the program is implemented. Recycling programs can be considered successful if they save scarce landfill space; they can be considered successful if they conserve natural resources; they can be successful if they save energy; or they can be successful if they fulfill the public need for environmental involvement. In almost all cases they are generally considered successful if they break even or make money in terms of the alternative of not recycling. The sole exception is encountered when a group is so environmentally involved that they will pay to recycle even when it costs more than the disposal option.

120. Existing Markets for Recyclables. In reviewing the possibilities for recycling in GMB, as in any other jurisdiction, one of the first questions to address is "What are the markets for the materials that are being considered for diversion from the waste stream?". When a jurisdiction is contemplating recycling as an option it must either already have markets for the materials in question or it must be willing to create markets through legislation if necessary.

121. A review of the immediate situation in GMB demonstrates that a recycling effort was already ongoing for one market which already exists. Specifically, there is recycling of glass bottles through a buy back and reuse program. The brewery producing Red Stripe beer, recovers approximately 50% of their glass bottles for reuse. Other smaller producers of beverage products buy bottles for reuse in packaging their own products. These bottles may or may not have been bottles produced for their use initially. Glass bottles appear to be the only readily recyclable product in the Montego Bay area.

122. In an effort to ascertain which markets were available for glass, metals, paper and plastics in the greater context of the island economy, interviews were held with industry representatives. In these interviews, the following information was obtained:

a. In reviewing the market for plastics an interview was conducted with Mr. John Marie Desilva of Thermo Plastics of Jamaica. This company is currently utilizing HDPE (High Density Polyethylene). The only recycling they are doing at this time is the utilization of their scrap. Further work with this company might develop a future market for HDPE waste. An interview was also held with a representative of POLYPAC Jamaica. This company is making plastic bags from scrap plastic.

b. There appears to be a strong potential for further glass recycling in Jamaica. An interview was conducted with Mr. Desmond Creary of West Indies Glass. His company produces 30,000 tons of glass bottles annually. They already purchase bottles from the scavengers at the dump in Kingston and would be interested in purchasing green, brown and clear bottle glass as raw material. They currently use recycled glass from on and off shore for production. Raw material, in the form of silica sand, is shipped from the Black River region, 120 miles from the plant. They also buy raw material from offshore markets for up to $US 175/ton and are willing to pay up to $US 30/ton for recyclable bottle glass. Mr. Creary indicated his company is developing a program to introduce glass recycling into schools in an effort to develop an expanded supply of raw materials.

c. An interview with the Managing Director of the West Indies Paper Company indicates there might be a market for recycled paper. This is a difficult market because currently there are over 40 grades of paper recognized by the scrap paper market and usable in various recycling applications. As West Indies Paper produces primarily tissue paper not all grades would be acceptable for their application. The company is currently hampered by lack of adequate de-inking and bleaching equipment to handle most grades of scrap paper. However, with proper equipment it would appear they could add 500 tons per month to their production with the use of recycled paper. They indicate that they would pay up to $US 100/ton for delivered clean waste paper of the type usable in their process. They are currently utilizing 400 tons of waste in their process: computer paper, envelope clippings and white ledger, which is imported and could be replaced by domestic product if it were available. It would appear there is a potential for up to 900 tons of domestic scrap paper a month to be utilized by this facility if it were available.

d. A cursory review of the scrap steel market was also undertaken. Presently, there are no large volume users of scrap steel on the island. The scrap steel which is collected is used locally by small manufacturers. No local companies are engaged in the collection and exportation of scrap steel. The

amount of scrap metal disposed at the Retirement Dump and the lack of activity on the part of the scavengers to recover it strongly indicates that there is little market in the Montego Bay area for the material.

d. According to the Carib Steel Company in Kingston, which used to manufacture steel, a major disincentive to the local production of steel is the low duty charged on imported finished products (5%) and the duty charged for raw ferrous metal materials (20%). Because the duty on finished products is low, it is unlikely that even a total exemption from duty on raw materials would make local steel manufacturing economically competitive with imported steel.

123. While it appears possible, based on these interviews, that good markets for glass, plastic and paper might be available in the context of Jamaica as a market place the problem for the Montego Bay area would be transporting the collected material to the end user. As there is no viable rail system in place material would have to be transported either by road or by boat to end users around the island. The cost effectiveness of the material when transportation costs are added might make markets questionable.

124. In the context of Montego Bay itself, there are no immediate markets for any material that is not currently being recycled. Given the scarcity of financial resources to provide basic collection and disposal services it does not make good economic sense to utilize available resources to subsidize a recycling program. There appears to be no immediate lack of landfill capacity which would financially offset a costly recycling program and thus lack of disposal space is not a primary criteria. Again, a recycling program should be included as a long term strategy in an integrated solid waste management plan. The concept should be reviewed, as an alternative, when disposal costs rise significantly, as a result of new legislation, and make recycling and transport of material to distant users a financially viable alternative.

COMPOSTING.

125. In all countries, some of the solid wastes generated within urban areas are technically and environmentally suitable for purposes of producing compost. In LDC's, the waste is higher in putrescible vegetable material, higher in moisture, lower in non-compostable materials such as paper, plastic, metal, and glass, and lower in hazardous elements such as heavy metals and pesticides than the waste in industrialized countries (IC's). For a comparative perspective on the greater amenability of wastes from LDC's to be composted, see Table 6, Box 8.

126. There is no doubt that a large portion of the solid waste in GMB could be converted into a compost of high quality or that farmers in the surrounding area would welcome receipt of high quality compost -- particularly food wastes from restaurants, hotels, and markets. However, this fact alone does not provide justification for implementing compost.

127. Composting Costs. Sanitary landfill is the lowest cost disposal option in all LDC's, except where land acquisition costs (including resettlement costs) are inordinately high within a site-specific area of an LDC. Composting costs are usually more expensive than sanitary landfilling by a factor of 2 to 3 in LDC's, as indicated in Table 7, Box 9. For purposes of this study, the cost of upgrading Retirement to a modified sanitary landfill in GMB would be $US 3 to 5/tonne, while the cost of implementing a new sanitary landfill for GMB would be $US 5 to 10/tonne. On the other hand, the cost of composting would be $US 10 to 20/tonne (depending on the level of mechanization utilized to speed up the process). At a composting cost of $US 10 to 20/tonne of refuse being composted, the cost of compost product would be $US 30 to 60/tonne because it takes roughly 3 tonnes of refuse to produce 1 tonne of compost.

GLOBAL PERSPECTIVE ON
REFUSE DIFFERENCES

	LOW INCOME COUNTRY	MIDDLE INCOME COUNTRY	HIGH INCOME COUNTRY
KG/CAPITA/DAY	0.4 to 0.6	0.5 to 0.9	0.7 to 1.8
PUTRESCIBLES %	40 to 85	20 to 65	20 to 50
PAPER %	1 to 10	15 to 40	15 to 40
PLASTIC %	1 to 5	2 to 6	2 to 10
METAL %	1 to 5	1 to 5	3 to 13
GLASS %	1 to 10	1 to 10	4 to 10
RUBBER,MISC.%	1 to 5	1 to 5	2 to 10
FINES %	15 to 60	15 to 50	5 to 20
MOISTURE %	40 to 80	40 to 60	20 to 30
DENSITY KG/C.M.	250 to 500	170 to 330	100 to 170
LOWER KCAL/KG	800 to 1100	1000 to 1700*	1500 to 2700

* Normal range is 1000 to 1300, except in some central and eastern European countries where the range is 1400 to 1700 kcal/kg.

BOX 8

DISPOSAL COSTS BY ALTERNATIVE TECHNOLOGIES

	LOW INCOME COUNTRY	MIDDLE INCOME COUNTRY	HIGH INCOME COUNTRY
AVE. INCOME FROM GNP	370 $/cap/yr	2,400 $/cap/yr	22,000 $/cap/yr
OPEN DUMPING	0.5-2 $/m.t	1-3 $/m.t.	5-10 $/m.t.
SANITARY LANDFILL COST	1-5 $/m.t.	3-10 $/m.t.	20-50 $/m.t.
TIDAL LAND RECLAMATION	3-15 $/m.t.	10-40 $/m.t.	30-100 $/m.t.
COMPOSTING	5-20 $/m.t.	10-40 $/m.t.	20-60 $/m.t.
INCINERATION	40-60 $/m.t.	30-80 $/m.t.	70-100 $/m.t.

Note:

1. Income based on 1992 Gross National Product data from the 1994 World Development Report published by the World Bank. Costs are estimated from 1992 information.

2. Composting costs in 1990 in Delhi, India and Bandung, Indonesia, by labor intensive systems of lowest costs were about 7 $/m.t. Composting costs in Bangkok, Thailand for a slightly more mechanized system are about 36 $/m.t.

3. Incineration costs in 1992 in Surabaya, Indonesia (without pollution control) were about 43 $/m.t., for refuse at a calorific value of 1100 kcal/kg at the source and 1200 kcal/kg after 5 days of drying in the pit. Fuel must be added daily, even during the dry season and even after 5 days drying in the pit, in order to sustain combustion.

4. Incineration costs in 1992 in Japan were about 90 $/m.t., for refuse at a calorific value of 1600 kcal/kg at the source and 2000 kcal/kg after source segregation of dry wastes. No fuel is required as the refuse is well above the 1300 kcal/kg minimum year-round to sustain combustion.

5. $/m.t means US Dollars per metric tone, and $/cap/yr means US Dollars per capita per year.

BOX 9

128. Only if the cost differential between composting and sanitary landfilling can be covered by the sale of compost would it be appropriate for composting to be implemented. The key question to be answered is whether the demand for compost exists or can readily be developed, and whether the prospective compost purchasers have adequate income or access to financing to cover the cost differential for composting.

129. Agricultural Markets. As indicated in Table 8, a high portion of the farm land in Jamaica produces extensive (i.e., low revenue) crops. The revenues from extensive crops generally would not be adequate to significantly create a market demand for compost. Major extensive crops include sugar cane, root crops, and maize. However, there are also intensive (i.e., high revenue) crops such as tomatoes, bananas, coffee and flowers. Whether the revenues from these intensive crops are sufficiently high to enable farmers to invest in compost needs to be explored in some detail. It also needs to be explored whether these crops exist within an economic transport distance (i.e., about 50 km by road) from the GMB. However, to illustrate the potential, farmers growing bananas have a gross revenue of $JA 120,000/hectare, while its $JA 125,000/hectare for coffee, and $JA 300,000/hectare for vegetables. The net revenue is expected to be about 25% of gross revenue, based on local agricultural extension service experience. The coffee and banana farmers are not generally operating at a subsistence level and are expected to be able to reinvest in their land for improved production yield and higher quality fruits. On the other hand, most of the vegetable farms are operating at a subsistence level because of the high fertilization requirement of their crops, and ability to reinvest would be limited.

130. If we look at compost costs in terms of whether they fall within the current investment levels made by farmers, we can see that the potential for selling the product at a price which covers cost does exist -- so long as transportation costs are minimal. The closest agricultural areas providing a potential market for compost are Cambridge and Catadupa, where bananas, coffee, and cocoa are grown.

131. Most farmers producing intensive crops now spend about 8,000 $JA/hectare on chemical fertilizer. According to rural agricultural experts in the GMB area, local application rates for compost are 3 to 10 tonnes/hectare at establishment (i.e., during the initial planting year for coffee and banana) or about 3 tonnes/hectare for maintenance (i.e., for vegetables and flowers). For an application rate of only 3 tonnes/hectare, the compost cost would be $JA 2,700-5,400/hectare (plus transportation costs which can be substantial because compost is bulky and 1 tonne takes up 3-4 cubic meters of truck capacity). Because compost could conceivably reduce the farmers dependence on chemical fertilizer (by complexing and adsorbing the chemical nutrients so that they

are more available over a longer period of time), a $JA 4,000/hectare reduction in costs for chemical fertilizer would nearly compensate for the costs of adding compost.

132. The product which would compete with compost as a soil conditioner is manure from animals or poultry. Poultry farming is the major supplier of manure in Jamaica. There are two poultry processing plants located on the South Coast of Jamaica, and related poultry farms are near. No poultry farms are within the GMB area. Currently, coffee farms provide a demand for poultry manure and within St. Catherine Parish poultry manure is priced at $JA 280 to 300/ton (or $JA 309 to 331/tonne). Therefore, manure is priced much lower than the cost of compost would be.

133. Land Reclamation Markets. From 1957 to 1974, Jamaica was the world's largest producer of bauxite. While Jamaica's position as the world's leading has been lost to Australia and Guinea, Jamaica still has a significant production of bauxite. Bauxite is removed from the ground through open strip mining. Upon completion of mining, the land is reclaimed by return of the original top soil material and then planted with crops or trees. Land reclamation activities provide one potential market for compost. In 1992, bauxite accounted for roughly 85 percent of the mining in Jamaica, at 11,367,000 tonnes mined. Country-wide, bauxite mining companies reclaim about 100 hectares annually, according to the Jamaica Bauxite Institute, and reclamation costs average US$ 11,115/hectare.

134. Currently most reclaimed lands are seeded for purposes of providing pasture land for cattle raising. Application of 10 tonnes/hectare initially would be needed to substantially alter the ability of these lands to support agriculture of potentially higher revenue potential, followed by maintenance applications of about 3 tonnes/hectare. If 10 tonnes/hectare of compost were applied, the 9,000-18,000 $JA/hectare costs would add about 4% to reclamation costs. For 100 hectares of reclamation annually, a potential market for initial compost application would be about 1,000 tonnes/year.

135. Unfortunately, the closest bauxite mining area to GMB is about 90 miles away, southeast, at Kirkvine in Manchester Parish. There are bauxite reserves at Maggotty St. Elizabeth Parish, about 40 miles inland. However the mining rights to these lands were held by the Revere Alumina Company which ceased operations in 1974. Mining rights to these areas have not been reissued and there are no immediate plans to commence bauxite mining in the area in the near future.

136. Transport costs would be about $JA 16/tonne/mile for trucking. Because compost is bulky (one tonne occupies about 3 cubic meters), transportation costs by road to Kirkvine could negate the viability of selling compost for land reclamation.

Table 8

PRODUCTION OF SELECTED AGRICULTURAL COMMODITIES, 1990 - 1992

COMMODITY	Unit	QUANTITY		
		1990	1991	1992
Sugar Cane	'000 tonnes	2,613	2,775	2,602
Bananas	metric tonnes	57,055	58,191	65,258
Plantains	metric tonnes	27,568	26,692	28,469
Citrus	'000 boxes	5,223	2,[illegible]75	2,602
Coconuts	'000 nuts	77,694	96,324	114,297
Cocoa	boxes	197,722	187,331	256,823
Coffee	boxes	263,546	347,448	350,000
Pimento	metric tonnes	1,583	458	487
Ginger	metric tonnes	865	827	761
Root Crops(1)	metric tonnes	235,677	247,216	292,141
Corn	metric tonnes	2,370	2,929	3,850
Peanuts	metric tonnes	1,861	2,386	4,109
Pumpkins	metric tonnes	26,247	26,237	34,187
Carrot	metric tonnes	15,530	15,225	18,819
Cabbage	metric tonnes	17,336	14,999	14,886
Turnips	metric tonnes	1,104	864	1,662
Peas and Beans	metric tonnes	8,164	9,115	6,670
Cucumber	metric tonnes	8,115	6,885	9,137
Okras	metric tonnes	1,255	1,177	1,855
Eggplant	metric tonnes	80	61	209
Escallion	metric tonnes	4,211	2,645	6,981
Thyme	metric tonnes	353	396	839
Tomatoes	metric tonnes	14,261	10,936	14,068
Lettuce	metric tonnes	2,355	3,379	3,873
Cho-cho	metric tonnes	4,726	3,493	3,565
Cauliflower	metric tonnes	551	399	494
Peppers	metric tonnes	4,551	5,146	8,197
Beetroot	metric tonnes	875	631	967
Watermelon	metric tonnes	6,080	4,787	8,103
Celery	metric tonnes	115	78	118

Source: Production Statistics, Statistical Institute of Jamaica

(1) Includes Sweet potatoes, Irish potatoes, Yams, Tannias, Onions, Cassava and Rice

Theoretically, it might be economic to transport compost by rail. The use of rail to transport compost from GMB will ultimately depend on the pricing policies established by the future owners/operators of the railway system. Presently, the Jamaica Railway Corporation is not offering rail services to the public and the corporate holdings are being divested by GOJ. To date, no offer has been accepted by the GOJ and the outcome of the divestiture can not be predicted.

ENERGY RECOVERY.

137. Could GMB's Waste Support Combustion. As indicated in Table 6, solid waste needs to have a Lower Heating Value (i.e., wet value, as received) of at least 1300 kcal/kg year-round in order to sustain combustion. If incoming solid waste is less than this calorific value, supplemental fuel will be required to maintain minimum furnace temperatures. Municipal solid waste in Jamaica would not meet this 1300 kcal/kg level, and would likely range from 900 to 1100 kcal/kg during most months of the year. Only with addition of an adequate quantity of hotel refuse and cruise ship refuse might attainment of the 1300 kcal/kg level be possible.

138. For GMB, as indicated in Annex A, the quantity of municipal solid waste from the local resident population of about 105,000 is estimated as 22,862 tonnes/year, and for the nonresident working population of about 25,000 is about 2,740 tonnes/year. The quantity of hotel refuse and cruise ship refuse are estimated, respectively, as 4,160 tonnes/year and 2,040 tonnes/year. Not all of the ship refuse is off-loaded at GMB, because only "home port" ships are provided with regular disposal service. The composition of the municipal refuse would have a moisture content of about 70%, a vegetable content of about 50%, and a calorific lower heating value of about 1,000 kcal/kg. On the other hand, the composition of the hotel and cruise ship refuse would have a moisture content of about 25%, a vegetable content of about 30%, and a calorific lower heating value of about 1,800 kcal/kg. Given that a calorific value of at least 1,300 kcal/kg is needed year-round to support combustion without fuel addition, it is not likely that the resulting mixture, which would be more than 80% municipal refuse, would be able to self-sustain combustion.

139. Incineration of Ship Vessel Waste. The International Convention for the Prevention of Pollution from Ships, 1973 and its subsequent modification by the Protocol of 1978 are together known as MARPOL 73/78. For countries signing MARPOL 73/78, Annex 1 and II are mandatory provisions on pollution control of oil and noxious liquids. Annex III, IV and V which deal in turn with packaged harmful substances, sewage, and garbage are optional provisions which a country, when signing MARPOL 73/78 may either accept or reject to comply with. In Annex V it is specified where and how ships are allowed to discharge their solid wastes at sea and port. Annex V requires ports to provide facilities for receipt of discharged wastes. Port reception facilities are to be implemented in the Caribbean with the financial assistance of the World Bank.

140. As noted above, ship refuse is likely to have a calorific lower heating value of about 1,800 kcal/kg, which would enable self-sustained combustion. If the port would like to offload more than home-port ship refuse, it could work with the private sector through a build, own, operate type of concession contract to build

a dedicated incinerator. The Port now offloads about 70 tonnes/week or 10 tonnes/day of refuse from home-port vessels. To achieve economies-of-scale in incineration, about 250 tonnes/day would be required for a waste-to-energy plant as typically used by cities in industrial countries for municipal refuse. However, there are package plants available of the type used for burning medical waste, and these are available to handle loads of 1 tonne/hour and can be operated on a batch or continuous basis.

141. Land Capacity Requirements of Incineration. From a technical standpoint it is important to note that both combustion processes ultimately require a landfill for disposal of ash. The volume of landfill required for ash is about 10% of the initial volume of refuse when it enters the site, and about 30% of the final volume of refuse after it has consolidated and naturally biodegraded. Ash from combustion processes generally consists of concentrated residual metals which must be landfilled in such a manner as to insure the absolute minimum possibility of groundwater contamination.

142. The combustion technologies themselves, as discussed below, are extremely expensive. Also, the landfills required to dispose of ash residual material are at the upper end of the landfill developmental cost spectrum, because of the special need to contain the heavy metals which have been rendered potentially more soluble by the combustion process.

143. Costs of Incineration. For self-sustained incineration with appropriate pollution control measures incorporated, the costs from around the world indicate the cost would be between $US 30-60/tonne of refuse at Jamaica's labor rates. It is common for waste-to-energy, straight incineration, and refuse derived fuel technologies to be costly compared to landfill -- typically 5 to 15 times more costly per tonne of refuse processed than sanitary landfill. Only under special conditions, are such technologies chosen to limit the need for land disposal capacity, when the appropriate technical and economic conditions exist. They are recommendable only when land disposal sites are unavailable because of environmental constraints or uneconomic because of land acquisition and development costs. Because transfer costs coupled with sanitary landfill costs are typically much lower than the costs of these combustion technologies, as indicated in Tables 1 and 7, only when distances to environmentally acceptable sites are greater than a couple of hundred miles does combustion begin to appear economic.

144. Based on our analysis for GMB, a waste-to-energy facility, which could manage the 80 tonnes/day waste disposal rate, and the lined landfill required for disposal of residual ash could not be constructed for under $US 30 million. This number does not talk to the issue that qualified personnel would have to be contracted to manage the facility and operating costs would be

relatively high because of the need to purchase fuel to sustain combustion. Assuming a $US 30 million capitalization cost amortized over 25 years and a minimal $US 200,000/year operating budget the current 25,040 tonnes generated would cost $US 56/tonne for disposal. Financially, a system that currently costs less than $US 1/tonne could not make this type of leap in the near term. Making the smaller step to upgrading the existing dump site to a controlled landfill is preferred, both environmentally and economically, in our best professional judgement.

HAZARDOUS WASTES.

145. Management and disposal of hazardous waste is recognized as a serious issue internationally. The long term negative impacts of improper hazardous waste management are painfully visible in the industrialized countries of the world. Governments are struggling to put together meaningful hazardous waste management programs which address identification of generators, current and past disposal practices, storage, transport, and remediation programs.

146. Ultimate management of hazardous waste mandates that a national program be in place which provides guidance for the local jurisdictions such as GMB to follow. The document "Procedures and Requirements for Permitting and Operation of Waste disposal Facilities" talks to the issue of disposal of hazardous waste, and represents a good first step for Jamaica and developing a national program. This document and the definition provided are limited in scope and do not allow for the disposal of normal household corrosives, household reactive substances, household ignitable substances or household toxic substances. This document does not require any clear plan to determine industrial and commercial users of hazardous waste nor does it address any alternatives to disposal of the waste. It would be appropriate for a national policy to be outlined to address these issues.

147. Any near term strategy GMB can pursue will of necessity be limited by available resources. However, it might be useful to deal with this topic in terms of what must be accomplished and then provide selection of strategies which can be implemented as funds become available. As with any other program it is first useful to answer the question "What is the scope of the problem?". Governments throughout the world are still struggling with the question of what concentration of a certain waste makes it hazardous. A perfect example of this occurs in the United States where the Resource Conservation and Recovery Act (RCRA) clearly defines hazardous wastes and prohibits their deposit in sanitary landfills. Sulfuric acid is by anyone's definition a hazardous waste. However, a homeowner, who uses sulfuric acid for pool cleaning, may dispose of it in the municipal waste stream as an unregulated household hazardous material.

148. The first question to be answered in GMB is "Which agency locally will have hazardous waste management as a programmatic responsibility?". Since no municipal agency is trained to manage the problem and has clearly delineated responsibility, municipal government must make the call as to what municipal agency will manage hazardous waste or whether management will be contracted to an outside firm. Once responsibility has been determined then a hazardous waste management policy should be written. This policy should research the following areas:

a. What should be considered hazardous waste in the context of GMB? Certain areas concerned with the shipping industry certainly have the potentially for the use and disposal of large amounts of hazardous waste. The airport would be another location where large amounts of hazardous wastes would be utilized. Any industry which utilizes quantities of acid, such as automobile battery recyclers, would be a source of hazardous waste. Establishments which are in the clothes cleaning business utilize hazardous materials in their operations.

b. Once known generators of hazardous materials are determined, the next step would be to determine where this material is currently being taken for disposal. Exact quantities of material being utilized and disposed of should be recorded.

c. Another critical issue "Who determines whether discharge of a given material is a hazardous waste incident?" and "What agency or agencies respond to an onsite incident?"

149. Given the scope of the problem the following issues should be addressed as part of a hazardous waste management policy:

a. Fundamental to success will be a disposal strategy. An environmentally safe disposal alternative for the various wastes identified and a legal method to enforce the disposal methods utilization is critical. No hazardous waste management program will be successful without an adequate disposal methodology.

b. For inclusion in the near-term solution and fundamental in the long-term will be an inventory program. All generators of hazardous waste must keep records of generation rates, on site storage amounts and amounts disposed of to include disposal location. Periodic reporting of this information enhances control of disposal and facilitates long term planning.

c. Another long term programmatic requirement, which might be waived in the near term due to funding constraints, would be a transportation management program. Transportation of hazardous material always represents a danger. Placing and enforcing safety restrictions, manifesting loads, managing routes, etc., are areas which require close scrutiny. At a minimum, a hazardous waste response

unit should be set up in the fire department to respond to hazardous waste incidents which occur during transport and given proper response techniques to address accidental spills and gaseous emissions of hazardous wastes.

d. An employee awareness program should be considered in the long term solution to hazardous waste management. Employers should be required to educate employees regarding the material they are working with to include any associated hazards related to contact and requirements for proper disposal.

e. A site inspection program should be considered as part of a long term hazardous waste management policy. This would include having hazardous waste generators, transporters and disposers submit a detailed management plan for their unique activity. Plans would then be reviewed and inspections conducted to insure compliance with both public policy and the individual activity's plan. Again, due to near term funding constraints this type of activity might be waived in the near term.

f. Working with businesses to develop alternatives for processes which generate hazardous waste would again be a long term goal. Costs to businesses for major changes to industrial processes might make this a hard sell. Ultimately this hazardous waste management tool might require national legislation to implement since it can change the position of a business within it's industry sector.

g. A program which identifies and manages household hazardous wastes such as chemical cleaners, fertilizers, weed killers, etc., should also be considered as part of the long term solution.

150. The above constitutes a brief overview of some of the key issues involved in a hazardous waste management program for GMB. It does not delve into any topic in depth. Based on the information provided above it should be clear that the management of hazardous materials requires direction and policy intervention at the national level. A program for GMB should be implemented in the context of the unique character of the hazardous material generated by the businesses and public agencies within the Montego Bay area. Within the IDB study a generic hazardous waste management plan for the island should be conducted. This should include the structure for local implementation of policy, regional and local disposal options, and should address both near and long term strategies based on known funding levels.

HOSPITAL WASTES.

151. According to dump attendant and inspectors engaged with the WP&M, most hospital and clinic wastes of a potentially pathogenic nature are disposed of through burning at Cornwall Hospital, the largest hospital within the GMB area. To investigate further, a review of the Cornwall Regional Hospital (CRH) was conducted as part of this study effort. The CRH is a multistory medical complex serving St. James and other parishes in the western section of the Island. The present capacity was given as being about one hundred and fifty. The complex includes four residence blocks for students and staff.

152. Solid waste management at CRH is the responsibility of the hospitals' Sanitation Dept. The staffing in this department is eighteen, nine of which are temporary. Removal of waste containers from the various sections of the hospital is carried out by staff from the Sanitation Department. Most potentially infectious/hazardous waste is separately stored and collected by the Sanitation Department.

153. The greater part of potentially infectious/hazardous waste is generated by the following sections:

- Laboratory
- Cytology unit
- Blood Bank unit
- HIV Department
- Hematology unit
- General Stores
- Morgue
- Wards

154. With the exception of the general stores, potentially hazardous waste produced by the sections listed above consists of sharps, bloodied waste, tissue, and organs. The general stores is presently holding a number of items of hazardous and nonhazardous chemicals which are to be discarded. Some of these articles have lost their labels thus making the selection of a disposal method complicated. The corrosivity of some theses chemicals were readily evident as sections of metal shelving were reduced to rust.

155. When the CRH was built approximately sixteen years ago, it included facilities for the disposal of all solid waste generated on site. This included a diesel fired incinerator, and garbage disposal units for the kitchen. Presently, the main components of the solid waste management system at CRH are an internal collection/sorting system, burning and/or burying of infectious/hazardous waste on the hospital compound, and contractual arrangements for nonhazardous waste with Western Parks And Markets (WP&M).

156. Sharps such as needles and blades are placed in special containers by medical personnel and collected by staff from the Sanitation Department. These are kept separate from other wastes and disposed of in a hole on the hospital compound. After placing in the hole gas oil is used to start a fire with the intention of "killing" any harmful microbes attached to these articles. When these holes are filled, they are covered, and another site selected. While not ideal, this practice is environmentally adequate and much preferred to disposal at the Retirement Dump.

157. The design of the CRH included an incinerator fired by diesel fuel. At the time of the field efforts under this study, this system was in need of repairs and being repaired as a part of the general refurbishing being carried out at the hospital. It was functioning well below standard, and required an inordinately long time to achieve complete combustion. In addition it required manual assistance to keep turning over refuse, and was not fuel efficient. By June 1994, Local Reviewers of this study commented that the incinerator had been repaired and was operating effectively. Residue from the incinerator is disposed of by burying on the compound.

158. Contractual arrangements exist with the WP&M for the removal of solid waste from two ramps on the compound. The contractual arrangements stipulate the collection of waste three times weekly but twice weekly collection sometimes occur. One ramp serves the hospital while the other serves the residence blocks. The hospital ramp is approximately 3m X 3m X 1.5m. The ramp serving the residence blocks is approximately 2m X 2m X 1m. Both ramps appeared to be undersized, and easily accessible to stray animals as there were no doors to secure the facility. This results in the overflowing of the ramps and scattering of refuse. It was observed that a disposal truck which was in operation required approximately forty-five minutes to collect all material from the ramp.

159. Based on discussion with staff, it is not improbable for contaminated gauze from the Blood Bank unit to get mixed with waste going to the ramps and ultimately taken to the Retirement dump. Plastic bags containing tainted blood samples are kept in a separate bag in a designated area in the unit from which they are collected by the Sanitation Department and burnt.

160. Plastic test tubes from the HIV Department which contain blood samples are autoclaved and their contents discarded to the drain which is linked to the main sewer. The used, and sterilized plastic containers used, are discarded together with other solid waste which is mainly packaging material, and occasionally, glass containers.

161. Petri dishes used by the microbiology laboratory for the culture of microorganisms, are kept separate by laboratory staff in

a designated area, and burned along with other potentially infectious waste.

162. The various tissue from the cytology department are placed in containers and taken by the Sanitation personnel for incineration.

163. The stores produces mainly packaging waste, but some amount of hazardous substances are generated mainly in the form of expired chemicals, in particular, corrosive and toxic materials. The labels on some of these chemicals have been attacked thus masking their chemical identity. Some characterization of these will be required to enable safe disposal. Presently, these material are disposed of by burying on the grounds of the hospital.

164. Though the hospitals kitchen facilities were built with garbage disposal units which discharged to the sewer none of these have been operating for some time. As a result refuse from the kitchen accounts for a significant portion of the solid waste going to the main ramp.

165. A significant portion of glass and plastic containers are recycled by the pharmaceutical department for the dispensing of medication. However substantial amounts of unwanted two litre bottles are produced. Recycling is also carried out to a limited extent by the general stores which finds a ready market for large metal drums, while returning large plastic drums to the suppliers of chemical stock. Staff in the pharmaceutical Department believe that a greater level of bottle recycling could be achieved particularly with respect to the reuse of saline bottles.

166. The operation is relatively effective in terms of keeping potentially infectious waste separated from relatively harmless material. The present system could benefit from some refinements, such as the following:

- The use of color coded disposal bags to segregate general hospital refuse from infectious medical waste as a further precaution against mixing of wastes.
- The use of special containers which are puncture-proof to store sharps and broken glass.
- Separate special containers to store low-level radioactive wastes until they decay to an acceptable level which would allow handling and burial.
- The restoration of the incinerator in order to serve the needs of the hospital as well as possibly providing a service to private medical facilities in the region.

- The construction of larger garbage ramps, and the securing of these from stray animals.

- The placement of additional litter containers at key positions on the hospital compound.

RECOMMENDATIONS

167. At the time of this study, which was November 1993 to April 1994, the existing charter of WP&M was inappropriate and the entire legal and institutional arrangement for solid waste management at the regional/local level needed to be resolved. There were three choices recommended as part of the draft report in April 1994. In the true spirit of decentralization of responsibility and authority for solid waste management, the decision on which choice to pursue was recommended to involve the PC's.

First Choice: The PC's could be assisted to form their own institutional arrangement for solid waste management. They could be free to arrange for it to be a department of parish government or a semi-private enterprise to serve the parish.

Second Choice: The PC's could be assisted to form a multi-parish institutional arrangement to serve 2 or more parishes, not necessarily along the lines of the current region served by the WP&M.

Third Choice: The WP&M could be rechartered to put the shares of the company into the hands of government, because government is providing its financial support. It is recommended that the PC's be empowered to appoint the rechartered WP&M's Board of Directors, the MOLGYS have representation on the Board, and that the structure of the Board include the heads of each PC being served by the WP&M.

168. All of the recommendations in this report are contingent upon resolution of WP&M's charter and development of a solid waste entity which would be free of legal and ethical conflict and which would be legally accountable to the MOLGYS and the PC's it serves. Without resolution of the WP&M's charter, it is not recommended that further budgetary support, technical assistance, or capital investment be provided to the WP&M. As of June 1994, the MOLGYS and PC's had begun the process of addressing the WP&M charter. The shareholders had willingly agreed to transfer their shares to government and to fully support the rechartering activities through super-majority vote.

169. The new solid waste entity needs to become financially self-sustaining over time and a program for revenue generation needs to be implemented which allows cost recovery to be fully realized within a 5 to 10 year period. A fee structure for service of households needs to be put into place which is based upon willingness and ability to pay. Fee structures are typically based upon the size of property owned for households, rather than on estimated waste quantities discharged, and enable some cross-subsidy from larger wealthier property owners to smaller poor property owners. In GMB, with the significant tourism activity,

the commercial sector should clearly bear a major share of the financial burden. Large generators should be charged refuse collection fees on the basis of each unit volume of waste discharged. General refuse from the ships should be accepted for disposal. Fees from the ports could provide the major source of revenues (through tipping fees collected at the disposal site) to upgrade the Retirement Dump Site to a controlled landfill initially (cut and cover operation) and then to a sanitary landfill in the expanded adjacent areas eventually.

170. The new solid waste entity should continue to use contractors for collection of at least half of the city's waste. A dynamic balance of service by the solid waste entity and its contractors provides the greatest opportunity for competition, if properly managed with competitive tenders, quantifiable outputs in the contract, and comparative performance monitoring. Also, appropriate involvement of the private sector through contract instruments which are at least the length of normal depreciation of assets (i.e., contracts of at least 5 years for collection and at least 10 years for transfer and disposal facilities) would enable cost-effective investment by the private sector -- thus saving on government investment in infrastructure.

171. Zoning for collection service areas should consider economies-of-scale and enable each contractor to use at least two trucks. With two trucks, if one breaks down there is still another to service the entire area during a second shift. Therefore, as a general rule, no zone should have less than 20,000 residents or less than 15 tonnes/day of refuse. For GMB, no less than three and no more than five zones are recommended. With the WP&M providing service in one zone, competitive forces would be enhanced.

172. The Retirement Dump Site is operated in an environmentally unacceptable manner and needs to be upgraded. This site is environmentally adequate for continued use and still has capacity to provide years of additional life. Therefore, upgrading the site to controlled landfill operations with daily soil cover to minimize leachate generation, fly production, odors and windblown litter are strongly recommended. No other method of disposal, including composting or incineration, can compete over the near-term with this alternative in providing cost-effective disposal.

173. For the long-term, it is recommended that a fraction (perhaps 20%) of the solid waste stream which is amenable to composting (such as market and restaurant waste) be separately handled at the source and separately collected for low-cost composting by the following steps: manual sorting by conveyor, trommel screening to remove oversized materials, windrow piling and turning weekly over a 5 week period to enable aerobic decomposition, static piling for another 4 week period to enable final stabilization, and vibration screening to produce a fine-grained salable product. Markets exist but would need to be

developed to support the compost operation. To minimize costs and enable flexibility of compost production, location of the compost facility adjacent to the Retirement Site would be ideal. In that way, the access road and some of the equipment used by Retirement could be shared by the compost operation.

174. There should be tipping fees paid, on a price/tonne delivered basis, by the solid waste entity and all contractors at the sanitary landfill and the compost plant. The tipping fees should be based upon the full cost of sanitary landfill. The fee structure could be differential so that higher fees are paid for loads from hotels, ports and other high-income commercial activities, to provide cross-subsidy for loads from residential areas. Disposal services rendered by the compost plant should be fully valued as equivalent to those rendered by the sanitary landfill. In that manner, the compost plant has a greater chance to become financially viable. It is likely that farmers in the region would be willing and able to pay only enough for compost to cover the cost differential between sanitary landfill costs and the typically higher costs of composting. It needs to be noted that one tonne of refuse typically makes about one-third tonne of compost, so that if the cost differential for composting is $JA 30/tonne of refuse, the price of the compost product would need to be $JA 90/tonne of compost.

175. Companies which compete on the open market to provide service directly to commercial establishments should be licensed by the PC's to provide service. They should be required to pay a license fee which is an estimated percentage of their next year's gross receipts. Each year, their gross receipts should be subject to audit as part of the licensing agreement and the next year's license fee correspondingly calculated. License fees can range from 5% to 50% of gross receipts and would provide a substantial revenue base for the solid waste management entity. With the income from this revenue, the solid waste entity would be able to properly provide performance and income audit functions. It is strongly recommended that these fees be placed in a special account available only to the solid waste entity, and not put into general local authority revenues for use on other infrastructure services.

176. Based on cost analysis done for this study for alternative collection systems, the container-lift (arm roll truck with roll-on/roll-off containers) system offers the lowest cost/tonne. Therefore, to the extent that this system can be utilized, it should. The container-lift system is appropriate for communal collection points, such as at the perimeter of inaccessible neighborhoods, for markets, hotels, apartment buildings, large institutions, and office buildings. Based on field observations, roughly 30% of GMB's waste could be collected by this system, which would mean implementation of 2 arm roll trucks able to lift containers of about 8 cubic meter capacity.

177. Based on the cost analysis done, rear-loading compaction trucks of about 10 cubic meter capacity are cost-effective. Therefore, the remaining 70% of GMB's waste could be collected by this system, which would mean implementation of 4 rear-end loaders. This system is economic for GMB when manually loaded from dustbins of about 100 litre size or with plastic bags. Purchase of large metal containers (of 1 cubic meter size or more) which would be mechanically lifted would negate the economies of the system for GMB.

178. There are markets locally for recyclable materials and implementation of source segregation programs at major waste generators, such as hotels, offices, schools, and commercial establishments, would enable the recovery of recyclables in a relatively clean and high quality condition. To encourage the market development locally, financial incentives should be granted to local manufacturers for implementation of facilities which enable greater utilization of secondary materials as feedstock. For example, financial incentives could be granted to paper companies to encourage them to invest in de-inking facilities in order to broaden the range of waste papers they could accept, or to steel scrap metal dealers to encourage them to invest in portable baling equipment so that a more exportable quality of steel scrap metal could be produced.

179. Hazardous waste management requires a national program of waste definition, manifest systems to enable source-to-grave tracking, and safe treatment and disposal. At the local level, commercial enterprises and manufacturers producing hazardous wastes need to be identified. At the central government level, there should be a public tender open to international waste management firms of high repute to build, own and operate a country-wide hazardous waste facility. Until there is a permitted environmentally acceptable disposal facility available within the country, nothing can be done at the local level to stop the discharge of hazardous wastes at municipal landfills. In the interim, hazardous wastes which do arrive at the site should be placed within a specially designated securely lined area for special burial, so that if an environmental impact from the hazardous wastes arises in the future the area requiring remediation will be confined.

ANNEX A

MONTEGO BAY GREATER METROPOLITAN AREA

JAMAICA

ANALYSIS OF SOLID WASTE COLLECTION EQUIPMENT

BASELINE DATA FOR PROJECTING WASTE QUANTITIES

A	B	C	D	E	F	G

GREATER MONTEGO BAY METROPOLITAN AREA (GMBM/ SOLID WASTE MANAGEMENT PLANNING STUDY 15-Jan-94

	COMMUNITY	AREA (hectares)	1982 POPULATION	1991 POPULATION	1991 DENSITY (pop./ha.)
11	Barracks Road	0.735	404	395	537.4
12	Long Acres	2.952	1252	1078	365.2
13	Whitehouse/Airport	299.548	431	459	1.5
14	Railway Lane	43.348	2324	1828	42.2
15	Newtown	12.761	1567	1275	99.9
16	Jackson Town	55.737	2549	2001	35.9
17	Barrett Town/Lilliput	1360.126	2425	2443	1.8
18	Belmont	701.577	2029	2414	3.4
19	Bogue/Reading	553.873	1764	2206	4.0
20	Bellfield	828.981	1446	1213	1.5
21	Brandon Hill	296.261	2391	1760	5.9
22	Mount Sallem/Barnett View	97.31	7670	7767	79.8
23	Canterbury/Howard Hill	15.737	2232	2626	166.9
24	Cartegena/Pitfour/				
25	Granville/Retirement	1007.695	8905	10277	10.2
26	Shipping/Industrial Zone	273.279	42	1060	3.9
27	Catherine Hall	125.417	818	1130	9.0
28	Catherine Mount	126.232	541	1050	8.3
29	Farm Heights/Villa	102.009	1134	1903	18.7
30	Ironshore/Providence	113.609	604	625	5.5
31	Tucker/Irwin	608.057	3060	3485	5.7
32	Red Hills/Mango Walk	247.719	2086	2137	8.6
33	Montego Hills/Heights	146.175	1443	1713	11.7
34	Sign/Orange	680.735	1160	1915	2.8
35	Infirmary Lands	45.93	728	1039	22.6
36	Paradise/Albion	99.572	2190	2783	27.9
37	Rosemount/Rose Hgts/Quarry	172.159	4840	6558	38.1
38	Salt Spring/Green Pond	594.178	2990	3709	6.2
39	Bottom Salt Spring	40.144	2856	4187	104.3
40	Old Norwood	111.819	3578	2624	23.5
41	New Norwood	70.098	1519	3671	52.4
42	Porto Bello/Irwin	4654.788	1157	2053	0.4
43	Rose Hall/Spring Farm	1095.436	320	606	0.6
44	Bottom Pen	63.175	1125	1361	21.5
45	Glendevon	71.184	6397	6587	92.5
46	Flanker	171.535	1909	3736	21.8
47	Unity Hall	546.037	288	370	0.7
48	Rose Hill/Greenwood	477.385	492	1394	2.9
49	Flower Hill/Coral Gardens/				
50	Torado Hgts	493.906	1621	1727	3.5
51	Commercial Resort Strip	96.076	538	198	2.1
52	Southern Mo-Bay/Fairfield	584.003	1146	1088	1.9
53	Bivston/Palmyra	1040.543	1388	1489	1.4
54	Irvali	1561.249	506	460	0.3
55					
56	GMBMA (total)	19689.092	83865	98400	5.0
57					

Note GMBMA's population is considered to be 60% urban, 20% semi-urban and 20% suburban according to the Montegro Bay Redevelopment Authority's planning studies
The nonresident worker population (or daily migrant population) into GMBMA works largely in the downtown Montego Bay commercial zone The downtown area has an daily working population of over 76,000

A	B	C	D	E	F	G	H
		GREATER MONTEGO BAY METROPOLITAN AREA (GMBMA) SOLID WASTE MANAGEMENT PLANNING STUDY				16 - Jan - 94	
		1993 POPULATION	1993 DENSITY (pop./ha.)	2000 POPULATION	2000 DENSITY (pop./ha.)	1993 BED NIGHTS	2000 BED NIGHTS
76	GMBMA	104393	5.3	128390	6.5	3[illegible]00000	3584000
77							
78							
79		1993	2000	1993	2000	1993	2000
80		NONRESIDENT	NONRESIDENT	SHIP PASSGR	SHIP PASSGR	SHIP PASSGR	SHIP PASSGR
81		WORKER DAYS	WORKER DAYS	DAYS IN PORT	DAYS IN PORT	DAYS TOTAL	DAYS TOTAL
82							
83							
84	GMBMA	25000	30747	224200	269040	1569400	1883280

Notes

a) Population and area information from the Montegro Bay Redevelopment Authority
b) Hotel information from the Jamaica Tourism Board
c) Projections based on the Greater Montego Bay Redevelopment Plan, 1992 - 3
d) Projected population assumes a growth rate of 3%/year
e) Ship passenger days assumes 950 passengers per ship based on 1992 port data
f) Bed nights includes hotels, villas, hostels, of which about 50% are hotel bed nights. about 50% are hotel bed nights
g) Bed night occupancy is expected to grow about 12% over the period of 1993 to 2000, based on a growth rate of 8.7% from 1987 to 1991
h) No data was available to project an increase in cruise ship passengers, but based on past trends an assumption of 20% growth between 1993 and 2000 was used.
i) Waste generation by the ocean going vessels needs to include the time at sea which is assumed to be about 7 total passenger days for every passenger day in port
j) No data was available to project the change in nonresident worker days, and a growth rate of 3% was assumed from 1993 to 2000

A	B	C	D	E	F	G

GREATER MONTEGO BAY METROPOLITAN AREA (GMBM/ 15-Jan-94
SOLID WASTE MANAGEMENT PLANNING STUDY

		1993 RESIDENT GENERAL REFUSE	1993 NONRESIDENT GENERAL REFUSE	1993 HOTEL REFUSE	1993 SHIP REFUSE	1993 TOTAL
118	GMBMA -- tonnes/year	22,862	2,738	4,160	2,040	31,800
119	% of total	71.89%	8.61%	13.08%	6.42%	
120						
121						
122						
123		2000 RESIDENT GENERAL REFUSE	2000 NONRESIDENT GENERAL REFUSE	2000 HOTEL REFUSE	2000 SHIP REFUSE	2000 TOTAL
124						
125						
126						
127						
128						
129	GMBMA -- tonnes/year	32,804	4,489	4,659	2,448	44,400
130	% of total	73.88%	10.11%	10.49%	5.51%	

NOTES

a) Waste generation rates based on data from countries of comparable income level and socio-economic conditions

A rate of 0.6 kg/capita/day is used for resident general refuse in 1993 and 0.7 kg/capita/day in 2000

A rate of 0.3 kg/capita/day is used for nonresident general refuse in 1993 and 0.4 kg/capita/day in 2000

A rate of 1.3 kg/capita/day is used for hotel general refuse in 1993 and 2000

A rate of 1.3 kg/capita/day is used for ship general refuse in 1993 and 2000

b) For ship general refuse, the total passenger days is used to estimate quantity (i.e., the number of passenger days in port multiplied by 7)

ANNEX B

MONTEGO BAY GREATER METROPOLITAN AREA

JAMAICA

ANALYSIS OF SOLID WASTE COLLECTION EQUIPMENT

PRIVATE SECTOR VERSUS PUBLIC SECTOR SERVICE COSTS

INTRODUCTION TO THE PUBLIC VERSUS PRIVATE COST ANALYSIS:

In the study area, there is no accurate view of what solid waste collection service would cost if all hidden costs within government were considered (i.e., opportunity cost of capital, economically determined renewal periods for equipment, exemption from customs duties, guarantees on borrowing and on equipment which allow avoidance of insurance costs, hidden administrative and benefit costs for personnel) and all legitimate costs for the private sector were considered (i.e., commercial borrowing interest rates, insurance costs, profit, economically determined depreciation and renewal periods, marketing).

It is essential to recognize that this analysis is preliminary and provided to indicate actual costs. Also, the analysis provides a format for future updated analysis as part of an annual continuous planning exercise which the study team recommends be conducted. In Montego Bay, there are no records kept at the disposal site or in the field to indicate the daily performance by the Western Parks and Markets and its contractors. Also, there have not been any time and motion studies performed over a significant time frame to determine how crews of various sizes on collection trucks of various types perform within the range of physical conditions existing in the area's various neighborhoods. And finally, there is no data on truck load weights to enable densities of loads to be definitively estimated.

To compensate for the above, interviews with public and private sector representatives were held to obtain an indication of productivity, several days of time and motion observations were conducted, and several days of observing operations at the disposal site were conducted. Much more needs to be done in any follow-on studies planned for the next year.

The costing tables provide analysis of the following:

- productivity per truck type and size for various transport distances from the collection route to the unloading point (e.g., disposal site) -- which indicates the important need for continuous data on load weights and time and motion.
- cost per tonne per truck type and size for various transport distances -- which indicates the truck systems which are lowest cost for the study area and the specific waste generation sources to be served.
- percentage breakdown of total cost into personnel costs, consumables costs, and ownership costs -- which enables choices to be made by decision makers between capital intensive or labor intensive systems.
- cost per capita per truck type and size for various transport distances -- which indicates the tariff requirements for full cost recovery.

WHAT ARE THE RESULTS OF THE ANALYSIS:

1. If private sector service is established in a way to encourage and enable the private sector to make investment (i.e., there are competitive tenders held for contracts of 5 or more years duration), the private sector costs will reflect no hidden subsidies which are inherent in the public sector costs. Based on the analyses accomplished, for capital intensive systems (i.e., container-lift arm roll, skip, or compaction trucks), private sector service will cost from 10-45% more per tonne than the subsidized public sector costs. For labor intensive systems (i.e., manually loaded open tippers or manually loaded compaction trucks), private sector service will cost from 5-20% more per tonne than the subsidized public sector costs.

2. Non-compaction container-lift systems, such as the arm roll or skip lift trucks, provide the lowest cost method of collection service for Montego Bay. However, they can be used only where there is a large source of waste generation, as the smallest container size would be 5 c.m. and costs go down appreciably when the required container size is higher at the source. Container lift systems should therefore be implemented for all large generators, such as markets, hospitals, inaccessible ghetto neighborhoods, and hotels.

3. Compaction systems which mechanically lift and unload containers at each stop along the route, such as front end loading compaction trucks which lift 5 c.m. containers and rear end loading compaction trucks which lift 1 c.m. containers, are the highest cost method of collection service for Montego Bay. In low-income developing countries, such large volume, capital intensive systems are justifiable only in large metropolitan areas where the distance and time required to travel to the unloading point (e.g., disposal site) are more than 15 km. These systems should not be implemented by government, unless government takes over all hotel and commercial service where the tipping fee would fully cover the cost of this more aesthetic, convenient and enclosed method of collection.

4. Compaction and non-compaction systems which are manually loaded are economic for Montego Bay because of the low cost of labor. However, every effort to get citizens to properly contain their waste in properly sized dustbins or plastic bags would enhance productivity and lower costs from what is currently shown. The roto packer compaction truck is somewhat more costly than the push-blade type of compaction truck; because the smaller opening of the hopper, the higher height of the hopper, and the slower loading movement of the packer collectively limit the ability of the crew to rapidly load the truck.

5. The current amount of municipal solid waste in Greater Montego Bay is estimated to total 25,600 tonnes/year (not including hotel refuse and ship refuse which amount to 4,160 and 2040 tonnes/year, respectively). Of the metropolitan area's population, roughly 60% is urban, 20% is semi-urban and 20% is suburban. Assuming that 95% service of the urban and suburban area would be a viable service goal, the total amount of refuse to be collected is roughly 19,500 tonnes/year, or 62 tonnes/work day (based on a work week of 6 days/week). Assuming that 30% of the waste could be served by the lowest cost container-lift system and that 70% of the waste could be served by the higher cost manually loaded rear end loading compaction trucks or open tippers, and assuming that the average distance of travel is 15 km one way from the collection service area to the disposal site, the following fleet size appears appropriate:

Container Lift System -- 30% of 19,500 tonnes/year -- 5,850 tonnes/year:

2 Arm Roll trucks of 8 c.m. capacity, averaging 3,700 tonnes/year productivity

Manual Load System -- 70% of 19,500 tonnes/year -- 13,650 tonnes/year:

4 Rear End Loading Compaction trucks of 10 c.m. capacity, averaging 3,700 tonnes/year productivity

6. The average cost for the above fleet, for complete debt service, operation and maintenance, would be about 1,075 $JA/tonne if private sector and 952 $JA/tonne if public sector (with hidden subsidies).

7. Based on the above average costs for solid waste collection, the user charge or tax to be collected from residents for full cost recovery would average 260 $JA/capita/year if private sector service or 230 $JA/capita/year if public sector service, coupled with commercial establishments, industries, and institutions charged on the basis of quantity they generate.

HOW ARE THE TABLES LABELED?

1. The tables providing costs for each truck type have a three part label, i.e., Table AR-15-DS. The first part (AR) indicates the type of truck, i.e., Arm Roll. The second part (15) indicates the capacity of the truck, i.e., 15 cubic meters. The third part (DS) indicates the one way distance traveled, i.e., direct short distance.

2. The types of trucks analyzed are as follows:

   AR - Arm Roll
   SK - Skip Lift
   SL - Side Loader
   FT - Farm Tractor
   TT - Transfer Trailer
   FC - Front End Loader lifting Containers
   RC - Rear End Loader lifting Containers
   RL - Rear End Loader (manually loaded)
   RP - Roto Packer (special type of rear end loader)

3. The distances analyzed are as follows:

   DX - direct extra long - 30 km one way
   DL - direct long - 20 km one way
   DS - direct short - 10 km one way
   T - transfer (or direct very short) - 5 km one way

4. The round-trip travel times for Montego Bay (including 10 minutes to unload at the dump site) are assumed as follows:

   DX - 105 minutes, 40 km/hour speed
   DL - 75 minutes, 40 km/hour speed
   DS - 55 minutes, 30 km/hour
   T - 45 minutes, 20 km/hour

5. The loading times and stop-to-stop times for various equipment units are assumed as follows:

   AR, SK - 10 minutes to pick up roll on/roll off or skip container
   OT, SL, RP - 12 minutes to load each c.m., 30 minutes of total stop-to-stop time
   RL - 9 minutes to load each c.m., 30 minutes of total stop-to-stop time
   RC, FC - 2 minutes to load each c.m., 40 minutes of total stop-to-stop time
   FT - 10 minutes to load each c.m., 60 minutes of total stop-to-stop time
   TT - 30 minutes to fill trailer by gravity feed from an unloading platform

MONTEGO BAY GREATER METROPOLITAN AREA

JAMAICA

ANALYSIS OF SOLID WASTE COLLECTION EQUIPMENT

PRIVATE SECTOR SERVICE COSTS

PRIVATE SECTOR SERVICE COSTS

ASSUMPTIONS:

1. Currently old and fully depreciated equipment is being used by the private sector. However, costing is based on assuming that the private sector, if properly engaged with contracts of 5 years duration or longer, would invest in new equipment.

2. Borrowing for purchase of equipment and spares, including shipping and customs duties, will be from commercial banks at non-subsidized commercial interest rates, i.e., currently 60% of capital cost per year.

3. Customs and brokerage charges are estimated to cost 45% of total equipment and spares purchase costs.

4. Commercial banks will require full insurance for theft and damage, i.e., currently costing 20% of capital cost per year.

5. While equipment may last many years, an economic life of 5 years is assumed, based on economic life calculations conducted in many other countries which indicate a range of 5 to 8 years is possible depending on road conditions, driver skills, and preventative maintenance efforts.

6. Private companies typically operate one shift daily, but for an extended period of about 10 hours, without overtime pay.

7. Loading rates are estimated based on observations and interviews conducted in Montego Bay in November 1993. Much more data of this kind would be needed to have definitive costing results. No differences were observed between the productivity of the private sector workers versus the Western Parks and Markets workers, which is not unusual given there is no significant difference in their respective compensation.

8. Personnel salaries are currently set by the Ministry of Local Government, and are the same for both the private and public sector.

9. Benefits provided are minimal, limited to medical assistance in some cases only for on-the-job injuries, with costs assumed to amount to up to 5% of salaries.

10. Consumables are purchased at market rates.

11. Downtime is minimal, because repairs are made immediately at private workshops, provided that parts are available, i.e., 90% availability of equipment is assumed.

12. Once all annual costs for personnel, consumables, debt service, and depreciation are determined, an added profit margin (of at least 10%) needs to be added to these costs.

1	B	C	D	E	F
2			JAMAICA		ECON-T.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			5.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD.	30 $JA	
6					
7		FRONT END	REAR END	REAR END	REAR END
8	CAPACITY:	CONTAINERS	CONTAINERS	MANUAL	MANUAL
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	12,636	11,166	5,701	4,135
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	33,114,375	23,402,209	4,567,500	3,197,250
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	6,622,875	4,680,442	913,500	639,450
22	Personnel	651,209	588,271	297,264	297,264
23	Consumables	1,138,497	1,079,279	1,155,825	1,078,846
24	Special Site Costs	0	144,595	0	0
25	Miscellaneous	4,567,500	3,227,891	630,000	441,000
26					
27	Total (with i)	27,349,674	19,875,590	4,978,602	3,843,970
28					
29	Cost per Tonne (with i)	2,164	1,780	873	930
30					
31					
32		ROTO PACKER			
33	CAPACITY:	MANUAL			
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	3,356			
38					
39	ECONOMIC LIFE:				
40	Years	5			
41					
42	COSTS:				
43	Initial Cost per Unit	2,968,875			
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	593,775			
47	Personnel	264,046			
48	Consumables	1,078,846			
49	Special Site Costs	0			
50	Miscellaneous	409,500			
51					
52	Total (with i)	3,634,475			
53					
54	Cost per Tonne (with i)	1,083			
55					
56					
57					
58	11-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-T.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			5.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD	30 $JA	
6					
7		ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
8	CAPACITY				
9	Size per Unit, cubic meters	15.0	8.0	4.0	13.0
10					
11	PRODUCTIVITY				
12	Tonnes per Year	9,305	4,963	1,380	2,816
13					
14	ECONOMIC LIFE				
15	Years	5	5	5	5
16					
17	COSTS				
18	Initial Cost per Unit	5,705,223	4,297,602	2,055,375	2,283,750
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	1,141,045	859,520	411,075	456,750
22	Personnel	370,903	370,903	212,940	316,429
23	Consumables	1,036,508	1,000,628	722,354	1,024,091
24	Special Site Costs	0	0	0	0
25	Miscellaneous	786,927	592,773	283,500	315,000
26					
27	Total (with i)	5,811,097	4,688,718	2,521,775	3,103,277
28					
29	Cost per Tonne (with i)	625	945	1,827	1,102
30					
31					
32		SKIP LIFT	SIDE LOADER TRANSFER TRUCK		
33	CAPACITY				
34	Size per Unit, cubic meters	6.0	8.0	50.0	
35					
36	PRODUCTIVITY				
37	Tonnes per Year	3,474	1,809	27,294	
38					
39	ECONOMIC LIFE				
40	Years	5	5	5	
41					
42	COSTS				
43	Initial Cost per Unit	3,864,935	1,827,000	7,308,000	
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	772,987	365,400	1,461,600	
47	Personnel	370,903	315,151	142,366	
48	Consumables	1,036,573	880,571	1,478,136	
49	Special Site Costs	0	0	0	
50	Miscellaneous	533,095	252,000	1,008,000	
51					
52	Total (with i)	4,390,701	2,605,928	7,261,322	
53					
54	Cost per Tonne (with i)	1,264	1,441	266	
55					
56					
57					
58	11-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-DS.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			10.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD:	30 $JA	
6					
7		FRONT END	REAR END	REAR END	REAR END
8	CAPACITY:	CONTAINERS	CONTAINERS	MANUAL	MANUAL
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	11,765	10,313	5,470	3,899
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	31,224,375	21,964,445	4,567,500	3,197,250
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	6,244,875	4,392,889	913,500	639,450
22	Personnel	624,508	502,155	297,264	297,264
23	Consumables	1,138,497	1,074,879	1,155,825	1,078,846
24	Special Site Costs	0	133,557	0	0
25	Miscellaneous	4,306,810	3,029,579	630,000	441,000
26					
27	Total (with i)	25,864,140	18,724,271	4,978,602	3,843,970
28					
29	Cost per Tonne (with i)	2,198	1,816	910	986
30					
31					
32		ROTO PACKER			
33	CAPACITY:	MANUAL			
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	3,182			
38					
39	ECONOMIC LIFE:				
40	Years	5			
41					
42	COSTS:				
43	Initial Cost per Unit	2,968,875			
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	593,775			
47	Personnel	264,046			
48	Consumables	1,078,846			
49	Special Site Costs	0			
50	Miscellaneous	409,500			
51					
52	Total (with i)	3,634,475			
53					
54	Cost per Tonne (with i)	1,142			
55					
56					
57					
58	11-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-DS WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			10.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD	30 $JA	
6					
7		ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
8	CAPACITY				
9	Size per Unit, cubic meters	15.0	8.0	4.0	13.0
10					
11	PRODUCTIVITY				
12	Tonnes per Year	7,873	4,199	1,291	2,699
13					
14	ECONOMIC LIFE				
15	Years	5	5	5	5
16					
17	COSTS				
18	Initial Cost per Unit	5,291,273	3,952,644	2,055,375	2,283,750
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	1,058,255	790,529	411,075	456,750
22	Personnel	338,738	338,738	212,940	316,429
23	Consumables	1,036,508	1,000,628	722,354	1,024,091
24	Special Site Costs	0	0	0	0
25	Miscellaneous	729,831	545,192	283,500	315,000
26					
27	Total (with i)	5,459,417	4,390,291	2,521,775	3,103,277
28					
29	Cost per Tonne (with i)	693	1,046	1,953	1,150
30					
31					
32		SKIP LIFT	SIDE LOADER TRANSFER TRUCK		
33	CAPACITY				
34	Size per Unit, cubic meters	6.0	8.0	50.0	
35					
36	PRODUCTIVITY				
37	Tonnes per Year	2,939	1,709	24,083	
38					
39	ECONOMIC LIFE				
40	Years	5	5	5	
41					
42	COSTS				
43	Initial Cost per Unit	3,644,162	1,827,000	7,308,000	
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	728,832	365,400	1,461,600	
47	Personnel	338,738	315,151	142,366	
48	Consumables	1,031,154	914,209	1,478,136	
49	Special Site Costs	0	0	0	
50	Miscellaneous	502,643	252,000	1,008,000	
51					
52	Total (with i)	4,182,709	2,639,565	7,261,322	
53					
54	Cost per Tonne (with i)	1,423	1,545	302	
55					
56					
57					
58	11-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-DL WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			20.0 KM ONE WAY TO UNLOAD		
5			Excnange/$USD	30 $JA	
6					
7		FRONT END	REAR END	REAR END	REAR END
8	CAPACITY	CONTAINERS	CONTAINERS	MANUAL	MANUAL
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY				
12	Tonnes per Year	10,339	8,947	5,060	3,499
13					
14	ECONOMIC LIFE				
15	Years	5	5	5	5
16					
17	COSTS				
18	Initial Cost per Unit	28,131,648	19,660,214	4,567,500	3,197,250
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	5,626,330	3,932,043	913,500	639,450
22	Personnel	580,816	520,301	297,264	297,264
23	Consumables	1,138,497	1,067,827	1,155,825	1,078,846
24	Special Site Costs	0	115,868	0	0
25	Miscellaneous	3,880,227	2,711,754	630,000	441,000
26					
27	Total (with i)	23,433,267	16,879,110	4,978,602	3,843,970
28					
29	Cost per Tonne (with i)	2,267	1,887	984	1,099
30					
31					
32					
33	CAPACITY	ROTO PACKER MANUAL			
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY				
37	Tonnes per Year	2,883			
38					
39	ECONOMIC LIFE				
40	Years	5			
41					
42	COSTS				
43	Initial Cost per Unit	2,968,875			
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	593,775			
47	Personnel	264,046			
48	Consumables	1,078,846			
49	Special Site Costs	0			
50	Miscellaneous	409,500			
51					
52	Total (with i)	3,634,475			
53					
54	Cost per Tonne (with i)	1,261			
55					
56					
57					
58	11-Jan-94				

JAMAICA

ECON-DL WK1

ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS

20.0 KM ONE WAY TO UNLOAD

Exchange/$USD 30 $JA

B	C	D	E	F
	ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
CAPACITY				
Size per Unit, cubic meters	15.0	8.0	4.0	13.0
PRODUCTIVITY				
Tonnes per Year	6,021	3,211	1,144	2,492
ECONOMIC LIFE				
Years	5	5	5	5
COSTS				
Initial Cost per Unit	4,755,574	3,506,228	2,055,375	2,283,750
Annual Cost per Unit				
Straight-Line Depreciation	951,115	701,246	411,075	456,750
Personnel	297,114	297,114	212,940	316,429
Consumables	1,036,508	1,000,628	722,354	1,024,091
Special Site Costs	0	0	0	0
Miscellaneous	655,941	483,618	283,500	315,000
Total (with i)	5,004,303	4,004,091	2,521,775	3,103,277
Cost per Tonne (with i)	831	1,247	2,205	1,245

B	C	D	E
	SKIP LIFT	SIDE LOADER TRANSFER TRUCK	
CAPACITY			
Size per Unit, cubic meters	6.0	8.0	50.0
PRODUCTIVITY			
Tonnes per Year	2,248	1,539	19,496
ECONOMIC LIFE			
Years	5	5	5
COSTS			
Initial Cost per Unit	3,358,456	1,827,000	7,308,000
Annual Cost per Unit			
Straight-Line Depreciation	671,691	365,400	1,461,600
Personnel	297,114	315,151	142,360
Consumables	1,024,140	880,571	1,478,136
Special Site Costs	0	0	0
Miscellaneous	463,235	252,000	1,008,000
Total (with i)	3,913,543	2,605,928	7,261,322
Cost per Tonne (with i)	1,741	1,693	372

11-Jan-94

1	B	C	D	E	F
2			JAMAICA		ECON-DX.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			30.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD.	30 $JA	
6					
7		FRONT END	REAR END	REAR END	REAR END
8	CAPACITY:	CONTAINERS	CONTAINERS	MANUAL	MANUAL
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	8,748	7,464	4,549	3,033
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	24,682,067	17,158,659	4,567,500	3,197,250
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	4,936,413	3,431,732	913,500	639,450
22	Personnel	532,082	474,863	297,264	297,264
23	Consumables	1,138,497	1,060,170	1,155,825	1,078,846
24	Special Site Costs	0	96,663	0	0
25	Miscellaneous	3,404,423	2,366,712	630,000	441,000
26					
27	Total (with i)	20,721,908	14,875,938	4,978,602	3,843,970
28					
29	Cost per Tonne (with i)	2,369	1,993	1,094	1,268
30					
31					
32		ROTO PACKER			
33	CAPACITY:	MANUAL			
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	2,527			
38					
39	ECONOMIC LIFE				
40	Years	5			
41					
42	COSTS				
43	Initial Cost per Unit	2,968,875			
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	593,775			
47	Personnel	264,046			
48	Consumables	1,078,846			
49	Special Site Costs	0			
50	Miscellaneous	409,500			
51					
52	Total (with i)	3,634,475			
53					
54	Cost per Tonne (with i)	1,438			
55					
56					
57					
58	11-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-DX.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			30.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD	30 $JA	
6					
7		ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
8	CAPACITY				
9	Size per Unit, cubic meters	15.0	8.0	4.0	13.0
10					
11	PRODUCTIVITY				
12	Tonnes per Year	4,450	2,373	976	2,235
13					
14	ECONOMIC LIFE				
15	Years	5	5	5	5
16					
17	COSTS				
18	Initial Cost per Unit	4,301,393	3,127,745	2,055,375	2,283,750
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	860,279	625,549	411,075	456,750
22	Personnel	261,824	261,824	212,940	316,429
23	Consumables	1,036,508	1,000,628	722,354	1,024,091
24	Special Site Costs	0	0	0	0
25	Miscellaneous	593,296	431,413	283,500	315,000
26					
27	Total (with i)	4,618,445	3,676,661	2,521,775	3,103,277
28					
29	Cost per Tonne (with i)	1,038	1,549	2,583	1,388
30					
31					
32		SKIP LIFT	SIDE LOADER TRANSFER TRUCK		
33	CAPACITY				
34	Size per Unit, cubic meters	6.0	8.0	50.0	
35					
36	PRODUCTIVITY				
37	Tonnes per Year	1,661	1,339	15,163	
38					
39	ECONOMIC LIFE				
40	Years	5	5	5	
41					
42	COSTS				
43	Initial Cost per Unit	3,116,227	1,827,000	7,308,000	
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	623,245	365,400	1,461,600	
47	Personnel	261,824	315,151	142,366	
48	Consumables	1,018,194	880,571	1,478,136	
49	Special Site Costs	0	0	0	
50	Miscellaneous	429,824	252,000	1,008,000	
51					
52	Total (with i)	3,685,337	2,605,928	7,261,322	
53					
54	Cost per Tonne (with i)	2,218	1,946	479	
55					
56					
57					
58					

Table FC--25-DX

JAMAICA Cost Comparisons

FEL CONT

January 1993

30 $JA per US$A

Type of Equipment	Front End Loader, Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25 0 cubic meters		
Capital Cost of Equipment	16,211,538 $JA	125000	
		4000	
Spare Parts	810,577	5% of Capital Cost of Equipment	
Customs	7,659,952		
Total Capital Investment	24,682,067 $JA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2 8 trips/shift	30 km one way	
Complete Loads per Shift	2 49 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	31 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in 1993 (24,682,067 @ int. of 60 00% over life utilized)				15,646,906
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year	62,400	
1 00 Workers	37,440	$JA/year	37,440	
6.29 Attndts	31,200	$JA/year	196,364	
1.00 Workshp Prsonnl	56,160	$JA/year	56,160	
0.50 Suprvsry Prsonnl	74,880	$JA/year	37,440	
0 50 Inspctn Peronnl	0	$JA/year	0	
Administration	30% of above		116,941	
Benefits	5% of above		25,337	
Annual Personnel Costs/Shift			532,082	
Annual Personnel Costs			532,082	

09-Jan-94

Table FC--25-DX

JAMAICA Cost Comparisons

FEL CONT

						$JA
Consumables						
Fuel	(10 00 litres/hr	).(	31,200 litres@	10 0	$JA/ltr	312,000
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 40 litres/hr	).(	1,248 litres@	60 0	$JA/ltr	74,880
Hydric Oil	(0.30 litres/hr	).(	936 litres@	60.0	$JA/ltr	56,160
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	10500 0	$JA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	0 0 units	15000 0	$JA/ea	0
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	6.2 sets @	2000 0	$JA/ea	12,480
Other	(15% additional over above costs)					148,500
(seals, grease, battery, alternator, etc)						
Total Consumables						1,138,497
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipement					3,404,423
Annual Cost of Equipment Unit If implemented during	1993					20,721,908

Tonnes Handled per year

(31.2 tonnes/day 312 days/yr 90% available) 8,748

Cost per Tonne 2,368.76 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 581.99 $JA

EQUIPMENT COST	75 51%
PERSONNEL COST	2 57%
CONSUMABLE COSTS	5 49%
OTHER COSTS	16.43%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Front End Loader, Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25 0 cubic meters		
Capital Cost of Equipment	18,477,273 SJA	125000	
		4000	
Spare Parts	923,864	5% of Capital Cost of Equipment	
Customs	8,730,511		
Total Capital Investment	28,131,648 SJA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3 3 trips/shift	20 km one way	
Complete Loads per Shift	2 95 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	37 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993 (28,131,648 @ int. of 60 00% over life utilized)			17,833,727
Cost of Personnel/Shift			
1 00 Driver	62,400	SJA/year	62,400
1 00 Workers	37,440	SJA/year	37,440
7 44 Attndts	31,200	SJA/year	232,066
1 00 Workshp Prsonnl	56,160	SJA/year	56,160
0 50 Suprvsry Prsonnl	74,880	SJA/year	37,440
0.50 Inspctn Peronnl	0	SJA/year	0
Administration	30% of above		127,652
Benefits	5% of above		27,658
Annual Personnel Costs/Shift			580,816
Annual Personnel Costs			580,816

JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(10 00 litres/hr	).(	31,200 litres@	10 0	SJA/ltr	312,000
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 40 litres/hr	).(	1,248 litres@	60 0	SJA/ltr	74,880
Hydric Oil	(0 30 litres/hr	).(	936 litres@	60 0	SJA/ltr	56,160
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	10500 0	SJA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	SJA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 5 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	0 0 units	15000 0	SJA/ea	0
Filters	(80 repl hrs	).(	39 0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs	).(	6.2 sets @	2000 0	SJA/ea	12,480
Other	(15% additional over above costs)					148,500
(seals, grease, battery, alternator, etc)						
Total Consumables						1,138,497
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc)	21% of capital cost of equipement					3,880,227
Annual Cost of Equipment Unit If implemented during	1993					23,433,267

Tonnes Handled per year

(36.8 tonnes/day 312 days/yr 90% available) 10,339

Cost per Tonne 2,266.59 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 537.75 SJA

EQUIPMENT COST	76.10%
PERSONNEL COST	2 48%
CONSUMABLE COSTS	4.86%
OTHER COSTS	16.56%
TOTAL COST	100.00%

Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1.0 c m. Containers		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	11,270,055 $JA	100000 $US/truck 700 SUS/container	
Spare Parts	563,503	5.00% of Capital Cost	
Customs	5,325,101		
Total Capital Investment	17,158,659 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.0 trips/shift	30 km one way	
Complete Loads per Shift	2.69 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	26.6 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(17,158,659 @ int of	60.00% over life)		10,877,530
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
2 00 Workers	37,440	$JA/year	74,880
5 37 Attndts	31,200	$JA/year	167,549
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0 20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		104,366
Benefits	5% of above		22,613
Annual Personnel Costs/Shift			474,863
Annual Personnel Cost			474,863

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Consumables						
Fuel	(8 00 litres/hr	).(	24,960 litres@	10.00	SJA/ltr	249,600
Engine Oil	(1.50 litres/hr	).(	4,680 litres@	70.00	SJA/ltr	327,600
Trans Oil	(0 04 litres/hr	).(	125 litres@	60.00	SJA/ltr	7,488
Hydric Oil	(0.04 litres/hr	).(	125 litres@	60.00	SJA/ltr	7,488
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17.0 tires @	9,100	SJA/ea	154,865
Brake Lnng	(600 repl hrs	).(	31.2 units @	1,500	SJA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2,000	SJA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2.0 units	15,000	SJA/ea	29,250
Filters	(80 repl hrs	).(	39.0 sets @	250	SJA/set	9,750
Prot. Gear	(1000 repl hrs	).(	28.9 sets @	2,000	SJA/ea	57,846
Other	(15% additional over above costs)					138,283
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,060,170
Special Costs Attributable to Storage and Containment at the Source						96,863
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					2,366,712
Annual Cost of Equipment Unit If implemented during	1993					14,875,938

Tonnes Handled per year			
(26.6 tonnes/day	312 days/yr	90% available)	7,464
Cost per Tonne		1,992.94 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)	472.83 SJA	

EQUIPMENT COST	73.12%
PERSONNEL COST	3.19%
CONSUMABLE COSTS	7.13%
OTHER COSTS	16.56%
TOTAL COST	100.00%

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Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1.0 c.m. Containers		
Capacity	18.0 cubic meters		
Capital Cost of Equipment	12,913,113 $JA	100000 $US/truck 700 $US/container	
Spare Parts	645,656	5.00% of Capital Cost	
Customs	6,101,446		
Total Capital Investment	19,660,214 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.6 trips/shift	20 km one way	
Complete Loads per Shift	3.22 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	31.9 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993 (19,660,214 @ int of 60.00% over life)			12,463,361
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
2.00 Workers	37,440	$JA/year	74,880
6.44 Attndts	31,200	$JA/year	200,837
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		114,352
Benefits	5% of above		24,776
Annual Personnel Costs/Shift			520,301
Annual Personnel Cost			520,301

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Consumables						
Fuel	(8.00 litres/hr)	(24,960 litres@	10.00	$JA/ltr	249,600
Engine Oil	(1.50 litres/hr)	(4,680 litres@	70.00	$JA/ltr	327,600
Trans Oil	(0.04 litres/hr)	(125 litres@	60.00	$JA/ltr	7,488
Hydric Oil	(0.04 litres/hr)	(125 litres@	60.00	$JA/ltr	7,488
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(17.0 tires @	9,100	$JA/ea	154,865
Brake Lnng	(600 repl hrs)	(31.2 units @	1,500	$JA/ea	46,800
Brake Drum	(1200 repl hrs)	(15.6 units @	2,000	$JA/ea	31,200
Clutch Plt	(1600 repl hrs)	(2.0 units	15,000	$JA/ea	29,250
Filters	(80 repl hrs)	(39.0 sets @	250	$JA/set	9,750
Prot. Gear	(1000 repl hrs)	(32.3 sets @	2,000	$JA/ea	64,503
Other (seals, grease, battery, alternator, etc.)	(15% additional over above costs)				139,282
Total Consumables/Year					1,067,827
Special Costs Attributable to Storage and Containment at the Source					115,868
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				2,711,754
Annual Cost of Equipment Unit If implemented during	1993				18,879,110

Tonnes Handled per year				
(31.9 tonnes/day	312 days/yr	90% available)		8,947
Cost per Tonne			1,886.50 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		447.57 $JA	

EQUIPMENT COST	73.84%
PERSONNEL COST	3.08%
CONSUMABLE COSTS	6.33%
OTHER COSTS	16.75%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1.0 c m Containers		
Capacity	18.0 cubic meters		
Capital Cost of Equipment	14,426,565 $JA		100000 SUS/truck 700 SUS/container
Spare Parts	721,328	5.00% of Capital Cost	
Customs	6,816,552		
Total Capital Investment	21,964,445 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	4.1 trips/shift		10 km one way
Complete Loads per Shift	3.71 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	36.7 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(21,964,445 @ int of	60.00% over life)		13,924,101
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
2.00 Workers	37,440	$JA/year	74,880
7.42 Attndts	31,200	$JA/year	231,499
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		123,551
Benefits	5% of above		26,769
Annual Personnel Costs/Shift			562,155
Annual Personnel Cost			562,155

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(8.00 litres/hr).(	24,960 litres@	10.00	$JA/ltr	249,600
Engine Oil	(1.50 litres/hr).(	4,680 litres@	70.00	$JA/ltr	327,600
Trans Oil	(0.04 litres/hr).(	125 litres@	60.00	$JA/ltr	7,488
Hydrlc Oil	(0.04 litres/hr).(	125 litres@	60.00	$JA/ltr	7,488
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	17.0 tires @	9,100	$JA/ea	154,665
Brake Lnng	(600 repl hrs).(	31.2 units @	1,500	$JA/ea	46,800
Brake Drum	(1200 repl hrs).(	15.6 units @	2,000	$JA/ea	31,200
Clutch Plt	(1600 repl hrs).(	2.0 units	15,000	$JA/ea	29,250
Filters	(80 repl hrs).(	39.0 sets @	250	$JA/set	9,750
Prot Gear	(1000 repl hrs).(	35.3 sets @	2,000	$JA/ea	70,636
Other	(15% additional over above costs)				140,202
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,074,879
Special Costs Attributable to Storage and Containment at the Source					133,557
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				3,029,579
Annual Cost of Equipment Unit If implemented during	1993				18,724,271

Tonnes Handled per year				
(36.7 tonnes/day	312 days/yr	90% available)		10,313
Cost per Tonne			1,815.55 $JA	
Aver Cost per Person (	0.24 tonnes/cap/yr)		430.74 $JA	

EQUIPMENT COST	74.36%
PERSONNEL COST	3.00%
CONSUMABLE COSTS	5.74%
OTHER COSTS	16.89%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1 0 c.m. Containers		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	15,370,909 $JA	100000 $US/truck 700 $US/container	
Spare Parts	768,545	5 00% of Capital Cost	
Customs	7,262,755		
Total Capital Investment	23,402,209 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	4.5 trips/shift	5 km one way	
Complete Loads per Shift	4 02 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	39.8 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in 1993				
(23,402,209 @ int of	60 00% over life)			14,835,555
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
2 00 Workers	37,440	$JA/year		74,880
8 03 Attndts	31,200	$JA/year		250,631
0 50 Workshp Prsonnl	56,160	$JA/year		28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0.20 Inspctn Peronnl	0	$JA/year		0
Administration	30% of above			129,290
Benefits	5% of above			28,013
Annual Personnel Costs/Shift				588,271
Annual Personnel Cost				588,271

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(8 00 litres/hr	).(	24,960 litres@	10 00	$JA/ltr	249,600
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 00	$JA/ltr	327,600
Trans Oil	(0 04 litres/hr	).(	125 litres@	60.00	$JA/ltr	7,488
Hydric Oil	(0 04 litres/hr	).(	125 litres@	60.00	$JA/ltr	7,488
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	9,100	$JA/ea	154,865
Brake Lnng	(600 repl hrs	).(	31 2 units @	1,500	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2,000	$JA/ea	31 200
Clutch Plt	(1600 repl hrs	).(	2 0 units	15,000	$JA/ea	29,250
Filters	(80 repl hrs	).(	39.0 sets @	250	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	37.2 sets @	2,000	$JA/ea	74,462
Other	(15% additional over above costs)					140,776
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,079,279
Special Costs Attributable to Storage and Containment at the Source						144,595
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					3,227,891
Annual Cost of Equipment Unit If implemented during	1993					19,875,590

Tonnes Handled per year				
(39.8 tonnes/day	312 days/yr	90% available)		11,166
Cost per Tonne			1,780 07 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		422 32 $JA	

EQUIPMENT COST	74.64%
PERSONNEL COST	2.96%
CONSUMABLE COSTS	5 43%
OTHER COSTS	16 97%
TOTAL COST	100 00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	3,000,000 $JA		100000 $US/truck
Spare Parts	150,000	5 00% of Capital Cost	
Customs	1,417,500		
Total Capital Investment	4,567,500 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	1 8 trips/shift		30 km one way
Complete Loads per Shift	1 64 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	16 2 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(4,567,500 @ int of	60 00% over life)		2,895,513
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
3 00 Workers	37,440	$JA/year	112,320
0 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0 20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		65,333
Benefits	5% of above		14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(8 00 litres/hr)	(24,960 litres@	10 0	$JA/ltr	249,600
Engine Oil	(1 50 litres/hr)	(4 680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 40 litres/hr)	(1,248 litres@	60 0	$JA/ltr	74,880
Hydric Oil	(0 30 litres/hr)	(936 litres@	60 0	$JA/ltr	56,160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(17 0 tires @	9100 0	$JA/ea	154,865
Brake Lnng	(600 repl hrs)	(31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs)	(15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs)	(2 0 units @	15000 0	$JA/ea	29,250
Filters	(80 repl hrs)	(39 0 sets @	250 0	$JA/set	9,750
Prot Gear	(1000 repl hrs)	(12 5 sets @	2000 0	$JA/ea	24,960
Other	(15% additional over above costs)				150,760
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					1,155,825
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc)		21% of capital cost of equipment			630,000
Annual Cost of Equipment Unit if implemented during		1993			4,978,602

Tonnes Handled per year			
(16 2 tonnes/day	312 days/yr	90% available)	4,549
	Cost per Tonne		1,094 45 $JA
q Aver. Cost per Person (	0 24 tonnes/cap/yr)		259 66 $JA

EQUIPMENT COST	58 16%
PERSONNEL COST	5 97%
CONSUMABLE COSTS	23 22%
OTHER COSTS	12.65%
TOTAL COST	100 00%

Table RL – 18 – DL REAR LOADER
JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	3,000,000 $JA		100000 $US/truck
Spare Parts	150,000	5.00% of Capital Cost	
Customs	1,417,500		
Total Capital Investment	4,567,500 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2 0 trips/shift		20 km one way
Complete Loads per Shift	1 82 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	18 0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(4,567,500 @ int of	60 00% over life)		2,895,513
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
3 00 Workers	37,440	$JA/year	112,320
0 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0 20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		65,333
Benefits	5% of above		14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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Table RL - 18 - DL REAR LOADER
JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(8 00 litres/hr).(	24,960 litres@	10 0	$JA/ltr	249,600
Engine Oil	(1 50 litres/hr).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 40 litres/hr).(	1,248 litres@	60 0	$JA/ltr	74,880
Hydric Oil	(0 30 litres/hr).(	936 litres@	60 0	$JA/ltr	56,160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	17 0 tires @	9100 0	$JA/ea	154,865
Brake Lnng	(600 repl hrs).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs).(	2 0 units @	15000 0	$JA/ea	29,250
Filters	(80 repl hrs).(	39 0 sets @	250 0	$JA/set	9,750
Prot Gear	(1000 repl hrs).(	12 5 sets @	2000 0	$JA/ea	24,960
Other	(15% additional over above costs)				150,760
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					1,155,825
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				630,000
Annual Cost of Equipment Unit If implemented during	1993				4,978,602

Tonnes Handled per year			
(18.0 tonnes/day	312 days/yr	90% available)	5,060
Cost per Tonne			983 90 $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		233 43 $JA

EQUIPMENT COST	58.16%
PERSONNEL COST	5.97%
CONSUMABLE COSTS	23.22%
OTHER COSTS	12.65%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	3,000,000 $JA		100000 $US/truck
Spare Parts	150,000	5.00% of Capital Cost	
Customs	1,417,500		
Total Capital Investment	4,567,500 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2 2 trips/shift		10 km one way
Complete Loads per Shift	1 97 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	19 5 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(4,567,500 @ int of	60 00% over life)		2,895,513
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
3 00 Workers	37,440	$JA/year	112,320
0 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0 20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		65,333
Benefits	5% of above		14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(8 00 litres/hr	).(	24,960 litres@	10 0	$JA/ltr	249,600
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 40 litres/hr	).(	1,248 litres@	60 0	$JA/ltr	74,880
Hydric Oil	(0 30 litres/hr	).(	936 litres@	60 0	$JA/ltr	56,160
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	9100 0	$JA/ea	154,865
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units @	15000 0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	12.5 sets @	2000 0	$JA/ea	24,960
Other	(15% additional over above costs)					150,760
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,155,825
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc)			21% of capital cost of equipment			630,000
Annual Cost of Equipment Unit If implemented during			1993			4,978,602

Tonnes Handled per year				
(19 5 tonnes/day	312 days/yr	90% available)		5,470
Cost per Tonne			910.20 $JA	
Aver. Cost per Person (	0 24 tonnes/cap/yr)		215 94 $JA	

EQUIPMENT COST	58.16%
PERSONNEL COST	5.97%
CONSUMABLE COSTS	23.22%
OTHER COSTS	12.65%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18.0 cubic meters		
Capital Cost of Equipment	3,000,000 $JA		100000 $US/truck
Spare Parts	150,000	5.00% of Capital Cost	
	1,417,500		
Total Capital Investment	4,567,500 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.3 trips/shift		5 km one way
Complete Loads per Shift	2.05 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	20.3 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(4,567,500 @ int of	60.00% over life)		2,895,513
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
3.00 Workers	37,440	$JA/year	112,320
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		65,313
Benefits	5% of above		14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(8.00 litres/hr).(	24,960 litres@	10.0	$JA/ltr	249,600
Engine Oil	(1.50 litres/hr).(	4,680 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0.40 litres/hr).(	1,248 litres@	60.0	$JA/ltr	74,880
Hydric Oil	(0.30 litres/hr).(	936 litres@	60.0	$JA/ltr	56,160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	17.0 tires @	9100.0	$JA/ea	154,885
Brake Lnng	(600 repl hrs).(	31.2 units @	1500.0	$JA/ea	46,800
Brake Drum	(1200 repl hrs).(	15.6 units @	2000.0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs).(	2.0 units @	15000.0	$JA/ea	29,250
Filters	(80 repl hrs).(	39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs).(	12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)				150,760
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					1,155,825
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc)	21% of capital cost of equipment				630,000
Annual Cost of Equipment Unit If implemented during	1993				4,978,602

Tonnes Handled per year

(20.3 tonnes/day 312 days/yr 90% available) 5,701

Cost per Tonne 873.35 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 207.20 $JA

EQUIPMENT COST	58.16%
PERSONNEL COST	5.97%
CONSUMABLE COSTS	23.22%
OTHER COSTS	12.65%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10 0 cubic meters		
Capital Cost of Equipment	2,100,000 $JA		70000 $US/truck
Spare Parts	105,000	5.00% of Capital Cost	
Customs	992,250		
Total Capital Investment	3,197,250 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2 4 trips/shift		30 km one way
Complete Loads per Shift	2.16 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	10 8 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993 (3,197,250 @ int of	60.00% over life)		2,026,859
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
3 00 Workers	37,440	$JA/year	112,320
0 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		65,333
Benefits	5% of above		14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(7 00 litres/hr).(	21,840 litres@	10 0	SJA/ltr	218,400
Engine Oil	(1 50 litres/hr).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 40 litres/hr).(	1,248 litres@	60 0	SJA/ltr	74,880
Hydric Oil	(0 30 litres/hr).(	936 litres@	60 0	SJA/ltr	56,160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	1 0 tires @	7000 0	SJA/ea	119,127
Brake Lnng	(800 repl hrs).(	31 2 units @	1500 0	SJA/ea	46,800
Brake Drum	(1200 repl hrs).(	15 6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs).(	2 0 units @	15000 0	SJA/ea	29 250
Filters	(80 repl hrs).(	39.0 sets @	250 0	SJA/set	9,750
Prot Gear	(1000 repl hrs).(	1 . 5 sets @	2000 0	SJA/ea	24,960
Other	(15% additional over above costs)				140,719
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					1,078,846
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21 % of capital cost of equipment				441,000
Annual Cost of Equipment Unit If implemented during	1993				3,843,970

Tonnes Handled per year				
(10.8 tonnes/day	312 days/yr	90% available)		3,033
Cost per Tonne			1,267.53 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		300 72 SJA	

EQUIPMENT COST	52.73%
PERSONNEL COST	7.73%
CONSUMABLE COSTS	28.07%
OTHER COSTS	11.47%
TOTAL COST	100.00%

Table RL - 10 - DL — REAR LOADER

JAMAICA — Cost Comparisons

January 1993 — 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10 0 cubic meters		
Capital Cost of Equipment	2,100,000 $JA		70000 $US/truck
Spare Parts	105,000	5.00% of Capital Cost	
Customs	992,250		
Total Capital Investment	3,197,250 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.8 trips/shift		20 km one way
Complete Loads per Shift	2 49 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	12 5 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993 (3,197,250 @ int of	60.00% over life)		2,026,859
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
3 00 Workers	37,440	$JA/year	112,320
0 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Personnl	0	$JA/year	0
Administration	30% of above		65,333
Benefits	5% of above		14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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Table RL - 10 - DL — REAR LOADER

JAMAICA — Cost Comparisons — SJA

Consumables						
Fuel	(7 00 litres/hr	).(	21,840 litres@	10 0	SJA/ltr	218,400
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 40 litres/hr	).(	1,248 litres@	60 0	SJA/ltr	74,880
Hydrlc Oil	(0 30 litres/hr	).(	936 litres@	60 0	SJA/ltr	56,160
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	SJA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	SJA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units @	15000 0	SJA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs	).(	12 5 sets @	2000 0	SJA/ea	24,960
Other	(15% additional over above costs)					140,719
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,078,846
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc)	21% of capital cost of equipment					441,000
Annual Cost of Equipment Unit If implemented during	1993					3,843,970

Tonnes Handled per year			
(12 5 tonnes/day	312 days/yr	90% available)	3,499
Cost per Tonne			1 098 53 SJA
Aver. Cost per Person (	0 24 tonnes/cap/yr)		260.63 SJA

EQUIPMENT COST	52.73%
PERSONNEL COST	7.73%
CONSUMABLE COSTS	28.07%
OTHER COSTS	11.47%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10.0 cubic meters		
Capital Cost of Equipment	2,100,000 $JA		70000 $US/truck
Spare Parts	105,000	5.00% of Capital Cost	
Customs	992,250		
Total Capital Investment	3,197,250 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.1 trips/shift		10 km one way
Complete Loads per Shift	2.78 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.50 Tonnes/cubic meter		
Typical Productivity	13.9 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(3,197,250 @ int of	60.00% over life)		2,026,859
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
3.00 Workers	37,440	$JA/year	112,320
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	0	$JA/year	0
Administration	30%	of above	65,333
Benefits	5%	of above	14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(7.00 litres/hr	).(	21,840 litres@	10.0	$JA/ltr	218,400
Engine Oil	(1.50 litres/hr	).(	4,680 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0.40 litres/hr	).(	1,248 litres@	60.0	$JA/ltr	74,880
Hydric Oil	(0.30 litres/hr	).(	936 litres@	60.0	$JA/ltr	56,160
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17.0 tires @	7000.0	$JA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31.2 units @	1500.0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15.6 units @	2000.0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2.0 units @	15000.0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)					140,719
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,078,846
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)			21% of capital cost of equipment			441,000
Annual Cost of Equipment Unit If implemented during			1993			3,843,970

Tonnes Handled per year			
(13.9 tonnes/day	312 days/yr	90% available)	3,899
Cost per Tonne			985.86 $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		233.89 $JA

EQUIPMENT COST	52.73%
PERSONNEL COST	7.73%
CONSUMABLE COSTS	28.07%
OTHER COSTS	11.47%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10 0 cubic meters		
Capital Cost of Equipment	2,100,000 $JA		70000 $US/truck
Spare Parts	105,000	5.00% of Capital Cost	
Customs	992,250		
Total Capital Investment	3,197,250 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3 3 trips/shift		5 km one way
Complete Loads per Shift	2.95 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	14 7 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993			
(3,197,250 @ int of	60.00% over life)		2,026,859
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
3 00 Workers	37,440	$JA/year	112,320
0 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		65,333
Benefits	5% of above		14,155
Annual Personnel Costs/Shift			297,264
Annual Personnel Costs			297,264

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(7 00 litres/hr	).(	21,840 litres@	10 0	$JA/ltr	218,400
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 40 litres/hr	).(	1,248 litres@	60 0	$JA/ltr	74,880
Hydric Oil	(0.30 litres/hr	).(	936 litres@	60 0	$JA/ltr	56,160
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	$JA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units @	15000 0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	12.5 sets @	2000 0	$JA/ea	24,960
Other	(15% additional over above costs)					140,719
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,078,846
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					441,000
Annual Cost of Equipment Unit If implemented during	1993					3,843,970

Tonnes Handled per year			
(14.7 tonnes/day	312 days/yr	90% available)	4,135
	Cost per Tonne		92[illegible] $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		220 53 $JA

EQUIPMENT COST	52.73%
PERSONNEL COST	7.73%
CONSUMABLE COSTS	28 07%
OTHER COSTS	11.47%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	9.0 cubic meters		
Capital Cost of Equipment	1,950,000 $JA	65000 $JA	
Spare Parts	97,500	5.00%	of Capital Cost of Equipment
Customs	921,375		
Total Capital Investment	2,968,875 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.2 trips/shift	30 km one way	
Complete Loads per Shift	2.00 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.50 Tonnes/cubic meter		
Typical Productivity	9.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993 (2,968,875 @ int. of 60.00% over life utilized)			1,882,083
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
3.00 Workers	37,440	$JA/year	112,320
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30%	of above	58,032
Benefits	5%	of above	12,574
Annual Personnel Costs/Shift			264,046
Annual Personnel Costs			264,046

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(7.00 litres/hr)	(21,840 litres@	10.0	$JA/ltr	218,400
Engine Oil	(1.50 litres/hr)	(4,680 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0.40 litres/hr)	(1,248 litres@	60.0	$JA/ltr	74,880
Hydrlc Oil	(0.30 litres/hr)	(936 litres@	60.0	$JA/ltr	56,160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(17.0 tires @	7000.0	$JA/ea	119,127
Brake Lnng	(600 repl hrs)	(31.2 units @	1500.0	$JA/ea	46,800
Brake Drum	(1200 repl hrs)	(15.6 units @	2000.0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs)	(2.0 units @	15000.0	$JA/ea	29,250
Filters	(80 repl hrs)	(39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs)	(12.5 sets @	2000.0	$JA/ea	24,960
Other (seals, grease, battery, alternator, etc.)	(15% additional over above costs)				140,719
Total Consumables					1,078,846
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	21% of capital cost of equipment				409,500
Annual Cost of Equipment Unit If implemented during 1993					3,634,475

Tonnes Handled per year				
(9.0 tonnes/day	312 days/yr	90%	available)	2,527
Cost per Tonne				1,438.14 $JA
Aver. Cost per Person (0.24 tonnes/cap/yr)	refuse			341.20 $JA

EQUIPMENT COST	51.78%
PERSONNEL COST	7.27%
CONSUMABLE COSTS	29.68%
OTHER COSTS	11.27%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	9 0 cubic meters		
Capital Cost of Equipment	1,950,000 $JA	65000 $JA	
Spare Parts	97,500	5.00% of Capital Cost of Equipment	
Customs	921,375		
Total Capital Investment	2,968,875 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.5 trips/shift	20 km one way	
Complete Loads per Shift	2 28 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	10.3 tonnes/day		

				SJA
Annualized Capital Cost, when purchased in 1993 (2,968,875 @ int. of 60.00% over life utilized)				1,882.083
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year	62,400	
3 00 Workers	37,440	$JA/year	112,320	
0 00 Attndts	31,200	$JA/year	0	
0 20 Workshp Prsonnl	56,160	$JA/year	11,232	
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488	
0 10 Inspctn Peronnl	0	$JA/year	0	
Administration	30%	of above	58,032	
Benefits	5%	of above	12,574	
Annual Personnel Costs/Shift			264,046	
Annual Personnel Costs			264,046	

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JAMAICA Cost Comparisons S :A

Consumables					
Fuel	(7 00 litres/hr)	(21,840 litres@	10 0	SJA/ltr	218,400
Engine Oil	(1.50 litres/hr)	(4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0.40 litres/hr)	(1,248 litres@	60 0	SJA/ltr	74,880
Hydric Oil	(0.30 litres/hr)	(936 litres@	60 0	SJA/ltr	56,160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(17 0 tires @	7000 0	SJA/ea	119,127
Brake Lnng	(600 repl hrs)	(31 2 units @	1500.0	SJA/ea	46,800
Brake Drum	(1200 repl hrs)	(15.6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs)	(2.0 units @	15000 0	SJA/ea	29,250
Filters	(80 repl hrs)	(39 0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs)	(12.5 sets @	2000.0	SJA/ea	24,960
Other	(15% additional over above costs)				140,719
(seals, grease, battery, alternator etc.)					
Total Consumables					1,070,846
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	21% of capital cost of equipment				409,500
Annual Cost of Equipment Unit If implemented during	1993				3,634,475

Tonnes Handled per year				
(10.3 tonnes/day	312 days/yr	90% available)		2,883
Cost per Tonne			1,260.59 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)	refuse	299.08 SJA	

EQUIPMENT COST	51.78%
PERSONNEL COST	7.27%
CONSUMABLE COSTS	29.68%
OTHER COSTS	11.27%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Londer, Manually Loaded		
Capacity	9 0 cubic meters		
Capital Cost of Equipment	1,950,000 $JA	65000 $JA	
Spare Parts	97,500	5.00%	of Capital Cost of Equipment
Customs	921,375		
Total Capital Investment	2,968,875 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.8 trips/shift	10 km one way	
Complete Loads per Shift	2 52 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.50 Tonnes/cubic meter		
Typical Productivity	11 3 tonnes/day		

				SJA
Annualized Capital Cost, when purchased in 1993				
(2,968,875 @ int. of	60.00%	over life utilized)		1,882,083
Cost of Personnel				
1.00 Driver	52,400	$JA/year	62,400	
3 00 Workers	37,440	$JA/year	112,320	
0 00 Attndts	31,200	$JA/year	0	
0.20 Workshp Prsonnl	56,160	$JA/year	11,232	
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488	
0 10 Inspctn Peronnl	0	$JA/year	0	
Administration	30%	of above	58,032	
Benefits	5%	of above	12,574	
Annual Personnel Costs/Shift			264,046	
Annual Personnel Costs			264,046	

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(7.00 litres/hr	).(	21,840 litres@	10 0	SJA/ltr	218,400
Engine Oil	(1.50 litres/hr	).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 40 litres/hr	).(	1,248 litres@	60 0	SJA/ltr	74,880
Hydric Oil	(0.30 litres/hr	).(	936 litres@	60 0	SJA/ltr	56,160
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	SJA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	SJA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units @	15000 0	SJA/ea	29,250
Filters	(80 repl hrs	).(	39.0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs	).(	12.5 sets @	2000 0	SJA/ea	24,960
Other	(15% additional over above costs)					140,719
(seals, grease, battery, alternator, etc.)						
Total Consumables						1,078,846
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)			21% of capital cost of equipment			409,500
Annual Cost of Equipment Unit If implemented during			1993			3,634,475

Tonnes Handled per year				
(11.3 tonnes/day	312 days/yr	90%	available)	3,182
Cost per Tonne				1,142.23 SJA
Aver. Cost per Person (	0 24 tonnes/cap/yr)	refuse		270.99 SJA

EQUIPMENT COST	51.78%
PERSONNEL COST	7.27%
CONSUMABLE COSTS	29.68%
OTHER COSTS	11.27%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	9.0 cubic meters		
Capital Cost of Equipment	1,950,000 $JA	65000 $JA	
Spare Parts	97,500	5.00% of Capital Cost of Equipment	
Customs	921,375		
Total Capital Investment	2,968,875 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.0 trips/shift	5 km one way	
Complete Loads per Shift	2.66 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.50 Tonnes/cubic meter		
Typical Productivity	12.0 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993 (2,968,875 @ int. of	60.00% over life utilized)		1,882,083
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
3.00 Workers	37,440	$JA/year	112,320
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30% of above		58,032
Benefits	5% of above		12,574
Annual Personnel Costs/Shift			264,046
Annual Personnel Costs			264,046

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JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(7.00 litres/hr),(	21,840 litres@	10.0	SJA/ltr	218,400
Engine Oil	(1.50 litres/hr),(	4,680 litres@	70.0	SJA/ltr	327,600
Trans Oil	(0.40 litres/hr),(	1,248 litres@	60.0	SJA/ltr	74,880
Hydric Oil	(0.30 litres/hr),(	936 litres@	60.0	SJA/ltr	56,160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs),(	17.0 tires @	7000.0	SJA/ea	119,127
Brake Lnng	(600 repl hrs),(	31.2 units @	1500.0	SJA/ea	46,800
Brake Drum	(1200 repl hrs),(	15.6 units @	2000.0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs),(	2.0 units @	15000.0	SJA/ea	29,250
Filters	(80 repl hrs),(	39.0 sets @	250.0	SJA/set	9,750
Prot. Gear	(1000 repl hrs),(	12.5 sets @	2000.0	SJA/ea	24,960
Other	(15% additional over above costs)				140,719
(seals, grease, battery, alternator, etc.)					
Total Consumables					1,078,846
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	21% of capital cost of equipment				409,500
Annual Cost of Equipment Unit If implemented during	1993				3,634,475

Tonnes Handled per year

(12.0 tonnes/day 312 days/yr 90% available) 3,356

Cost per Tonne 1,083.05 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) refuse 256.95 SJA

EQUIPMENT COST	51.78%
PERSONNEL COST	7.27%
CONSUMABLE COSTS	29.68%
OTHER COSTS	11.27%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Arm Roll Truck Loading Set of Liftable Containers		
Capacity	15 0 cubic meters		
Capital Cost of Equipment	2,825,217 $JA		60000 $US/truck 3000 $US/container
Spare Parts	141,261	5.00% of Capital Cost	
Customs	1,334,915		
Total Capital Investment	4,301,393 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	4.7 trips/shift		30 km one way
Complete Loads per Shift	4 23 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 25 Tonnes/cubic meter		
Typical Productivity	15 8 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(4,301,393 @ int of	60.00% over life)		2,726,818
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
1 00 Workers	37,440	$JA/year	37,440
2 35 Attndts	31,200	$JA/year	73,252
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00% of above		57,544
Benefits	5 00% of above		12,468
Annual Personnel Costs/Shift			261,824
Annual Personnel Costs			261,824

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(10.0 litres/hr	).(	31,200 litres@	10 0	$JA/ltr	312,000
Engine Oil	(1.50 litres/hr	).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0.03 litres/hr	).(	94 litres@	60 0	$JA/ltr	5,516
Hydrlc Oil	(0.04 litres/hr	).(	125 litres@	60 0	$JA/ltr	7,488
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17.0 tires @	7000 0	$JA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31.2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units	15000 0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	6.2 sets @	2000 0	$JA/ea	12,480
Other	(15% additional over above costs)					135,197
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,036,508
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					593,296
Annual Cost of Equipment Unit If implemented during	1993					4,618,445

Tonnes Handled per year

(15.8 tonnes/day 312 days/yr 90% available) 4,450

Cost per Tonne 1,037.84 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 246.23 $JA

EQUIPMENT COST	59.04%
PERSONNEL COST	5.67%
CONSUMABLE COSTS	22.44%
OTHER COSTS	12.85%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Arm Roll Truck Loading Set of Liftable Containers		
Capacity	15 0 cubic meters		
Capital Cost of Equipment	3,123,529 $JA		60000 $US/truck 3000 $US/container
Spare Parts	156,176	5.00%	of Capital Cost
Customs	1,475,868		
Total Capital Investment	4,755,574 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	6 4 trips/shift		20 km one way
Complete Loads per Shift	5.72 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 25 Tonnes/cubic meter		
Typical Productivity	21 4 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(4,755,574 @ int of	60 00% over life)		3,014,740
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA year	62,400
1 00 Workers	37,440	$JA/year	37,440
3 18 Attndts	31,200	$JA/year	99,106
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74 880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00%	of above	65,300
Benefits	5 00%	of above	14,148
Annual Personnel Costs/Shift			297,114
Annual Personnel Costs			297,114

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JAMAICA Cost Comparisons

						$JA
Consumables						
Fuel	(10 0 litres/hr	).(	31,200 litres@	10 0	$JA/ltr	312,000
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0 03 litres/hr	).(	94 litres@	60 0	$JA/ltr	5,616
Hydric Oil	(0 04 litres/hr	).(	125 litres@	60.0	$JA/ltr	7,488
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	$JA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units	15000 0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9,750
Prot Gear	(1000 repl hrs	).(	6.2 sets @	2000.0	$JA/ea	12,480
Other	(15% additional over above costs)					135,197
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,036,508
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					655,941
Annual Cost of Equipment Unit If implemented during	1993					5,004,303

Tonnes Handled per year

(21 4 tonnes/day 312 days/yr 90% available) 6,021

Cost per Tonne 831 19 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 197 20 $JA

EQUIPMENT COST	60.24%
PERSONNEL COST	5.94%
CONSUMABLE COSTS	20.71%
OTHER COSTS	13.11%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Arm Roll Truck Loading Set of Liftable Containers		
Capacity	15 0 cubic meters		
Capital Cost of Equipment		3,475,385 $JA	60000 $US/truck 3000 $US/container
Spare Parts		173,769	5 00% of Capital Cost
Customs		1,642,119	
Total Capital Investment		5,291,273 $JA	
Estimated Economic Life Based on Planned Use		5 years (replace containers mid-way)	
Number of Shifts per Day		1 00 shifts/day	
Hours of Operation/Year		3,120 hours/year	
Number of Trips per Shift		8 3 trips/shift	10 km one way
Complete Loads per Shift		7 48 loads/shift	
Typical Density of Solid Waste in Loaded Vehicle		0 25 Tonnes/cubic meter	
Typical Productivity		28 0 tonnes/day	

			$JA
Annualized Capital Cost, when purchased in 1993 (5,291,273 @ int of	60.00%	over life)	3,354,340
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
1 00 Workers	37,440	$JA/year	37,440
4 15 Attndts	31,200	$JA/year	129,600
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00%	of above	74,448
Benefits	5 00%	of above	16,130
Annual Personnel Costs/Shift			338,738
Annual Personnel Costs			338,738

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JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(10 0 litres/hr).(	31,200 litres@	10 0	SJA/ltr	312,000
Engine Oil	(1 50 litres/hr).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 03 litres/hr).(	94 litres@	60 0	SJA/ltr	5,616
Hydric Oil	(0 04 litres/hr).(	125 litres@	60 0	SJA/ltr	7,488
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	17 0 tires @	7000 0	SJA/ea	119,127
Brake Lnng	(600 repl hrs).(	31 2 units @	1500 0	SJA/ea	46,800
Brake Drum	(1200 repl hrs).(	15 6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs).(	2 0 units	15000 0	SJA/ea	29,250
Filters	(80 repl hrs).(	39 0 sets @	250 0	SJA/set	9,750
Prot Gear	(1000 repl hrs).(	6 2 sets @	2000 0	SJA/ea	12,480
Other	(15% additional over above costs)				135,197
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					1,036,508
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc)	21% of capital cost of equipment				729,831
Annual Cost of Equipment Unit If implemented during	1993				5,459,417

Tonnes Handled per year

(28 0 tonnes/day 312 days/yr 90% available) 7,873

Cost per Tonne 693 42 SJA

Aver. Cost per Person (0 24 tonnes/cap/yr) 164 51 SJA

EQUIPMENT COST	61.44%
PERSONNEL COST	6.20%
CONSUMABLE COSTS	18.99%
OTHER COSTS	13.37%
TOTAL COST	100 00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Arm Roll Truck Loading Set of Liftable Containers		
Capacity	15 0 cubic meters		
Capital Cost of Equipment	3,747,273 $JA		60000 $US/truck 3000 $US/container
Spare Parts	187,364	5 00%	of Capital Cost
Customs	1,770,586		
Total Capital Investment	5,705,223 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3 120 hours/year		
Number of Trips per Shift	9 8 trips/shift		5 km one way
Complete Loads per Shift	8 84 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 25 Tonnes/cubic meter		
Typical Productivity	33 1 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in 1993				
(5 705,223 @ int of	60 00%	over life)		3,616,759
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
1 00 Workers	37,440	$JA/year		37,440
4 91 Attndts	31 200	$JA/year		153,164
0 20 Workshp Prsonnl	56,160	$JA/year		11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year		7,488
0 10 Inspctn Peronnl	0	$JA/year		0
Administration	30 00%	of above		81,517
Benefits	5 00%	of above		17,662
Annual Personnel Costs/Shift				370,903
Annual Personnel Costs				370,903

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(10 0 litres/hr	).(	31,200 litres@	10 0	SJA/ltr	312,000
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 03 litres/hr	).(	94 litres@	60 0	SJA/ltr	5,616
Hydric Oil	(0 04 litres/hr	).(	125 litres@	60 0	SJA/ltr	7,488
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	SJA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	SJA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units	15000 0	SJA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs	).(	6 2 sets @	2000 0	SJA/ea	12,480
Other	(15% additional over above costs)					135,197
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,036,508
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					786,927
Annual Cost of Equipment Unit If implemented during	1993					5,811,097

Tonnes Handled per year				
(33 1 tonnes/day	312 days/yr	90% available)		9,305
Cost per Tonne			624 53 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		148 17 SJA	

EQUIPMENT COST	62.24%
PERSONNEL COST	6 38%
CONSUMABLE COSTS	17.84%
OTHER COSTS	13.54%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US$

Type of Equipment	Arm Roll Truck Loading Roll On/Roll Off Containers		
Capacity	8 0 cubic meters		
Capital Cost of Equipment	2,054,348 $JA		40000 $US/truck 2500 $US/container
Spare Parts	102,717	5 00%	of Capital Cost
Customs	970,679		
Total Capital Investment	3,127,745 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	4 7 trips/shift		30 km one way
Complete Loads per Shift	4 23 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 25 Tonnes/cubic meter		
Typical Productivity	8 5 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(3,127,745 @ int of	60 00%	over life)	1,982,797
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
1 00 Workers	37,440	$JA/year	37,440
2 35 Attndts	31,200	$JA/year	73,252
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00%	of above	57,544
Benefits	5 00%	of above	12,468
Annual Personnel Costs/Shift			261,824
Annual Personnel Costs			261,824

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(9 0 litres/hr	).(	28,080 litres@	10 0	$JA/ltr	280,800
Engine Oil	(1.50 litres/hr	).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 03 litres/hr	).(	94 litres@	60 0	$JA/ltr	5,616
Hydric Oil	(0 04 litres/hr	).(	125 litres@	60 0	$JA/ltr	7,488
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	$JA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units	15000 0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	6 2 sets @	2000 0	$JA/ea	12,480
Other	(15% additional over above costs)					130,517
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,000,628
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc)	21% of capital cost of equipment					431,413
Annual Cost of Equipment Unit If implemented during	1993					3,676,661

Tonnes Handled per year

(8 5 tonnes/day 312 days/yr 90% available) 2,373

Cost per Tonne 1,549.13 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 367 53 $JA

EQUIPMENT COST	53.93%
PERSONNEL COST	7.12%
CONSUMABLE COSTS	27.22%
OTHER COSTS	11.73%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Arm Roll Truck Loading Roll On/Roll Off Containers		
Capacity	8 0 cubic meters		
Capital Cost of Equipment	2,302,941 $JA		40000 $US/truck 2500 $US/container
Spare Parts	115,147	5 00% of Capital Cost	
Customs	1,088,140		
Total Capital Investment	3,506,228 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	6.4 trips/shift		20 km one way
Complete Loads per Shift	5 72 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 25 Tonnes/cubic meter		
Typical Productivity	11 4 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(3,506,228 @ int of	60 00% over life)		2,222,732
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
1 00 Workers	37,440	$JA/year	37,440
3 18 Attndts	31,200	$JA/year	99,106
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00%	of above	65,300
Benefits	5 00%	of above	14,148
Annual Personnel Costs/Shift			297,114
Annual Personnel Costs			297,114

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JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(9 0 litres/hr).(	28,080 litres@	10 0	$JA/ltr	280,800
Engine Oil	(1 50 litres/hr).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 03 litres/hr).(	94 litres@	60 0	$JA/ltr	5,616
Hydric Oil	(0.04 litres/hr).(	125 litres@	60 0	$JA/ltr	7,488
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	17 0 tires @	7000 0	$JA/ea	119,127
Brake Lnng	(600 repl hrs).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs).(	15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs).(	2 0 units	15000 0	$JA/ea	29,250
Filters	(60 repl hrs).(	39.0 sets @	250 0	$JA/set	9,750
Prot. Gear	(1000 repl hrs).(	6 2 sets @	2000 0	$JA/ea	12,480
Other	(15% additional over above costs)				130,517
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,000,628
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				483,618
Annual Cost of Equipment Unit If implemented during	1993				4,004,091

Tonnes Handled per year

(11.4 tonnes/day 312 days/yr 90% available) 3,211

Cost per Tonne 1,246.98 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 295 85 $JA

EQUIPMENT COST	55.51%
PERSONNEL COST	7.42%
CONSUMABLE COSTS	24.99%
OTHER COSTS	12.08%
TOTAL COST	100.00%

Table AR - 8 - DS — ARM ROLL

JAMAICA — Cost Comparisons

January 1993 — 30 $JA per US Dollar

Type of Equipment	Arm Roll Truck Loading Roll On/Roll Off Containers		
Capacity	8 0 cubic meters		
Capital Cost of Equipment	2,596,154 $JA		40000 $US/truck 2500 $US/container
Spare Parts	129,808	5 00% of Capital Cost	
Customs	1,226,683		
Total Capital Investment	3,952,644 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	8 3 trips/shift		10 km one way
Complete Loads per Shift	7.48 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 25 Tonnes/cubic meter		
Typical Productivity	15 0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(3,952,644 @ int of	60 00% over life)		2,505,732
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62 400
1 00 Workers	37,440	$JA/year	37,440
4 15 Attndts	31,200	$JA/year	129,600
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00% of above		74,448
Benefits	5 00% of above		16,130
Annual Personnel Costs/Shift			338,738
Annual Personnel Costs			338,738

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Table AR - 8 - DS — ARM ROLL

JAMAICA — Cost Comparisons — $JA

Consumables						
Fuel	(9.0 litres/hr	).(	28,080 litres@	10 0	$JA/ltr	280,800
Engine Oil	(1.50 litres/hr	).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 03 litres/hr	).(	94 litres@	60 0	$JA/ltr	5 616
Hydric Oil	(0 04 litres/hr	).(	125 litres@	60 0	$JA/ltr	7,488
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	$JA/ea	119,127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15.5 units @	2000 0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs	).(	2 0 units	15000 0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9,750
Prot Gear	(1000 repl hrs	).(	6 2 sets @	2000.0	$JA/ea	12,480
Other	(15% additional over above costs)					130,517
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,000,628
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					515,192
Annual Cost of Equipment Unit If implemented during	1993					4,390,291

Tonnes Handled per year				
(15.0 tonnes/day	312 days/yr	90% available)		4,199
Cost per Tonne			1,045.55 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		248 06 $JA	

EQUIPMENT COST	57 07%
PERSONNEL COST	7.72%
CONSUMABLE COSTS	22.79%
OTHER COSTS	12.42%
TOTAL COST	100.00%

Table AR-8-T — ARM ROLL

JAMAICA — Cost Comparisons

January 1993 — 30 $JA per US Dollar

Type of Equipment	Arm Roll Truck Loading Roll On/Roll Off Containers		
Capacity	8.0 cubic meters		
Capital Cost of Equipment		2,822,727 $JA	40000 $US/truck 2500 $US/container
Spare Parts		141,136	5.00% of Capital Cost
Customs		1,333,739	
Total Capital Investment		4,297,602 $JA	
Estimated Economic Life Based on Planned Use		5 years (replace containers mid-way)	
Number of Shifts per Day		1.00 shifts/day	
Hours of Operation/Year		3,120 hours/year	
Number of Trips per Shift		9.8 trips/shift	5 km one way
Complete Loads per Shift		9.84 loads/shift	
Typical Density of Solid Waste in Loaded Vehicle		0.25 Tonnes/cubic meter	
Typical Productivity		17.7 tonnes/day	

			$JA	SJA
Annualized Capital Cost, when purchased in 1993				
(4,297,602 @ int of	60.00% over life)			2,724,414
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year		62,400
1.00 Workers	37,440	$JA/year		37,440
4.91 Attndts	31,200	$JA/year		153,164
0.20 Workshp Prsonnl	56,160	$JA/year		11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year		7,488
0.10 Inspctn Personnl	0	$JA/year		0
Administration	30.00% of above			81,517
Benefits	5.00% of above			17,662
Annual Personnel Costs/Shift				370,903
Annual Personnel Costs				370,903

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Table AR-8-T — ARM ROLL

JAMAICA — Cost Comparisons — SJA

Consumables						
Fuel	(9.0 litres/hr)	(28,080 litres@	10.0	SJA/ltr		280,800
Engine Oil	(1.50 litres/hr)	(4,680 litres@	70.0	SJA/ltr		327,600
Trans Oil	(0.03 litres/hr)	(94 litres@	60.0	SJA/ltr		5,616
Hydric Oil	(0.04 litres/hr)	(125 litres@	60.0	SJA/ltr		7,488
(Wheels per Equipment Unit)		6				
Tires	(1100 repl hrs)	(17.0 tires @	7000.0	SJA/ea		119,127
Brake Lnng	(600 repl hrs)	(3.2 units @	1500.0	SJA/ea		46,800
Brake Drum	(1200 repl hrs)	(15.6 units @	2000.0	SJA/ea		31,200
Clutch Plt	(1600 repl hrs)	(2.0 units	15000.0	SJA/ea		29,250
Filters	(80 repl hrs)	(39.0 sets @	250.0	SJA/set		9,750
Prot. Gear	(1000 repl hrs)	(6.2 sets @	2000.0	SJA/ea		12,480
Other	(15% additional over above costs)					130,517
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,000,628
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					592,773
Annual Cost of Equipment Unit If implemented during	1993					4,688,718

Tonnes Handled per year				
(17.7 tonnes/day	312 days/yr	90% available)		4,963
Cost per Tonne			944.83 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		224.16 SJA	

EQUIPMENT COST	58.11%
PERSONNEL COST	7.91%
CONSUMABLE COSTS	21.34%
OTHER COSTS	12.64%
TOTAL COST	100.00%

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JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Farm Tractor of about 65 hp with Open Tipping Trailer		
Capacity	4 0 cubic meters		
Capital Cost of Equipment	1,350,000 $JA		35000 $US/tractor 5000 $US/trailer
Spare Parts	67,500	5 00% of Capital Cost	
Customs	637,875		
Total Capital Investment	2,055,375 $JA		
Estimated Economic Life Based on Planned Use	5 years (trailer replaced mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.6 trips/shift		30 km one way
Complete Loads per Shift	2 9 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 30 Tonnes/cubic meter		
Typical Productivity	3 5 tonnes/day		

			$JA
Annualized Capital Cost when purchased in 1993			
2,055,375 @ int of	60 00% over life)		1,302,931
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
2 00 Workers	37,440	$JA/year	74,880
0 00 Attndts	31,200	$JA/year	0
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00%	of above	46,800
Benefits	5 00%	of above	10,140
Annual Personnel Costs/Shift			212,940
Annual Personnel Costs			212,940

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JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(6 0 litres/hr).(	18,720 litres@	10 0	SJA/ltr	187,200
Engine Oil	(1 00 litres/hr).(	3,120 litres@	70 0	SJA/ltr	218,400
Trans Oil	(0 02 litres/hr).(	62 litres@	60 0	SJA/ltr	3,744
Hydric Oil	(0 15 litres/hr).(	468 litres@	60 0	SJA/ltr	28,080
(Wheels per Equipment Unit)		6			
Tires	(2000 repl hrs).(	9 4 tires @	7000 0	SJA/ea	65 520
Brake Lnng	(600 repl hrs).(	31 2 units @	1500 0	SJA/ea	46,800
Brake Drum	(1200 repl hrs).(	15 6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(2500 repl hrs).(	1 2 units	15000 0	SJA/ea	18,720
Filters	(80 repl hrs).(	39.0 sets @	250 0	SJA/set	9,750
Prot Gear	(1000 repl hrs).(	9.4 sets @	2000 0	SJA/ea	18,720
Other	(15% additional over above costs)				94,220
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					722,354
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc)	21% of capital cost of equipment				283,500
Annual Cost of Equipment Unit If implemented during	1993				2,521,775

Tonnes Handled per year

(3 5 tonnes/day 312 days/yr 90% available) 976

Cost per Tonne 2,582 83 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 612 78 SJA

EQUIPMENT COST	51.67%
PERSONNEL COST	8.44%
CONSUMABLE COSTS	28 64%
OTHER COSTS	11.24%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Farm Tractor of about 65 hp with Open Tipping Trailer		
Capacity	4.0 cubic meters		
Capital Cost of Equipment	1,350,000 $JA		35000 $US/tractor 5000 $US/trailer
Spare Parts	67,500	5.00% of Capital Cost	
Customs	637,875		
Total Capital Investment	2,055,375 $JA		
Estimated Economic Life Based on Planned Use	5 years (trailer replaced mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.1 trips/shift		20 km one way
Complete Loads per Shift	3.4 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	4.1 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(2,055,375 @ int of	60.00% over life)		1,302,981
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
2.00 Workers	37,440	$JA/year	74,880
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00% of above		46,800
Benefits	5.00% of above		10,140
Annual Personnal Costs/Shift			212,940
Annual Personnel Costs			212,940

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(6.0 litres/hr	).(	18,720 litres@	10.0	$JA/ltr	187,200
Engine Oil	(1.00 litres/hr	).(	3,120 litres@	70.0	$JA/ltr	218,400
Trans Oil	(0.02 litres/hr	).(	62 litres@	60.0	$JA/ltr	3,744
Hydric Oil	(0.15 litres/hr	).(	468 litres@	60.0	$JA/ltr	28,080
(Wheels per Equipment Unit)			6			
Tires	(2000 repl hrs	).(	9.4 tires @	7000.0	$JA/ea	65,520
Brake Lnng	(600 repl hrs	).(	31.2 units @	1500.0	$JA/ea	46,800
Brake Drum	(1200 repl hrs	).(	15.6 units @	2000.0	$JA/ea	31,200
Clutch Plt	(2500 repl hrs	).(	1.2 units	15000.0	$JA/ea	18,720
Filters	(80 repl hrs	).(	39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs	).(	9.4 sets @	2000.0	$JA/ea	18,720
Other	(15% additional over above costs)					91,220
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						722,354
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment					283,500
Annual Cost of Equipment Unit If implemented during	1993					2,521,775

Tonnes Handled per year				
(4.1 tonnes/day	312 days/yr	90% available)		1,144
	Cost per Tonne		2,204.85 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		523.10 $JA	

EQUIPMENT COST	51.67%
PERSONNEL COST	8.44%
CONSUMABLE COSTS	28.64%
OTHER COSTS	11.24%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Farm Tractor of about 65 hp with Open Tipping Trailer		
Capacity	4 0 cubic meters		
Capital Cost of Equipment	1,350,000 $JA		35000 $US/tractor 5000 $US/trailer
Spare Parts	67,500	5 00% of Capital Cost	
Customs	637,875		
Total Capital Investment	2,055,375 $JA		
Estimated Economic Life Based on Planned Use	5 years (trailer replaced mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.5 trips/shift		10 km one way
Complete Loads per Shift	3 8 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 30 Tonnes/cubic meter		
Typical Productivity	4 6 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(2,055,375 @ int of	60 00% over life)		1,302,981
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
2 00 Workers	37,440	$JA/year	74,880
0 00 Attndts	31,200	$JA/year	0
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00%	of above	46,800
Benefits	5.00%	of above	10,140
Annual Personnel Costs/Shift			212,940
Annual Personnel Costs			212,940

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(6 0 litres/hr)	(18,720 litres@	10 0	$JA/ltr	187,200
Engine Oil	(1 00 litres/hr)	(3,120 litres@	70 0	$JA/ltr	218,400
Trans Oil	(0 02 litres/hr)	(62 litres@	60 0	$JA/ltr	3,744
Hydric Oil	(0 15 litres/hr)	(468 litres@	60 0	$JA/ltr	28,080
(Wheels per Equipment Unit)		6			
Tires	(2000 repl hrs)	(9 4 tires @	7000 0	$JA/ea	65,520
Brake Lnng	(600 repl hrs)	(31.2 units @	1500 0	$JA/ea	46,800
Brake Drum	(1200 repl hrs)	(15 6 units @	2000 0	$JA/ea	31,200
Clutch Plt	(2500 repl hrs)	(1 2 units	15000 0	$JA/ea	18,720
Filters	(80 repl hrs)	(39 0 sets @	250 0	$JA/set	9,750
Prot. Gear	(1000 repl hrs)	(9.4 sets @	2000 0	$JA/ea	18,720
Other	(15% additional over above costs)				94,220
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					722,354
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc)	21% of capital cost of equipment				283,500
Annual Cost of Equipment Unit If implemented during	1993				2,521,775

Tonnes Handled per year

(4 6 tonnes/day 312 days/yr 90% available) 1,291

Cost per Tonne 1,952.87 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 463 32 $JA

EQUIPMENT COST	51.67%
PERSONNEL COST	8 44%
CONSUMABLE COSTS	28.64%
OTHER COSTS	11.24%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Farm Tractor of about 65 hp with Open Tipping Trailer		
Capacity	4.0 cubic meters		
Capital Cost of Equipment	1,350,000 $JA	35000 $US/tractor 5000 $US/trailer	
Spare Parts	67,500	5.00% of Capital Cost	
Customs	637,875		
Total Capital Investment	2,055,375 $JA		
Estimated Economic Life Based on Planned Use	5 years (trailer replaced mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.7 trips/shift	5 km one way	
Complete Loads per Shift	4.1 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	4.9 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(2,055,375 @ int of	60.00% over life)		1,302,981
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
2.00 Workers	37,440	$JA/year	74,880
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00% of above		46,800
Benefits	5.00% of above		10,140
Annual Personnel Costs/Shift			212,940
Annual Personnel Costs			212,940

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JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(6.0 litres/hr).(	18,720 litres@	10.0	SJA/ltr	187,200
Engine Oil	(1.00 litres/hr).(	3,120 litres@	70.0	SJA/ltr	218,400
Trans Oil	(0.02 litres/hr).(	62 litres@	60.0	SJA/ltr	3,744
Hydric Oil	(0.15 litres/hr).(	468 litres@	60.0	SJA/ltr	28,080
(Wheels per Equipment Unit)		6			
Tires	(2000 repl hrs).(	9.4 tires @	7000.0	SJA/ea	65,520
Brake Lining	(600 repl hrs).(	31.2 units @	1500.0	SJA/ea	46,800
Brake Drum	(1200 repl hrs).(	15.6 units @	2000.0	SJA/ea	31,200
Clutch Plt	(2500 repl hrs).(	1.2 units	15000.0	SJA/ea	18,720
Filters	(80 repl hrs).(	39.0 sets @	250.0	SJA/set	9,750
Prot. Gear	(1000 repl hrs).(	9.4 sets @	2000.0	SJA/ea	18,720
Other	(15% additional over above costs)				94,220
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					722,354
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes insurance, registration, etc.)	21% of capital cost of equipment				283,500
Annual Cost of Equipment Unit If implemented during	1993				2,521,775

Tonnes Handled per year			
(4.9 tonnes/day	312 days/yr	90% available)	1,380
	Cost per Tonne		1,826.88 SJA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		433.43 SJA

EQUIPMENT COST	51.67%
PERSONNEL COST	8.44%
CONSUMABLE COSTS	28.64%
OTHER COSTS	11.24%
TOTAL COST	100.00%

Table OT-13-DX OPEN TIPPER
JAMAICA Cost Comparisons
January 1993 30 SJA per US Dollar

Type of Equipment	Open Tipper, Manually Loaded from Dustbins		
Capacity	13.0 cubic meters		
Capital Cost of Equipment	1,500,000 SJA		50000 $US/truck
Spare Parts	75,000	5.00% of Capital Cost	
Customs	708,750		
Total Capital Investment	2,283,750 SJA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	1.9 trips/shift		30 km one way
Complete Loads per Shift	2.0 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	8.0 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993 (2,283,750 @ int of	60.00% over life)		1,447,756
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.15 Workshp Prsonnl	56,160	$JA/year	8,424
0.15 Suprvsry Prsonnl	74,880	$JA/year	11,232
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00%	of above	69,545
Benefits	5.00%	of above	15,068
Annual Personnel Costs/Shift			316,429
Annual Personnel Costs			316,429

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Table OT-13-DX OPEN TIPPER
JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(9.00 litres/hr).(	28,080 litres@	10.0	SJA/ltr	280,800
Engine Oil	(1.50 litres/hr).(	4,680 litres@	70.0	SJA/ltr	327,600
Trans Oil	(0.32 litres/hr).(	998 litres@	60.0	SJA/ltr	59,904
Hydric Oil	(0.11 litres/hr).(	343 litres@	60.0	SJA/ltr	20,592
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs).(	11.3 tires @	7000.0	SJA/ea	79,418
Brake Lnng	(600 repl hrs).(	20.8 units @	1500.0	SJA/ea	31,200
Brake Drum	(1200 repl hrs).(	10.4 units @	2000.0	SJA/ea	20,800
Clutch Plt	(1600 repl hrs).(	2.0 units	15000.0	SJA/ea	29,250
Filters	(80 repl hrs).(	39.0 sets @	250.0	SJA/set	9,750
Prot. Gear	(1000 repl hrs).(	15.6 sets @	2000.0	SJA/ea	31,200
Other	(15% additional over above costs)				133,577
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,024,091
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				315,000
Annual Cost of Equipment Unit If implemented during	1993				3,103,277

Tonnes Handled per year				
(8.0 tonnes/day	312 days/yr	90% available)		2,235
Cost per Tonne			1,388.24 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		329.36 SJA	

EQUIPMENT COST	46.65%
PERSONNEL COST	10.20%
CONSUMABLE COSTS	33.00%
OTHER COSTS	10.15%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Open Tipper. Manually Loaded from Dustbins		
Capacity	13 0 cubic meters		
Capital Cost of Equipment	1,500,000 $JA		50000 $US/truck
Spare Parts	75,000	5.00% of Capital Cost	
Customs	708,750		
Total Capital Investment	2,283,750 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.1 trips/shift		20 km one way
Complete Loads per Shift	2.3 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	8.9 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(2,283,750 @ int of	60 00% over life)		1,447,756
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
4 00 Workers	37,440	$JA/year	149,760
0 00 Attndts	31,200	$JA/year	0
0 15 Workshp Prsonnl	56,160	$JA/year	8,424
0 15 Supvsry Prsonnl	74,850	$JA/year	11,232
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00%	of above	69,545
Benefits	5 00%	of above	15,068
Annual Personnel Costs/Shift			316,429
Annual Personnel Costs			316,429

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JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(9 00 litres/hr).(	28,080 litres@	10 0	SJA/ltr	280,800
Engine Oil	(1 50 litres/hr).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0.32 litres/hr).(	998 litres@	60 0	SJA/ltr	59,904
Hydric Oil	(0.11 litres/hr).(	343 litres@	60 0	SJA/ltr	20,592
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs).(	11 3 tires @	7000 0	SJA/ea	79,418
Brake Lnng	(600 repl hrs).(	20 8 units @	1500 0	SJA/ea	31,200
Brake Drum	(1200 repl hrs).(	10 4 units @	2000 0	SJA/ea	20,800
Clutch Plt	(1600 repl hrs).(	2 0 units	15000 0	SJA/ea	29,250
Filters	(80 repl hrs).(	39 0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs).(	15.6 sets @	2000 0	SJA/ea	31,200
Other	(15% additional over above costs)				133,577
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,024,091
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				315,000
Annual Cost of Equipment Unit If implemented during	1993				3,103,277

Tonnes Handled per year

(8.9 tonnes/day 312 days/yr 90% available) 2,492

Cost per Tonne 1,245.12 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 295.41 SJA

EQUIPMENT COST	46.65%
PERSONNEL COST	10.20%
CONSUMABLE COSTS	33.00%
OTHER COSTS	10.15%
TOTAL COST	100 00%

Table OT-13-DS OPEN TIPPER
JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Open Tipper, Manually Loaded from Dustbins		
Capacity	10.0 cubic meters		
Capital Cost of Equipment	1,500,000 $JA		50000 $US/truck
Spare Parts	75,000	5.00% of Capital Cost	
Customs	708,750		
Total Capital Investment	2,283,750 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.2 trips/shift		10 km one way
Complete Loads per Shift	2.5 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	9.6 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993 (2,283,750 @ int of	60.00% over life)		1,447,756
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.15 Workshp Prsonnl	56,160	$JA/year	8,424
0.15 Suprvsry Prsonnl	74,880	$JA/year	11,232
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00% of above		69,545
Benefits	5.00% of above		15,068
Annual Personnel Costs/Shift			316,429
Annual Personnel Costs			316,429

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Table OT-13-DS OPEN TIPPER
JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(9.00 litres/hr).(	28,080 litres@	10.0	SJA/ltr	280,800
Engine Oil	(1.50 litres/hr).(	4,680 litres@	70.0	SJA/ltr	327,600
Trans Oil	(0.32 litres/hr).(	998 litres@	60.0	SJA/ltr	59,904
Hydric Oil	(0.11 litres/hr).(	343 litres@	60.0	SJA/ltr	20,592
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs).(	11.3 tires @	7000.0	SJA/ea	79,418
Brake Lnng	(600 repl hrs).(	20.8 units @	1500.0	SJA/ea	31,200
Brake Drum	(1200 repl hrs).(	10.4 units @	2000.0	SJA/ea	20,800
Clutch Plt	(1600 repl hrs).(	2.0 units	15000.0	SJA/ea	29,250
Filters	(80 repl hrs).(	39.0 sets @	250.0	SJA/set	9,750
Prot. Gear	(1000 repl hrs).(	15.6 sets @	2000.0	SJA/ea	31,200
Other	(15% additional over above costs)				133,577
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,024,091
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	21% of capital cost of equipment				315,000
Annual Cost of Equipment Unit If implemented during	1993				3,103,277

Tonnes Handled per year

(9.6 tonnes/day 312 days/yr 90% available) 2,699

Cost per Tonne 1,149.71 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 272.77 SJA

EQUIPMENT COST	45.65%
PERSONNEL COST	10.20%
CONSUMABLE COSTS	33.00%
OTHER COSTS	10.15%
TOTAL COST	100.00%

Table OT-13-T OPEN TIPPER
JAMAICA Cost Comparisons
January 1993 30 $JA per US Dollar

Type of Equipment	Open Tipper, Manually Loaded from Dustbins		
Capacity	13.0 cubic meters		
Capital Cost of Equipment	1,500,000 $JA		50000 $US/truck
Spare Parts	75,000	5.00% of Capital Cost	
Customs	708,750		
Total Capital Investment	2,283,750 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.3 trips/shift		5 km one way
Complete Loads per Shift	2.6 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	10.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(2,283,750 @ int of	60.00% over life)		1,447,756
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attnds	31,200	$JA/year	0
0.15 Workshp Prsonnl	56,160	$JA/year	8,424
0.15 Supryslry Prsonnl	74,880	$JA/year	11,232
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00% of above		69,545
Benefits	5.00% of above		15,068
Annual Personnel Costs/Shift			316,429
Annual Personnel Costs			316,429

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Table OT-13-T OPEN TIPPER
JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(9.00 litres/hr).(	28,080 litres@	10.0	$JA/ltr	280,800
Engine Oil	(1.50 litres/hr).(	4,680 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0.32 litres/hr).(	998 litres@	60.0	$JA/ltr	59,904
Hydric Oil	(0.11 litres/hr).(	343 litres@	60.0	$JA/ltr	20,592
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs).(	11.3 tires @	7000.0	$JA/ea	79,418
Brake Lnng	(600 repl hrs).(	20.8 units @	1500.0	$JA/ea	31,200
Brake Drum	(1200 repl hrs).(	10.4 units @	2000.0	$JA/ea	20,800
Clutch Plt	(1600 repl hrs).(	2.0 units	15000.0	$JA/ea	29,250
Filters	(80 repl hrs).(	39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs).(	15.6 sets @	2000.0	$JA/ea	31,200
Other	(15% additional over above costs)				133,577
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,024,091
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				315,000
Annual Cost of Equipment Unit If implemented during	1993				3,103,277

Tonnes Handled per year

(10.0 tonnes/day 312 days/yr 90% available) 2,816

Cost per Tonne 1,102.01 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 261.45 $JA

EQUIPMENT COST	46.65%
PERSONNEL COST	10.20%
CONSUMABLE COSTS	33.00%
OTHER COSTS	10.15%
TOTAL COST	100.00%

Table SK-6-DX
JAMAICA

SKIP
Cost Comparisons
30 $JA per US Dollar

January 1993

Type of Equipment	Container Lift (Skip) Truck Loading Set of Liftable Containers		
Capacity	6 0 cubic meters		
Capital Cost of Equipment	2,046,723 $JA		50000 $US/truck 1600 $US/container
Spare Parts	102,339	5 00% of Capital Cost	
Customs	967,105		
Total Capital Investment	3,116,227 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	4.7 trips/shift		30 km one way
Complete Loads per Shift	3 29 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 30 Tonnes/cubic meter		
Typical Productivity	5 9 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(3,116,227 @ int of	60 00% over life)		1,975,495
(reflects opportunity cost of capital, even if a grant)			
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
1 00 Workers	37,440	$JA/year	37,440
2 35 Attndts	31,200	$JA/year	73,252
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Supervsry Prsonnl	74,880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00%	of above	57,544
Benefits	5 00%	of above	12,468
Annual Personnel Costs/Shift			261,824
Annual Personnel Costs			261,824

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Table SK-6-DX
JAMAICA
Cost Comparisons
SKIP
$JA

Consumables						
Fuel	(9 0 litres/hr	).(	28,080 litres@	10 0	$JA/ltr	280 800
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	$JA/ltr	327,600
Trans Oil	(0 03 litres/hr	).(	94 litres@	60 0	$JA/ltr	5,616
Hydric Oil	(0.03 litres/hr	).(	94 litres@	60 0	$JA/ltr	5,616
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	$JA/ea	119 127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	$JA/ea	46 800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	$JA/ea	31 200
Clutch Plt	(1600 repl hrs	).(	2 0 units	15000 0	$JA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	$JA/set	9 750
Prot Gear	(1000 repl hrs	).(	14 8 sets @	2000 0	$JA/ea	29,626
Other	(15% additional over above costs)					132,808
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,018,194
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc)			21% of capital cost of equipment			429,824
A ial Cost of Equipment Unit If implemented during 1993						3,685,337

Tonnes Handled per year			
(5 9 tonnes/day	312 days/yr	90% available)	1,661
Cost per Tonne			2,218 27 $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		526 33 $JA

EQUIPMENT COST	53 60%
PERSONNEL COST	7.10%
CONSUMABLE COSTS	27 63%
OTHER COSTS	11.66%
TOTAL COST	100.00%

Type of Equipment	Container Lift (Skip) Truck Loading Set of Liftable Containers		
Capacity	6.0 cubic meters		
Capital Cost of Equipment	2,205,882 $JA		50000 $US/truck 1600 $US/container
Spare Parts	110,294	5.00%	of Capital Cost
Customs	1,042,279		
Total Capital Investment	3,358,456 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	6.4 trips/shift		20 km one way
Complete Loads per Shift	4.45 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	8.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(3,358,456 @ int of	60.00%	over life)	2,129,054
(reflects opportunity cost of capital, even if a grant)			
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
1.00 Workers	37,440	$JA/year	37,440
3.18 Attndts	31,200	$JA/year	99,106
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00%	of above	65,300
Benefits	5.00%	of above	14,148
Annual Personnel Costs/Shift			297,114
Annual Personnel Costs			297,114

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Consumables					
Fuel	(8.0 litres/hr).(	28,080 litres@	10.0	$JA/ltr	280,800
Engine Oil	(1.50 litres/hr).(	4,680 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0.03 litres/hr).(	94 litres@	60.0	$JA/ltr	5,616
Hydric Oil	(0.03 litres/hr).(	94 litres@	60.0	$JA/ltr	5,616
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	17.0 tires @	7000.0	$JA/ea	119,127
Brake Lnng	(600 repl hrs).(	31.2 units @	1500.0	$JA/ea	46,800
Brake Drum	(1200 repl hrs).(	15.6 units @	2000.0	$JA/ea	31,200
Clutch Plt	(1600 repl hrs).(	2.0 units	15000.0	$JA/ea	29,250
Filters	(30 repl hrs).(	39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs).(	17.4 sets @	2000.0	$JA/ea	34,797
Other	(15% additional over above costs)				133,583
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,024,140
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				483,235
Annual Cost of Equipment Unit If implemented during	1993				3,913,543

Tonnes Handled per year			
(8.0 tonnes/day	312 days/yr	90% available)	2,248
Cost per Tonne			1,741.12 $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		413.08 $JA

EQUIPMENT COST	54.40%
PERSONNEL COST	7.59%
CONSUMABLE COSTS	26.17%
OTHER COSTS	11.84%
TOTAL COST	100.00%

Table SK-6-DS
JAMAICA

SKIP
Cost Comparisons
30 SJA per US Dollar

January 1993

Type of Equipment	Container Lift (Skip) Truck Loading Set of Liftable Containers		
Capacity	6 0 cubic meters		
Capital Cost of Equipment	2,393,538 SJA		50000 $US/truck 1600 $US/container
Spare Parts	119,677	5.00%	of Capital Cost
Customs	1,130,947		
Total Capital Investment	3,644,162 SJA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	8 3 trips/shift		10 km one way
Complete Loads per Shift	5 82 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 30 Tonnes/cubic meter		
Typical Productivity	10.5 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993			
(3,644,162 @ int of	60.00%	over life)	2,310,174
(reflects opportunity cost of capital, even if a grant)			
Cost of Personnel/Shift			
1 00 Driver	62,400	SJA/year	62,400
1.00 Workers	37,440	SJA/year	37,440
4 15 Attndts	31,200	SJA/year	129,600
0 20 Workshp Prsonnl	56,160	SJA/year	11,232
0 10 Suprvsry Prsonnl	74,880	SJA/year	7,488
0 10 Inspctn Peronnl	0	SJA/year	0
Administration	30.00%	of above	74,448
Benefits	5.00%	of above	16,130
Annual Personnel Costs/Shift			338,738
Annual Personnel Costs			338,738

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Table SK-6-DS
JAMAICA

SKIP
Cost Comparisons
SJA

Consumables						
Fuel	(9 0 litres/hr	).(	28,080 litres@	10 0	SJA/ltr	280,800
Engine Oil	(1 50 litres/hr	).(	4,680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 03 litres/hr	).(	94 litres@	60 0	SJA/ltr	5,616
Hydrlc Oil	(0.03 litres/hr	).(	94 litres@	60 0	SJA/ltr	5,616
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	17 0 tires @	7000 0	SJA/ea	119 127
Brake Lnng	(600 repl hrs	).(	31 2 units @	1500 0	SJA/ea	46 800
Brake Drum	(1200 repl hrs	).(	15 6 units @	2000 0	SJA/ea	31,200
Clutch Plt	(1800 repl hrs	).(	2 0 units	15000 0	SJA/ea	29,250
Filters	(80 repl hrs	).(	39 0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs	).(	20 4 sets @	2000 0	SJA/ea	40 896
Other	(15% additional over above costs)					134 498
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,031,154
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc)	21 % of capital cost of equipment					502,643
Annual Cost of Equipment Unit If implemented during	1993					4,182,709

Tonnes Handled per year			
(10 5 tonnes/day	312 days/yr	90% available)	2 939
	Cost per Tonne	1,423 02 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)	337 61 SJA	

EQUIPMENT COST	55.23%
PERSONNEL COST	8.10%
CONSUMABLE COSTS	24 65%
OTHER COSTS	12.02%
TOTAL COST	100.00%

Table SK-6-T
JAMAICA

SKIP
Cost Comparisons
30 SJA per US Dollar

January 1993

Type of Equipment	Container Lift (Skip) Truck Loading Set of Liftable Containers		
Capacity	6.0 cubic meters		
Capital Cost of Equipment		2,538,545 SJA	50000 $US/truck 1600 $US/container
Spare Parts		126,927	5.00% of Capital Cost
Customs		1,199,403	
Total Capital Investment		3,864,935 SJA	
Estimated Economic Life Based on Planned Use		5 years (replace containers mid-way)	
Number of Shifts per Day		1.00 shifts/day	
Hours of Operation/Year		3,120 hours/year	
Number of Trips per Shift		9.8 trips/shift	5 km one way
Complete Loads per Shift		6.87 loads/shift	
Typical Density of Solid Waste in Loaded Vehicle		0.30 Tonnes/cubic meter	
Typical Productivity		12.4 tonnes/day	

			SJA	SJA
Annualized Capital Cost, when purchased in 1993				
(3,864,935 @ int of	60.00% over life)			2,450,130
(reflects opportunity cost of capital, even if a grant)				
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year		62,400
1.00 Workers	37,440	$JA/year		37,440
4.91 Attndts	31,200	$JA/year		153,164
0.20 Workshp Prsonnl	56,160	$JA/year		11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year		7,488
0.10 Inspctn Peronnl	0	$JA/year		0
Administration	30.00%	of above		81,517
Benefits	5.00%	of above		17,662
Annual Personnel Costs/Shift				370,903
Annual Personnel Costs				370,903

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Table SK-6-T
JAMAICA
Cost Comparisons
SKIP
SJA

Consumables					
Fuel	(9.0 litres/hr)	(28,080 litres@	10.0	SJA/ltr	280,800
Engine Oil	(1.50 litres/hr)	(4,680 litres@	70.0	SJA/ltr	327,600
Trans Oil	(0.03 litres/hr)	(94 litres@	60.0	SJA/ltr	5,616
Hydric Oil	(0.03 litres/hr)	(94 litres@	60.0	SJA/ltr	5,616
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(17.0 tires @	7000.0	SJA/ea	119,127
Brake Lnng	(600 repl hrs)	(31.2 units @	1500.0	SJA/ea	46,800
Brake Drum	(1200 repl hrs)	(15.6 units @	2000.0	SJA/ea	31,200
Clutch Plt	(1600 repl hrs)	(2.0 units	15000.0	SJA/ea	29,250
Filters	(60 repl hrs)	(39.0 sets @	250.0	SJA/set	9,750
Prot. Gear	(1000 repl hrs)	(22.8 sets @	2000.0	SJA/ea	45,609
Other	(15% additional over above costs)				135,205
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,036,573
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	21% of capital cost of equipment				533,095
Annual Cost of Equipment Unit If implemented during	1993				4,390,701

Tonnes Handled per year

(12.4 tonnes/day 312 days/yr 90% available) 3,474

Cost per Tonne 1,263.97 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 299.88 SJA

EQUIPMENT COST	55.80%
PERSONNEL COST	8.45%
CONSUMABLE COSTS	23.61%
OTHER COSTS	12.14%
TOTAL COST	100.00%

Table SL-8-DX SIDE LOADER
JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8 0 cubic meters		
Capital Cost of Equipment	1,200,000 SJA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	567,000		
Total Capital Investment	1,827,000 SJA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2 3 trips/shift		30 km one way
Complete Loads per Shift	2 0 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 30 Tonnes/cubic meter		
Typical Productivity	4 8 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993			
(1,827,000 @ int of	60 00% over life)		1,158,205
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
4 00 Workers	37,440	$JA/year	149,760
0 00 Attndts	31,200	$JA/year	0
0 20 Workshp Prsonnl	56,160	$JA/year	11,232
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0 10 Inspctn Peronnl	0	$JA/year	0
Administration	30 00% of above		69,264
Benefits	5.00% of above		15,007
Annual Personnel Costs/Shift			315,151
Annual Personnel Costs			315,151

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Table SL-8-DX SIDE LOADER
JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(5 00 litres/hr) (	15,600 litres@	10 0	SJA/ltr	156,000
Engine Oil	(1 50 litres/hr) (	4 680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 32 litres/hr) (	998 litres@	60 0	SJA/ltr	59,904
Hydric Oil	(0 11 litres/hr) (	343 litres@	60 0	SJA/ltr	20,592
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs) (	11 3 tires @	7000 0	SJA/ea	79,418
Brake Lnng	(600 repl hrs) (	20 8 units @	1500 0	SJ/ea	31,200
Brake Drum	(1200 repl hrs) (	10 4 units @	2000 0	SJA/ea	20,800
Clutch Plt	(1600 repl hrs) (	2 0 units	15000 0	SJA/ea	29,250
Filters	(80 repl hrs) (	39 0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs) (	15 6 sets @	2000 0	SJA/ea	31,200
Other	(15% additional over above costs)				114,857
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					880,571
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				252,000
Annual Cost of Equipment Unit If implemented during	1993				2,605,928

Tonnes Handled per year				
(4.8 tonnes/day	312 days/yr	90% available)		1 339
Cost per Tonne			1,946 05 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		461 70 SJA	

EQUIPMENT COST	44.45%
PERSONNEL COST	12 09%
CONSUMABLE COSTS	33.79%
OTHER COSTS	9.67%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1992 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	567,000		
Total Capital Investment	1,827,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	2.7 trips/shift		20 km one way
Complete Loads per Shift	2.28 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	5.5 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,827,000 @ int of	50.00% over life)		1,158,205
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00%	of above	69,264
Benefits	5.00%	of above	15,007
Annual Personnel Costs/Shift			315,151
Annual Personnel Costs			315,151

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JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(5.00 litres/hr)	(15,600 litres@	10.0	$JA/ltr	156,000
Engine Oil	(1.50 litres/hr)	(4,580 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0.32 litres/hr)	(998 litres@	60.0	$JA/ltr	59,904
Hydric Oil	(0.11 litres/hr)	(343 litres@	60.0	$JA/ltr	20,592
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs)	(11.3 tires @	7000.0	$JA/ea	79,418
Brake Lnng	(600 repl hrs)	(20.8 units @	1500.0	$JA/ea	31,200
Brake Drum	(1200 repl hrs)	(10.4 units @	2000.0	$JA/ea	20,800
Clutch Plt	(1600 repl hrs)	(2.0 units	15000.0	$JA/ea	29,250
Filters	(80 repl hrs)	(39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs)	(15.6 sets @	2000.0	$JA/ea	31,200
Other	(15% additional over above costs)				114,857
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					880,571
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				252,000
Annual Cost of Equipment Unit If implemented during	1993				2,605,928

Tonnes Handled per year			
(5.5 tonnes/day	312 days/yr	90% available)	1,539
Cost per Tonne			1,693.31 $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		401.74 $JA

EQUIPMENT COST	44.45%
PERSONNEL COST	12.09%
CONSUMABLE COSTS	33.79%
OTHER COSTS	9.67%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8 0 cubic meters		
Capital Cost of Equipment	1,200,000 SJA		40000 SUS/truck
Spare Parts	60,000	5 00% of Capital Cost	
Customs	567,000		
Total Capital Investment	1,827,000 SJA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3 0 trips/shift		10 km one way
Complete Loads per Shift	2 54 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 30 Tonnes/cubic meter		
Typical Productivity	6.1 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993 (1,827,000 @ int of	60.00%	over life)	1,158,205
Cost of Personnel/Shift			
1.00 Driver	62,400	SJA/year	62,400
4 00 Workers	37 440	SJA/year	149,760
0 00 Attndts	31 200	SJA/year	0
0 20 Workshp Prsonnl	56,160	SJA/year	11,232
0 10 Suprvsry Prsonnl	74,880	SJA/year	7,488
0 10 Inspctn Peronnl	0	SJA/year	0
Administration	30.00%	of above	69,264
Benefits	5.00%	of above	15,007
Annual Personnel Costs/Shift			315,151
Annual Personnel Costs			315,151

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(5.00 litres/hr	).(	15.600 litres@	10 0	SJA/ltr	156,000
Engine Oil	(1 50 litres/hr	).(	4.680 litres@	70 0	SJA/ltr	327,600
Trans Oil	(0 32 litres/hr	).(	998 litres@	60 0	SJA/ltr	59,904
Hydric Oil	(0 11 litres/hr	).(	343 litres@	60 0	SJA/ltr	20,592
(Wheels per Equipment Unit)			4			
Tires	(1100 repl hrs	).(	11.3 tires @	7000 0	SJA/ea	79 418
Brake Lnng	(600 repl hrs	) (	20 8 units @	1500 0	SJA/ea	31,200
Brake Drum	(1200 repl hrs	) (	10 4 units @	2000 0	SJA/ea	20 800
Clutch Plt	(800 repl hrs	).(	3 9 units	15000 0	SJA/ea	58,500
Filters	(80 repl hrs	).(	39 0 sets @	250 0	SJA/set	9,750
Prot Gear	(1000 repl hrs	).(	15 6 sets @	2000 0	SJA/ea	31,200
Other	(15% additional over above costs)					119,245
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						914,209
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc)			21% of capital cost of equipment			252,000
Annual Cost of Equipment Unit If implemented during			1993			2,639,565

Tonnes Handled per year				
(6 1 tonnes/day	312 days/yr	90% available)		1,709
	Cost per Tonne		1,544.51 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		366.43 SJA	

EQUIPMENT COST	43.88%
PERSONNEL COST	11.94%
CONSUMABLE COSTS	34.63%
OTHER COSTS	9.55%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	567,000		
Total Capital Investment	1,827,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3.2 trips/shift		5 km one way
Complete Loads per Shift	2.7 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	6.4 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,827,000 @ int of	60.00% over life)		1,158,205
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	0	$JA/year	0
Administration	30.00% of above		69,264
Benefits	5.00% of above		15,007
Annual Personnel Costs/Shift			315,151
Annual Personnel Costs			315,151

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(5.00 litres/hr).(	15,600 litres@	10.0	$JA/ltr	156,000
Engine Oil	(1.50 litres/hr).(	4,680 litres@	70.0	$JA/ltr	327,600
Trans Oil	(0.32 litres/hr).(	998 litres@	60.0	$JA/ltr	59,904
Hydric Oil	(0.11 litres/hr).(	343 litres@	60.0	$JA/ltr	20,592
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs).(	11.3 tires @	7000.0	$JA/ea	79,418
Brake Lnng	(600 repl hrs).(	20.8 units @	1500.0	$JA/ea	31,200
Brake Drum	(1200 repl hrs).(	10.4 units @	2000.0	$JA/ea	20,800
Clutch Plt	(1600 repl hrs).(	2.0 units	15000.0	$JA/ea	29,250
Filters	(80 repl hrs).(	39.0 sets @	250.0	$JA/set	9,750
Prot. Gear	(1000 repl hrs).(	15.6 sets @	2000.0	$JA/ea	31,200
Other	(15% additional over above costs)				114,857
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					880,571
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	21% of capital cost of equipment				252,000
Annual Cost of Equipment Unit If implemented during	1993				2,605,928

Tonnes Handled per year			
(6.4 tonnes/day	312 days/yr	90% available)	1,809
Cost per Tonne			1,440.58 $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		341.78 $JA

EQUIPMENT COST	44.45%
PERSONNEL COST	12.09%
CONSUMABLE COSTS	33.79%
OTHER COSTS	9.67%
TOTAL COST	100.00%

Table TT - 50 - DX — TRANSFER TRK

JAMAICA — Cost Comparisons

January 1993 — 30 SJA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site	
Capacity	50 0 cubic meters (useable space – minus ejection system)	
Capital Cost of Equipment	4,800,000 SJA	80000 $US/truck tractor 40000 $US/trailer+eject
Spare Parts	240,000	5 00% of Capital Cost
Customs	2,268,000	
Total Capital Investment	7,308,000 SJA	
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)	
Number of Shifts per Day	1.0 shifts/day	
Hours of Operation/Year	3,120 hours/year	
Number of Trips per Shift	4.0 trips/shift	30 km one way
Complete Loads per Shift	3 6 loads/shift	
Typical Density of Solid Waste in Loaded Vehicle	0 35 Tonnes/cubic meter	
Typical Productivity	54.0 tonnes/day	

			$JA
Annualized Capital Cost, when purchased in 1993 (7,308,000 @ int of 60.00% over life)			4,632,820
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
0.00 Workers	37,440	$JA/year	0
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	0	$JA/year	0
Administration	30.00% of above		31,637
Benefits	5.00% of above		5,273
Annual Personnel Costs/Shift			142,366
Annual Personnel Costs			142,366

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Table TT - 50 - DX — TRANSFER TRK

JAMAICA — Cost Comparisons — SJA

Consumables					
Fuel	(15 0 litres/hr)	(46,800 litres@	10 0	SJA/ltr	468 000
Engine Oil	(1.70 litres/hr)	(5 304 litres@	70 0	SJA/ltr	371,280
Trans Oil	(0 04 litres/hr)	(125 litres@	60 0	SJA/ltr	7,488
Hydric Oil	(0 04 litres/hr)	(125 litres@	60 0	SJA/ltr	7,488
(Wheels per Equipment Unit)		14			
Tires	(1500 repl hrs)	(29 1 tires @	10500 0	SJA/ea	293 840
Brake Lnng	(600 repl hrs)	(72 8 units @	1500 0	SJA/ea	109 200
Brake Drum	(1200 repl hrs)	(36 4 units @	2000 0	SJA/ea	72 800
Clutch Plt	(1600 repl hrs)	(2 0 units	15000 0	SJA/ea	29 250
Filters	(80 repl hrs)	(39.0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs)	(3.1 sets @	2000 0	SJA/ea	6,240
Other	(15% additional over above costs)				192 300
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,478,136
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				1,008,000
Annual Cost of Equipment Unit If implemented during	1993				7,261,322

Tonnes Handled per year				
(54 0 tonnes/day	312 days/yr	90% available)		15,163
Cost per Tonne			478 88 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		113 61 SJA	

EQUIPMENT COST	63.80%
PERSONNEL COST	1.96%
CONSUMABLE COSTS	20.36%
OTHER COSTS	13.88%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50 0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 SJA		80000 $US/truck tractor 40000 $US/trailer + eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	2,268,000		
Total Capital Investment	7,308,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	5.1 trips/shift		20 km one way
Complete Loads per Shift	4.6 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 35 Tonnes/cubic meter		
Typical Productivity	69 4 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993			
(7,308,000 @ int of	60 00% over life)		4,632,820
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
1 00 Workers	37,440	$JA/year	0
1 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0 20 Inspctn Peronnl	0	$JA/year	0
Administration	30.00% of above		31,637
Benefits	5 00% of above		5,273
Annual Personnel Costs/Shift			142,366
Annual Personnel Costs			142,366

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(15.0 litres/hr)	(46,800 litres@	10.0	SJA/ltr	468,000
Engine Oil	(1.70 litres/hr)	(5 304 litres@	70 0	SJA/ltr	371,280
Trans Oil	(0 04 litres/hr)	(125 litres@	60 0	SJA/ltr	7,488
Hydrlc Oil	(0.04 litres/hr)	(125 litres@	60 0	SJA/ltr	7,488
(Wheels per Equipment Unit)		18			
Tires	(1500 repl hrs)	(29 1 tires @	10500 0	SJA/ea	203,840
Brake Lnng	(600 repl hrs)	(72 8 units @	1500 0	SJA/ea	109,200
Brake Drum	(1200 repl hrs)	(36 4 units @	2000 0	SJA/ea	72,800
Clutch Plt	(1600 repl hrs)	(2 0 units	15000 0	SJA/ea	29,250
Filters	(80 repl hrs)	(39 0 sets @	250 0	SJA/set	9 750
Prot. Gear	(1000 repl hrs)	(3.1 sets @	2000 0	SJA/ea	6,240
Other	(15% additional over above costs)				192,800
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,478,136
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	21% of capital cost of equipment				1,008,000
Annual Cost of Equipment Unit If implemented during	1993				7,261,322

Tonnes Handled per year

(69.4 tonnes/day 312 days/yr 90% available) 19 496

Cost per Tonne 372 46 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 88.37 SJA

EQUIPMENT COST	63 80%
PERSONNEL COST	1.96%
CONSUMABLE COSTS	20.36%
OTHER COSTS	13 58%
TOTAL COST	100.00%

January 1993 30 SJA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 SJA		80000 SUS/truck tractor 40000 SUS/trailer + eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	2,268,000		
Total Capital Investment	7,308,000 SJA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	6.4 trips/shift		10 km one way
Complete Loads per Shift	5.7 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	85.8 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in			1993	
(7,308,000 @ int of	60.00% over life)			4,632,820
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year		62,400
0.00 Workers	37,440	$JA/year		0
0.00 Attndts	31,200	$JA/year		0
0.50 Workshp Prsonnl	56,160	$JA/year		28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0.20 Inspctn Peronnl	0	$JA/year		0
Administration	30.00%	of above		31,637
Benefits	5.00%	of above		5,273
Annual Personnel Costs/Shift				142,366
Annual Personnel Costs				142,366

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Consumables						
Fuel	(15.0 litres/hr)	(46,800 litres@	10.0	SJA/ltr	488,000
Engine Oil	(1.70 litres/hr)	(5,304 litres@	70.0	SJA/ltr	371,280
Trans Oil	(0.04 litres/hr)	(125 litres@	60.0	SJA/ltr	7,488
Hydric Oil	(0.04 litres/hr)	(125 litres@	60.0	SJA/ltr	7,488
(Wheels per Equipment Unit)		14			
Tires	(1500 repl hrs)	(29.1 tires @	10500.0	SJA/ea	203,840
Brake Lnng	(600 repl hrs)	(72.8 units @	1500.0	SJA/ea	109,200
Brake Drum	(1200 repl hrs)	(36.4 units @	2000.0	SJA/ea	72,800
Clutch Plt	(1600 repl hrs)	(2.0 units	15000.0	SJA/ea	29,250
Filters	(80 repl hrs)	(39.0 sets @	250.0	SJA/set	9,750
Prot. Gear	(1000 repl hrs)	(3.1 sets @	2000.0	SJA/ea	6,240
Other	(15% additional over above costs)				192,800
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,478,136
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	21% of capital cost of equipment				1,008,000
Annual Cost of Equipment Unit If implemented during	1993				7,261,322

Tonnes Handled per year				
(85.8 tonnes/day	312 days/yr	90% available)		24,083
Cost per Tonne			301.52 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		71.53 SJA	

EQUIPMENT COST	63.80%
PERSONNEL COST	1.96%
CONSUMABLE COSTS	20.36%
OTHER COSTS	13.88%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50 0 cubic meters (useable space -- minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer + eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	2,268,000		
Total Capital Investment	7,308,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	7 2 trips/shift		5 km one way
Complete Loads per Shift	6 5 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 35 Tonnes/cubic meter		
Typical Productivity	97 2 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in 1993				
(7,308,000 @ int of	60 00% over life)			4,632,820
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
0 00 Workers	37,440	$JA/year		0
0 00 Attndts	31,200	$JA/year		0
0.50 Workshp Prsonnl	56,160	$JA/year		23,080
0 20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0 20 Inspctn Peronnl	0	$JA/year		0
Administration	30.00%	of above		31,637
Benefits	5.00%	of above		5,273
Annual Personnel Costs/Shift				142,366
Annual Personnel Costs				142,366

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(15 0 litres/hr	).(	46,300 litres@	10 0	SJA/ltr	468,000
Engine Oil	(1.70 litres/hr	).(	5 304 litres@	70 0	SJA/ltr	371,280
Trans Oil	(0 04 litres/hr	).(	125 litres@	60 0	SJA/ltr	7,488
Hydric Oil	(0.04 litres/hr	).(	125 litres@	60 0	SJA/ltr	7,488
(Wheels per Equipment Unit)			14			
Tires	(1500 repl hrs	).(	29 1 tires @	10500 0	SJA/ea	203,840
Brake Lnng	(600 repl hrs	).(	72 8 units @	1500 0	SJA/ea	109,200
Brake Drum	(1200 repl hrs	).(	36 4 units @	2000 0	SJA/ea	72,800
Clutch Plt	(1600 repl hrs	).(	2 0 units	15000 0	SJA/ea	29,250
Filters	(80 repl hrs	).(	39.0 sets @	250 0	SJA/set	9,750
Prot. Gear	(1000 repl hrs	).(	3 1 sets @	2000 0	SJA/ea	6,240
Other	(15% additional over above costs)					192,800
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,478,136
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc)			21% of capital cost of equipment			1,008,000
Annual Cost of Equipment Unit If implemented during			1993			7,261,322

Tonnes Handled per year				
(97 2 tonnes/day	312 days/yr	90% available)		27,294
	Cost per Tonne		266 04 SJA	
Ave. Cost per Person (	0.24 tonnes/cap/yr)		63 12 SJA	

EQUIPMENT COST	63 80%
PERSONNEL COST	1.96%
CONSUMABLE COSTS	20 36%
OTHER COSTS	13.88%
TOTAL COST	100.00%

MONTEGO BAY GREATER METROPOLITAN AREA

JAMAICA

ANALYSIS OF SOLID WASTE COLLECTION EQUIPMENT

PUBLIC SECTOR SERVICE COSTS

PUBLIC SECTOR SERVICE COSTS

ASSUMPTIONS:

1. Typically Western Parks and Markets is provided with new equipment by the Ministry of Local Government.

2. Borrowing for purchase of equipment and spares, including shipping and customs duties, is assumed to be at the interest rate which the government uses to finance its treasure bonds, i.e., currently 43% per year.

3. Customs duties and brokerage charges are estimated to cost about 5% of total equipment and spares purchase costs.

4. Western Parks and Markets is not required to fully cover all insurance needs, because of hidden subsidies when the government accepts responsibility for repair and replacement costs, insurance at 11% of capital cost per year is assumed.

5. While equipment may last many years, an economic life of 5 years is assumed, based on economic life calculations conducted in many other countries which indicate a range of 5 to 8 years is possible depending on road conditions, driver skills, and preventative maintenance efforts.

6. Western Parks and Markets typically operates one shift daily, for a period of about 8 hours, without overtime pay.

7. Loading rates are estimated based on observations and interviews conducted in Montego Bay in November 1993. Much more data of this kind would be needed to have definitive costing results. No differences were observed between the productivity of the private sector workers versus the Western Parks and Markets workers, which is not unusual given there is no significant difference in their respective compensation.

8. Personnel salaries are currently set by the Ministry of Local Government, and are the same for both the private and public sector.

9. Benefits provided are currently minimal. Social security is provided; medical assistance and disability pay for on-the-job injuries is provided; and medical insurance is planned for the coming year... at an assumed total cost of 15% of salaries.

10. Consumables are purchased at market rates.

11. Downtime is low, because repairs are made immediately at private workshops, but higher than the private sector because there are fewer disincentives to maximize performance. It is assumed that the fleet is 80% available.

HOW ARE THE TABLES LABELED?

1. The tables providing costs for each truck type have a three part label, i.e., Table AR-15-DS. The first part (AR) indicates the type of truck, i.e., Arm Roll. The second part (15) indicates the capacity of the truck, i.e., 15 cubic meters. The third part (DS) indicates the one way distance traveled, i.e., direct short distance.

2. The types of trucks analyzed are as follows:

   AR - Arm Roll
   SK - Skip Lift
   SL - Side Loader
   FT - Farm Tractor
   TT - Transfer Trailer
   FC - Front End Loader lifting Containers
   RC - Rear End Loader lifting Containers
   RL - Rear End Loader (manually loaded)
   RP - Roto Packer (special type of rear end loader)

3. The distances analyzed are as follows:

   DX - direct extra long - 30 km one way
   DL - direct long - 20 km one way
   DS - direct short - 10 km one way
   T - transfer (or direct very short) - 5 km one way

4. The round-trip travel times for Montego Bay (including 10 minutes to unload at the dump site) are assumed as follows:

   DX - 105 minutes, 40 km/hour speed
   DL - 75 minutes, 40 km/hour speed
   DS - 55 minutes, 30 km/hour
   T - 45 minutes, 20 km/hour

5. The loading times and stop-to-stop times for various equipment units are assumed as follows:

   AR, SK - 10 minutes to pick up roll on/roll off or skip container
   OT, SL, RP - 12 minutes to load each c.m., 30 minutes of total stop-to-stop time
   RL - 9 minutes to load each c.m., 30 minutes of total stop-to-stop time
   RC, FC - 2 minutes to load each c.m., 40 minutes of total stop-to-stop time
   FT - 10 minutes to load each c.m., 60 minutes of total stop-to-stop time
   TT - 30 minutes to fill trailer by gravity feed from an unloading platform

1	B	C	D	E	F
2					
3			JAMAICA		ECON-T.WK1
4			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
5			5.0 KM ONE WAY TO UNLOAD		
6			Exchange/$USD:	30 $JA	
7					
8	CAPACITY:	FRONT END CONTAINERS	REAR END CONTAINERS	REAR END MANUAL	REAR END MANUAL
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	8,736	7,719	3,941	2,859
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	19,569,375	13,915,555	3,307,500	2,315,250
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	3,913,875	2,783,111	661,500	463,050
22	Personnel	635,556	555,599	329,199	329,199
23	Consumables	910,797	853,175	924,660	863,077
24	Special Site Costs	0	112,463	0	0
25	Miscellaneous	1,952,500	1,388,400	330,000	231,000
26					
27	Total (with i)	13,071,500	9,716,634	3,201,771	2,555,814
28					
29	Cost per Tonne (with i)	1,496	1,259	812	894
30					
31					
32					
33	CAPACITY:	ROTO PACKER MANUAL			
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	2,320			
38					
39	ECONOMIC LIFE:				
40	Years	5			
41					
42	COSTS:				
43	Initial Cost per Unit	2,149,875			
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	429,975			
47	Personnel	286,143			
48	Consumables	863,077			
49	Special Site Costs	0			
50	Miscellaneous	214,500			
51					
52	Total (with i)	2,415,363			
53					
54	Cost per Tonne (with i)	1,041			
55					
56					
57					
58	14-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-T.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			5.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD:	30 $JA	
6					
7		ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
8	CAPACITY:				
9	Size per Unit, cubic meters	15.0	8.0	4.0	13.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	7,719	3,431	954	1,947
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	3,698,386	2,751,239	1,488,375	1,653,750
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	739,677	550,248	297,675	330,750
22	Personnel	349,748	349,748	232,323	341,309
23	Consumables	829,206	800,502	577,883	819,273
24	Special Site Costs	0	0	0	0
25	Miscellaneous	369,000	274,500	148,500	165,000
26					
27	Total (with i)	3,357,075	2,770,559	1,686,767	2,134,538
28					
29	Cost per Tonne (with i)	435	808	1,767	1,096
30					
31					
32		SKIP LIFT	SIDE LOADER	TRANSFER TRUCK	
33	CAPACITY:				
34	Size per Unit, cubic meters	6.0	8.0	50.0	
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	2,402	1,251	18,870	
38					
39	ECONOMIC LIFE:				
40	Years	5	5	5	
41					
42	COSTS:				
43	Initial Cost per Unit	2,567,823	1,323,000	5,292,000	
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	513,565	264,600	1,058,400	
47	Personnel	349,748	339,963	163,363	
48	Consumables	822,996	704,457	1,182,509	
49	Special Site Costs	0	0	0	
50	Miscellaneous	256,200	132,000	528,000	
51					
52	Total (with i)	2,685,032	1,823,585	4,462,531	
53					
54	Cost per Tonne (with i)	1,118	1,458	236	
55					
56					
57					
58	16-Jan-94				

1	B	C	D	E	F
2					
3			JAMAICA,		ECON–DS.WK1
4			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
5			10.0 KM ONE WAY TO UNLOAD		
6			Exchange/$USD:	30 $JA	
7					
8	CAPACITY:	FRONT END CONTAINERS	REAR END CONTAINERS	REAR END MANUAL	REAR END MANUAL
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	8,134	7,130	3,782	2,696
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	18,504,892	13,105,779	3,307,500	2,315,250
19					
20	Annual Cost per Unit				
21	Straight–Line Depreciation	3,700,978	2,621,156	661,500	463,050
22	Personnel	613,686	534,208	329,199	329,199
23	Consumables	910,797	850,437	924,660	863,077
24	Special Site Costs	0	103,878	0	0
25	Miscellaneous	1,846,293	1,307,606	330,000	231,000
26					
27	Total (with i)	12,422,715	9,207,013	3,201,771	2,555,814
28					
29	Cost per Tonne (with i)	1,527	1,291	847	948
30					
31					
32		ROTO PACKER MANUAL			
33	CAPACITY:				
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	2,200			
38					
39	ECONOMIC LIFE:				
40	Years	5			
41					
42	COSTS:				
43	Initial Cost per Unit	2,149,875			
44					
45	Annual Cost per Unit				
46	Straight–Line Depreciation	429,975			
47	Personnel	286,143			
48	Consumables	863,077			
49	Special Site Costs	0			
50	Miscellaneous	214,500			
51					
52	Total (with i)	2,415,363			
53					
54	Cost per Tonne (with i)	1,098			
55					
56					
57					
58	14–Jan–94				

1	B	C	D	E	F
2			JAMAICA		ECON-DS.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			10.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD:	30 $JA	
6					
7		ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
8	CAPACITY:				
9	Size per Unit, cubic meters	15.0	8.0	4.0	13.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	5,443	2,903	893	1,866
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	3,465,242	2,556,952	1,488,375	1,653,750
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	693,048	511,390	297,675	330,750
22	Personnel	323,403	323,403	232,323	341,309
23	Consumables	829,206	800,502	577,883	819,273
24	Special Site Costs	0	0	0	0
25	Miscellaneous	345,738	255,115	148,500	165,000
26					
27	Total (with i)	3,193,422	2,629,791	1,686,767	2,134,538
28					
29	Cost per Tonne (with i)	587	906	1,889	1,144
30					
31					
32		SKIP LIFT	SIDE LOADER	TRANSFER TRUCK	
33	CAPACITY:				
34	Size per Unit, cubic meters	6.0	8.0	50.0	
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	2,032	1,182	16,650	
38					
39	ECONOMIC LIFE:				
40	Years	5	5	5	
41					
42	COSTS:				
43	Initial Cost per Unit	2,443,479	1,323,000	5,292,000	
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	488,696	264,600	1,058,400	
47	Personnel	323,403	339,963	163 363	
48	Consumables	819,624	731,367	1,182,509	
49	Special Site Costs	0	0	0	
50	Miscellaneous	243,794	132,000	528,000	
51					
52	Total (with i)	2,582,084	1,850,495	4,462,531	
53					
54	Cost per Tonne (with i)	1,271	1,566	268	
55					
56					
57					
58		16-Jan-94			

1	B	C	D	E	F
2			JAMAICA		ECON-DL.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			20.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD:	30 $JA	
6					
7		FRONT END CONTAINERS	REAR END CONTAINERS	REAR END MANUAL	REAR END MANUAL
8	CAPACITY:				
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	7,148	6,186	3,498	2,419
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	16,763,011	11,807,994	3,307,500	2,315,250
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	3,352,602	2,361,599	661,500	463,050
22	Personnel	577,898	499,926	329,199	329,199
23	Consumables	910,797	846,049	924,660	863,077
24	Special Site Costs	0	90,119	0	0
25	Miscellaneous	1,672,500	1,178,122	330,000	231,000
26					
27	Total (with i)	11,361,067	8,390,269	3,201,771	2,555,814
28					
29	Cost per Tonne (with i)	1,589	1,356	915	1,056
30					
31					
32		ROTO PACKER MANUAL			
33	CAPACITY:				
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	1,993			
38					
39	ECONOMIC LIFE:				
40	Years	5			
41					
42	COSTS:				
43	Initial Cost per Unit	2,149,875			
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	429,975			
47	Personnel	286,143			
48	Consumables	863,077			
49	Special Site Costs	0			
50	Miscellaneous	214,500			
51					
52	Total (with i)	2,415,363			
53					
54	Cost per Tonne (with i)	1,212			
55					
56					
57					
58	14-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-DL.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			20.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD:	30 $JA	
6					
7		ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
8	CAPACITY:				
9	Size per Unit, cubic meters	15.0	8.0	4.0	13.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	4,162	2,220	791	1,723
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	3,163,526	2,305,522	1,488,375	1,653,750
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	632,705	461,104	297,675	330,750
22	Personnel	289,309	289,309	232,323	341,309
23	Consumables	829,206	800,502	577,883	819,273
24	Special Site Costs	0	0	0	0
25	Miscellaneous	315,635	230,029	148,500	165,000
26					
27	Total (with i)	2,981,636	2,447,620	1,686,767	2,134,538
28					
29	Cost per Tonne (with i)	716	1,103	2,135	1,239
30					
31					
32		SKIP LIFT	SIDE LOADER	TRANSFER TRUCK	
33	CAPACITY:				
34	Size per Unit, cubic meters	6.0	8.0	50.0	
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	1,554	1,064	13,478	
38					
39	ECONOMIC LIFE:				
40	Years	5	5	5	
41					
42	COSTS:				
43	Initial Cost per Unit	2,282,564	1,323,000	5,292,000	
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	456,513	264,600	1,058,400	
47	Personnel	289,309	339,963	163,363	
48	Consumables	815,260	704,457	1,182,509	
49	Special Site Costs	0	0	0	
50	Miscellaneous	227,739	132,000	528,000	
51					
52	Total (with i)	2,448,857	1,823,585	4,462,531	
53					
54	Cost per Tonne (with i)	1,576	1,714	331	
55					
56					
57					
58	16-Jan-94				

1	B	C	D	E	F
2					
3			JAMAICA		ECON-DX.WK1
4			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
5			30.0 KM ONE WAY TO UNLOAD		
6			Exchange/$USD:	30 $JA	
7					
8	CAPACITY:	FRONT END CONTAINERS	REAR END CONTAINERS	REAR END MANUAL	REAR END MANUAL
9	Size per Unit, cubic meters	25.0	18.0	18.0	10.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	6,048	5,161	3,145	2,097
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	14,820,144	10,399,072	3,307,500	2,315,250
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	2,964,029	2,079,814	661,500	463,050
22	Personnel	537,980	462,708	329,199	329,199
23	Consumables	910,797	841,285	924,660	863,077
24	Special Site Costs	0	75,182	0	0
25	Miscellaneous	1,478,654	1,037,549	330,000	231,000
26					
27	Total (with i)	10,176,922	7,503,583	3,201,771	2,555,814
28					
29	Cost per Tonne (with i)	1,683	1,454	1,018	1,219
30					
31					
32		ROTO PACKER MANUAL			
33	CAPACITY:				
34	Size per Unit, cubic meters	9.0			
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	1,747			
38					
39	ECONOMIC LIFE:				
40	Years	5			
41					
42	COSTS:				
43	Initial Cost per Unit	2,149,875			
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	429,975			
47	Personnel	286,143			
48	Consumables	863,077			
49	Special Site Costs	0			
50	Miscellaneous	214,500			
51					
52	Total (with i)	2,415,363			
53					
54	Cost per Tonne (with i)	1,382			
55					
56					
57					
58	14-Jan-94				

1	B	C	D	E	F
2			JAMAICA		ECON-DX.WK1
3			ECONOMIC ANALYSIS OF COLLECTION AND TRANSPORT SYSTEMS		
4			30.0 KM ONE WAY TO UNLOAD		
5			Exchange/$USD:	30 $JA	
6					
7		ARM ROLL	ARM ROLL	FARM TRACTOR	OPEN TIPPER
8	CAPACITY:				
9	Size per Unit, cubic meters	15.0	8.0	4.0	13.0
10					
11	PRODUCTIVITY:				
12	Tonnes per Year	3,077	1,641	675	1,545
13					
14	ECONOMIC LIFE:				
15	Years	5	5	5	5
16					
17	COSTS:				
18	Initial Cost per Unit	2,907,724	2,092,353	1,488,375	1,653,750
19					
20	Annual Cost per Unit				
21	Straight-Line Depreciation	581,545	418,471	297,675	330,750
22	Personnel	260,403	260,403	232,323	341,309
23	Consumables	829,206	800,502	577,883	819,273
24	Special Site Costs	0	0	0	0
25	Miscellaneous	290,113	208,761	148,500	165,000
26					
27	Total (with i)	2,802,078	2,293,171	1,666,767	2,134,538
28					
29	Cost per Tonne (with i)	911	1,398	2 499	1,381
30					
31					
32		SKIP LIFT	SIDE LOADER TRANSFER TRUCK		
33	CAPACITY:				
34	Size per Unit, cubic meters	6.0	8.0	50.0	
35					
36	PRODUCTIVITY:				
37	Tonnes per Year	1,149	926	10,483	
38					
39	ECONOMIC LIFE:				
40	Years	5	5	5	
41					
42	COSTS:				
43	Initial Cost per Unit	2,146,136	1,323,000	5,292,000	
44					
45	Annual Cost per Unit				
46	Straight-Line Depreciation	429,227	264,600	1,058,400	
47	Personnel	260,403	339,963	163,363	
48	Consumables	811,560	704,457	1,182,509	
49	Special Site Costs	0	0	0	
50	Miscellaneous	214,127	132,000	528,000	
51					
52	Total (with i)	2,335,903	1,823,585	4,462,531	
53					
54	Cost per Tonne (with i)	2,034	1,970	426	
55					
56					
57					
58	16-Jan-94				

Table FC--25 -DX
JAMAICA Cost Comparisons

FEL CONT

January 1993

30 $JA per US Dollar

Type of Equipment	Front End Loader, Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25.0 cubic meters		
Capital Cost of Equipment	13,442,308 SJA	125000	
		4000	
Spare Parts	672,115	5% of Capital Cost of Equipment	
Customs	705,721		
Total Capital Investment	14,820,144 SJA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.2 trips/shift	30 km one way	
Complete Loads per Shift	1.94 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	24 tonnes/day		

				SJA
Annualized Capital Cost, when purchased in 1993 (14,820,144 @ int. of 43.00% over life utilized)				7,249,490
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year	62,400	
1.00 Workers	37,440	$JA/year	37,440	
4.90 Attndts	31,200	$JA/year	152,727	
1.00 Workshp Prsonnl	56,160	$JA/year	56,160	
0.50 Suprvsry Prsonnl	74,880	$JA/year	37,440	
0.50 Inspctn Peronnl	56,160	$JA/year	28,080	
Administration	25% of above		93,562	
Benefits	15% of above		70,171	
Annual Personnel Costs/Shift			537,980	
Annual Personnel Costs			537,980	

13-Jan-94

Table FC-25-DX
JAMAICA Cost Comparisons

FEL CONT

						$JA
Consumables						
Fuel	(10.00 litres/hr)	(24,960 litres@	10.0	$JA/ltr	249,600
Engine Oil	(1.50 litres/hr)	(3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.40 litres/hr)	(998 litres@	60.0	$JA/ltr	59,904
Hydric Oil	(0.30 litres/hr)	(749 litres@	60.0	$JA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(13.6 tires @	10500.0	$JA/ea	95,302
Brake Lnng	(600 repl hrs)	(25.0 units @	1500.0	$JA/ea	37,440
Brake Drum	(1200 repl hrs)	(12.5 units @	2000.0	$JA/ea	24,960
Clutch Plt	(1600 repl hrs)	(0.0 units	15000.0	$JA/ea	0
Filters	(80 repl hrs)	(31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	(5.0 sets @	2000.0	$JA/ea	9,984
Other	(15% additional over above costs)				118,800
(seals, grease, battery, alternator, etc.)					
Total Consumables					910,797
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipement				1,478,854
Annual Cost of Equipment Unit If implemented during	1993				10,176,922

Tonnes Handled per year

(24.2 tonnes/day 312 days/yr 80% available) 6,048

Cost per Tonne 1,682.69 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 399.22 $JA

EQUIPMENT COST	71.23%
PERSONNEL COST	5.29%
CONSUMABLE COSTS	8.95%
OTHER COSTS	14.53%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Front End Loader, Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25.0 cubic meters		
Capital Cost of Equipment	15,204,545 $JA	125000	
		4000	
Spare Parts	760,227	5% of Capital Cost of Equipment	
Customs	798,239		
Total Capital Investment	16,763,011 $JA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.3 trips/shift	20 km one way	
Complete Loads per Shift	2.29 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	29 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in 1993 (16,763,011 @ int. of 43.00% over life utilized)				8,199,872
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year	62,400	
1.00 Workers	37,440	$JA/year	37,440	
5.79 Attndts	31,200	$JA/year	180,496	
1.00 Workshp Prsonnl	56,160	$JA/year	56,160	
0.50 Suprvsry Prsonnl	74,880	$JA/year	37,440	
0.50 Inspctn Peronnl	56,160	$JA/year	28,080	
Administration	25% of above		100,504	
Benefits	15% of above		75,378	
Annual Personnel Costs/Shift			577,898	
Annual Personnel Costs			577,898	

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(10.00 litres/hr	).(	24,960 litres@	10.0	$JA/ltr	249,600
Engine Oil	(1.50 litres/hr	).(	3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.40 litres/hr	).(	998 litres@	60.0	$JA/ltr	59,904
Hydric Oil	(0.30 litres/hr	).(	749 litres@	60.0	$JA/ltr	44,928
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	13.6 tires @	10500.0	$JA/ea	95,302
Brake Lnng	(600 repl hrs	).(	25.0 units @	1500.0	$JA/ea	37,440
Brake Drum	(1200 repl hrs	).(	12.5 units @	2000.0	$JA/ea	24,960
Clutch Plt	(1600 repl hrs	).(	0.0 units	15000.0	$JA/ea	0
Filters	(80 repl hrs	).(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs	).(	5.0 sets @	2000.0	$JA/ea	9,984
Other	(15% additional over above costs)					118,800
(seals, grease, battery, alternator, etc.)						
Total Consumables						910,797
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipement					1,672,500
Annual Cost of Equipment Unit If implemented during	1993					11,361,067

Tonnes Handled per year			
(28.6 tonnes/day	312 days/yr	80% available)	7,148
Cost per Tonne			1,589.49 $JA
Aver. Cost per Person (	0.24 tonnes/cap/yr)		377.11 $JA

EQUIPMENT COST	72.18%
PERSONNEL COST	5.09%
CONSUMABLE COSTS	8.02%
OTHER COSTS	14.72%
TOTAL COST	100.00%

Table FC-25-DS

JAMAICA Cost Comparisons

FEL CONT

January 1993

30 $JA per US Dollar

Type of Equipment	Front End Loader, Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25.0 cubic meters		
Capital Cost of Equipment	16,784,483 $JA	125000	
		4000	
Spare Parts	839,224	5% of Capital Cost of Equipment	
Customs	881,185		
Total Capital Investment	18,504,892 $JA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.9 trips/shift	10 km one way	
Complete Loads per Shift	2.61 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	33 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in 1993 (18,504,892 @ int. of 43.00% over life utilized)				9,051,939
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year	62,400	
1.00 Workers	37,440	$JA/year	37,440	
6.58 Attndts	31,200	$JA/year	205,392	
1.00 Workshp Prsonnl	56,160	$JA/year	56,160	
0.50 Suprvsry Prsonnl	74,880	$JA/year	37,440	
0.50 Inspctn Peronnl	56,160	$JA/year	28,080	
Administration	25% of above		106,728	
Benefits	15% of above		80,046	
Annual Personnel Costs/Shift			613,686	
Annual Personnel Costs			613,686	

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Table FC-25-DS

JAMAICA Cost Comparisons

FEL CONT

$JA

Consumables						
Fuel	(10.00 litres/hr)	(24,960 litres@	10.0	$JA/ltr	249,600
Engine Oil	(1.50 litres/hr)	(3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.40 litres/hr)	(998 litres@	60.0	$JA/ltr	59,904
Hydric Oil	(0.30 litres/hr)	(749 litres@	60.0	$JA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(13.6 tires @	10500.0	$JA/ea	95,302
Brake Lnng	(600 repl hrs)	(25.0 units @	1500.0	$JA/ea	37,440
Brake Drum	(1200 repl hrs)	(12.5 units @	2000.0	$JA/ea	24,960
Clutch Plt	(1600 repl hrs)	(0.0 units	15000.0	$JA/ea	0
Filters	(80 repl hrs)	(31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	(5.0 sets @	2000.0	$JA/ea	9,984
Other	(15% additional over above costs)				118,800
(seals, grease, battery, alternator, etc.)					
Total Consumables					910,797
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipement				1,846,293
Annual Cost of Equipment Unit If implemented during	1993				12,422,715

Tonnes Handled per year				
(32.6 tonnes/day	312 days/yr	60% available)		3,134
Cost per Tonne			1,527.35 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		362.30 $JA	

EQUIPMENT COST	72.87%
PERSONNEL COST	4.94%
CONSUMABLE COSTS	7.33%
OTHER COSTS	14.86%
TOTAL COST	100.00%

Table FC-25-T
JAMAICA Cost Comparisons FEL CONT

January 1993

30 $JA per US Dollar

Type of Equipment	Front End Loader, Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25.0 cubic meters		
Capital Cost of Equipment	17,750,000 $JA	125000	
Spare Parts		4000	
Customs	887,500	5% of Capital Cost of Equipment	
Total Capital Investment	931,875		
	19,569,375 $JA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid-way through truck life)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	3.1 trips/shift	5 km one way	
Complete Loads per Shift	2.80 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	35 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993 (19,569,375 @ int. 43.00% over life utilized)			9,572,646
Cost of Personnel/Shift			
1.00 Driver	,400	$JA/year	62,400
1.00 Workers	37,440	$JA/year	37,440
7.07 Attndts	31,200	$JA/year	220,606
1.00 Workshp Prsonnl	56,160	$JA/year	56,160
0.50 Suprvsry Prsonnl	74,880	$JA/year	37,440
0.50 Inspctn Personnl	56,160	$JA/year	28,080
Administration	25% of above		110,532
Benefits	15% of above		82,899
Annual Personnel Costs/Shift			635,556
Annual Personnel Costs			635,556

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Table FC-25-T
JAMAICA Cost Comparisons FEL CONT

					$JA
Consumables					
Fuel	(10.00 litres/hr).(	24,960 litres@	10.0	$JA/ltr	249,600
Engine Oil	(1.50 litres/hr).(	3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.40 litres/hr).(	998 litres@	60.0	$JA/ltr	59,904
Hydric Oil	(0.30 litres/hr).(	749 litres@	60.0	$JA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	13.6 tires @	10500.0	$JA/ea	95,302
Brake Lnng	(600 repl hrs).(	25.0 units @	1500.0	$JA/ea	37,440
Brake Drum	(1200 repl hrs).(	12.5 units @	2000.0	$JA/ea	24,960
Clutch Plt	(1600 repl hrs).(	0.0 units	15000.0	$JA/ea	0
Filters	(80 repl hrs).(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs).(	5.0 sets @	2000.0	$JA/ea	9,984
Other	(15% additional over above costs)				118,800
(seals, grease, battery, alternator, etc.)					
Total Consumables					910,797
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipement				1,952,500
Annual Cost of Equipment Unit If implemented during	1993				13,071,500

Tonnes Handled per year				
(35.0 tonnes/day	312 days/yr	80% available)		8,736
Cost per Tonne			1,496.28 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		354.99 $JA	

EQUIPMENT COST	73.23%
PERSONNEL COST	4.86%
CONSUMABLE COSTS	6.97%
OTHER COSTS	14.94%
TOTAL COST	100.00%

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Table RC-18-DX
JAMAICA

R/LOAD CONT
Cost Comparisons
30 $JA per US Dollar

January 1993

Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1.0 c.m. Containers		
Capacity	18.0 cubic meters		
Capital Cost of Equipment	9,432,265 $JA	100000 $US/truck 700 $US/container	
Spare Parts	471,613	5.00% of Capital Cost	
Customs	495,194		
Total Capital Investment	10,399,072 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.3 trips/shift	30 km one way	
Complete Loads per Shift	2.09 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	20.7 tonnes/day		

			$JA	$JA
Annualized Capital Cost, when purchased in 1993 (10,399,072 @ int of	43.00% over life)			5,086,858
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year		62,400
2.00 Workers	37,440	$JA/year		74,880
4.18 Attndts	31,200	$JA/year		130,316
0.50 Workshp Prsonnl	56,160	$JA/year		28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0.20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			80,471
Benefits	15% of above			60,353
Annual Personnel Costs/Shift				462,708
Annual Personnel Cost				462,708

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Table RC-18-DX
JAMAICA

R/LOAD CONT
Cost Comparisons
$JA

Consumables					
Fuel	(8.00 litres/hr).(	19,968 litres@	10.00	$JA/ltr	199,680
Engine Oil	(1.50 litres/hr).(	3,744 litres@	70.00	$JA/ltr	262,080
Trans Oil	(0.04 litres/hr).(	100 litres@	60.00	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr).(	100 litres@	60.00	$JA/ltr	5,990
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	13.6 tires @	9,100	$JA/ea	123,892
Brake Lnng	(600 repl hrs).(	25.0 units @	1,500	$JA/ea	37,440
Brake Drum	(1200 repl hrs).(	12.5 units @	2,000	$JA/ea	24,960
Clutch Plt	(1600 repl hrs).(	1.6 units	15,000	$JA/ea	23,400
Filters	(80 repl hrs).(	31.2 sets @	250	$JA/set	7,800
Prot. Gear	(1000 repl hrs).(	20.2 sets @	2,000	$JA/ea	40,319
Other	(15% additional over above costs)				109,733
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					841,285
Special Costs Attributable to Storage and Containment at the Source					75,182
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				1,037,549
Annual Cost of Equipment Unit if implemented during	1993				7,503,583

Tonnes Handled per year			
(20.7 tonnes/day	312 days/yr	80% available)	5,161
Cost per Tonne		1,454.04 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)	344.97 $JA	

EQUIPMENT COST	67.79%
PERSONNEL COST	6.17%
CONSUMABLE COSTS	11.21%
OTHER COSTS	14.83%
TOTAL COST	100.00%

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Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1.0 c.m. Containers		
Capacity	18.0 cubic meters		
Capital Cost of Equipment	10,710,199 $JA	100000 $US/truck 700 $US/container	
Spare Parts	535,510	5.00% of Capital Cost	
Customs	562,285		
Total Capital Investment	11,807,994 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.8 trips/shift	20 km one way	
Complete Loads per Shift	2.50 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	24.8 tonnes/day		

			$JA	$JA
Annualized Capital Cost, when purchased in 1993				
(11,807,994 @ int of	43.00% over life)			5,776,053
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year		62,400
2.00 Workers	37,440	$JA/year		74,880
5.01 Attndts	31,200	$JA/year		156,207
0.50 Workshp Prsonnl	56,160	$JA/year		28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0.20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			86,944
Benefits	15% of above			65,208
Annual Personnel Costs/Shift				499,926
Annual Personnel Cost				499,926

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Consumables						
Fuel	(8.00 litres/hr)	(19,968 litres@	10.00	$JA/ltr	199,680
Engine Oil	(1.50 litres/hr)	(3,744 litres@	70.00	$JA/ltr	262,080
Trans Oil	(0.04 litres/hr)	(100 litres@	60.00	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr)	(100 litres@	60.00	$JA/ltr	5,990
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(13.6 tires @	9,100	$JA/ea	123,892
Brake Lnng	(600 repl hrs)	(25.0 units @	1,500	$JA/ea	37,440
Brake Drum	(1200 repl hrs)	(12.5 units @	2,000	$JA/ea	24,960
Clutch Plt	(1600 repl hrs)	(1.6 units	15,000	$JA/ea	23,400
Filters	(80 repl hrs)	(31.2 sets @	250	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	(22.2 sets @	2,000	$JA/ea	44,462
Other	(15% additional over above costs)				110,354
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					846,049
Special Costs Attributable to Storage and Containment at the Source					90,119
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				1,178,122
Annual Cost of Equipment Unit If implemented during	1993				8,390,269

Tonnes Handled per year				
(24.8 tonnes/day	312 days/yr	80% available)		6,186
Cost per Tonne			1,356.38 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		321.80 $JA	

EQUIPMENT COST	68.84%
PERSONNEL COST	5.96%
CONSUMABLE COSTS	10.08%
OTHER COSTS	15.12%
TOTAL COST	100.00%

Table RC - 18 - DS
JAMAICA

R/LOAD CONT
Cost Comparisons
30 $JA per US Dollar

January 1993

Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1 0 c m Containers		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	11,887,328 $JA	100000 $US/truck 700 $US/container	
Spare Parts	594,356	5 00% of Capital Cost	
Customs	624,085		
Total Capital Investment	13,105,779 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	3 2 trips/shift	10 km one way	
Complete Loads per Shift	2 89 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	28 6 tonnes/day		

			SJA	SJA
Annualized Capital Cost, when purchased in 1993 (13,105,779 @ int of 43 00% over life)				6,410,884
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year	62,400	
2 00 Workers	37,440	$JA/year	74,880	
5 77 Attndts	31,200	$JA/year	180,055	
0 50 Workshp Prsonnl	56,160	$JA/year	28,080	
0 20 Supryvsry Prsonnl	74,880	$JA/year	14,976	
0 20 Inspctn Peronnl	56,160	$JA/year	11,232	
Administration	25% of above		92,906	
Benefits	15% of above		69,679	
Annual Personnel Costs/Shift			534,208	
Annual Personnel Cost				534,208

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Table RC - 18 - DS
JAMAICA, Cost Comparisons

R/LOAD CONT

					SJA
Consumables					
Fuel	(8 00 litres/hr).(	19,968 litres@	10 00	SJA/ltr	199,680
Engine Oil	(1 50 litres/hr).(	3,744 litres@	70 00	SJA/ltr	262,080
Trans Oil	(0 04 litres/hr).(	100 litres@	60 00	SJA/ltr	5,990
Hydric Oil	(0 04 litres/hr).(	100 litres@	60.00	SJA/ltr	5,990
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	13 6 tires @	9,100	SJA/ea	123,992
Brake Lnng	(600 repl hrs).(	25 0 units @	1,500	SJA/ea	37,440
Brake Drum	(1200 repl hrs).(	12 5 units @	2,000	SJA/ea	24 960
Clutch Plt	(1600 repl hrs).(	1 6 units	15,000	SJA/ea	23,400
Filters	(80 repl hrs).(	31 2 sets @	250	SJA/set	7,800
Prot. Gear	(1000 repl hrs).(	24 1 sets @	2,000	SJA/ea	48 278
Other	(15% additional over above costs)				110,927
(seals, grease, battery alternator, etc)					
Total Consumables/Year					850,437
Special Costs Attributable to Storage and Containment at the Source					103,878
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				1,307,606
Annual Cost of Equipment Unit If implemented during	1993				9,207,013

Tonnes Handled per year

(28.6 tonnes/day 312 days/yr 80% available) 7,130

Cost per Tonne 1,291.27 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 308.35 SJA

EQUIPMENT COST	69.63%
PERSONNEL COST	5.80%
CONSUMABLE COSTS	9 24%
OTHER COSTS	15.33%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Rear Loader, Partially Mechanically Loaded from 1 0 c m Containers		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	12,621,818 SJA	100000 $US/truck 700 $US/container	
Spare Parts	631,091	5 00% of Capital Cost	
Customs	662,645		
Total Capital Investment	13,915,555 SJA		
Estimated Economic Life Based on Planned Use	5 years (replace containers mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	3 5 trips/shift	5 km one way	
Complete Loads per Shift	3 12 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	30 9 tonnes/day		

			$JA	SJA
Annualized Capital Cost, when purchased in 1993				
(13 915,555 @ int of	43.00% over life)			6,806,997
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year	62,400	
2 00 Workers	37,440	$JA/year	74,880	
5 25 Attndts	31,200	$JA/year	194,936	
0 50 Workshp Prsonnl	56 160	$JA/year	28,080	
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976	
0 20 Inspctn Peronnl	56,160	$JA/year	11,232	
Administration	25% of above		96,626	
Benefits	15% of above		72,469	
Annual Personnel Costs/Shift			555,599	
Annual Personnel Cost			555,599	

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(2 00 litres/hr)	(19,968 litres@	10.00	SJA/ltr	199,680
Engine Oil	(1 50 litres/hr)	(3,744 litres@	70 00	SJA/ltr	262,080
Trans Oil	(0 04 litres/hr)	(100 litres@	60.00	SJA/ltr	5,990
Hydric Oil	(0 04 litres/hr)	(100 litres@	60.00	SJA/ltr	5,990
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(13 6 tires @	9,100	SJA/ea	123,892
Brake Lining	(600 repl hrs)	(25 0 units @	1,500	SJA/ea	37,440
Brake Drum	(1200 repl hrs)	(12.5 units @	2,000	SJA/ea	24,960
Clutch Plt	(1600 repl hrs)	(1 6 units	15,000	SJA/ea	23,400
Filters	(80 repl hrs)	(31 2 sets @	250	SJA/set	7,800
Prot. Gear	(1000 repl hrs)	(25.3 sets @	2,000	SJA/ea	50,658
Other	(15% additional over above costs)				111,284
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					853,175
Special Costs Attributable to Storage and Containment at the Source					112,463
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				1,388,400
Annual Cost of Equipment Unit If implemented during	1993				9,716,634

Tonnes Handled per year

(30.9 tonnes/day 312 days/yr 80% available) 7,719

Cost per Tonne 1,258.72 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) 298.63 SJA

EQUIPMENT COST	70.06%
PERSONNEL COST	5.72%
CONSUMABLE COSTS	8.78%
OTHER COSTS	15.45%
TOTAL COST	100.00%

Table RL - 10 - DX — REAR LOADER

JAMAICA — Cost Comparisons

January 1993 — 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10 0 cubic meters		
Capital Cost of Equipment	2,100,000 $JA		70000 $US/truck
Spare Parts	105,000	5 00% of Capital Cost	
Customs	110,250		
Total Capital Investment	2,315,250 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	1 9 trips/shift		30 km one way
Complete Loads per Shift	1 68 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	8 4 tonnes/day		

			$JA	$JA
Annualized Capital Cost, when purchased in 1993				
(2,315,250 @ int of	43 00% over life)			1,132,538
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
3 00 Workers	37,440	$JA/year		112,320
0 00 Attndts	31,200	$JA/year		0
0 50 Workshp Prsonnl	56,160	$JA/year		28,080
0 20 Supervsry Prsonnl	74,880	$JA/year		14,976
0 20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			57,252
Benefits	15% of above			42,939
Annual Personnel Costs/Shift				329,199
Annual Personnel Costs				329,199

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Table RL - 10 - DX — REAR LOADER

JAMAICA — Cost Comparisons — $JA

Consumables					
Fuel	(7 00 litres/hr).(	17,472 litres@	10 0	$JA/ltr	174,720
Engine Oil	(1 50 litres/hr).(	3,744 litres@	70 0	$JA/ltr	262,080
Trans Oil	(0 40 litres/hr).(	998 litres@	60 0	$JA/ltr	59,904
Hydric Oil	(0 30 litres/hr).(	749 litres@	60 0	$JA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	13 6 tires @	7000 0	$JA/ea	95,302
Brake Lnng	(600 repl hrs).(	25 0 units @	1500 0	$JA/ea	37,440
Brake Drum	(1200 repl hrs).(	12 5 units @	2000 0	$JA/ea	24,960
Clutch Plt	(1600 repl hrs).(	1 6 units @	15000 0	$JA/ea	23,400
Filters	(80 repl hrs).(	31.2 sets @	250 0	$JA/set	7,800
Prot. Gear	(1000 repl hrs).(	10 0 sets @	2000 0	$JA/ea	19,968
Other	(15% additional over above costs)				112,575
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					863,077
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				231,000
Annual Cost of Equipment Unit If implemented during	1993				2,555,814

Tonnes Handled per year

(8.4 tonnes/day 312 days/yr 80% available) 2,097

Cost per Tonne 1,219 00 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 289 21 $JA

EQUIPMENT COST	44.31%
PERSONNEL COST	12.88%
CONSUMABLE COSTS	33.77%
OTHER COSTS	9.04%
TOTAL COST	100.00%

Table RL – 10 - DL — REAR LOADER

JAMAICA — Cost Comparisons

January 1993 — 30 SJA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10 0 cubic meters		
Capital Cost of Equipment	2,100,000 SJA		70000 SUS/truck
Spare Parts	105,000	5 00% of Capital Cost	
Customs	110,250		
Total Capital Investment	2,315,250 SJA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2 2 trips/shift		20 km one way
Complete Loads per Shift	1 94 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	9 7 tonnes/day		

			SJA	SJA
Annualized Capital Cost, when purchased in 1993				
(2,315,250 @ int of	43 00% over life)			1,132,538
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
3 00 Workers	37,440	$JA/year		112,320
0 00 Attndts	31,200	$JA/year		0
0 50 Workshp Prsonnl	56,160	$JA/year		28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0 20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			57,252
Benefits	15% of above			42,939
Annual Personnel Costs/Shift				329,199
Annual Personnel Costs				329,199

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Table RL – 10 – DL — REAR LOADER

JAMAICA — Cost Comparisons — SJA

Consumables						
Fuel	(7 00 litres/hr)	(17,472 litres @	10 0	SJA/ltr	174,720
Engine Oil	(1 50 litres/hr)	(3,744 litres @	70 0	SJA/ltr	262,080
Trans Oil	(0 40 litres/hr)	(998 litres @	60 0	SJA/ltr	59,904
Hydric Oil	(0 30 litres/hr)	(749 litres @	60 0	SJA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(13 6 tires @	7000 0	SJA/ea	95,302
Brake Lnng	(600 repl hrs)	(25 0 units @	1500 0	SJA/ea	37,440
Brake Drum	(1200 repl hrs)	(12 5 units @	2000 0	SJA/ea	24,960
Clutch Plt	(1600 repl hrs)	(1 6 units @	15000 0	SJA/ea	23,400
Filters	(80 repl hrs)	(31 2 sets @	250 0	SJA/set	7,800
Prot. Gear	(1000 repl hrs)	(10 0 sets @	2000 0	SJA/ea	19,968
Other	(15% additional over above costs)				112,575
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					863,077
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc)	11% of capital cost of equipment				231,000
Annual Cost of Equipment Unit If implemented during	1993				2,555,814

Tonnes Handled per year

(9.7 tonnes/day — 312 days/yr — 80% available) — 2,419

Cost per Tonne — 1,056.47 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) — 250.65 SJA

EQUIPMENT COST	44.31%
PERSONNEL COST	12.88%
CONSUMABLE COSTS	33.77%
OTHER COSTS	9.04%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10 0 cubic meters		
Capital Cost of Equipment	2,100,000 $JA		70000 $US/truck
Spare Parts	105,000	5 00% of Capital Cost	
Customs	110,250		
Total Capital Investment	2,315,250 $JA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2 4 trips/shift		10 km one way
Complete Loads per Shift	2 16 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	10 8 tonnes/day		

			$JA	$JA
Annualized Capital Cost, when purchased in 1993				
(2,315,250 @ int of	43 00% over life)			1,132,538
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
3 00 Workers	37,440	$JA/year		112,320
0 00 Attndts	31,200	$JA/year		0
0 50 Workshp Prsonnl	56,160	$JA/year		28,080
0 20 Supryvsry Prsonnl	74,880	$JA/year		14,976
0 20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			57,252
Benefits	15% of above			42,939
Annual Personnel Costs/Shift				329,199
Annual Personnel Costs				329,199

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(7 00 litres/hr)	(17,472 litres@	10 0	$JA/ltr		174,720
Engine Oil	(1 50 litres/hr)	(3,744 litres@	70 0	$JA/ltr		262,080
Trans Oil	(0 40 litres/hr)	(998 litres@	60 0	$JA/ltr		59,904
Hydrlc Oil	(0 30 litres/hr)	(749 litres@	60 0	$JA/ltr		44,928
(Wheels per Equipment Unit)		6				
Tires	(1100 repl hrs)	(13 6 tires @	7000 0	$JA/ea		95,302
Brake Lnng	(600 repl hrs)	(25 0 units @	1500 0	$JA/ea		37,440
Brake Drum	(1200 repl hrs)	(12 5 units @	2000 0	$JA/ea		24,960
Clutch Plt	(1600 repl hrs)	(1 6 units @	15000 0	$JA/ea		23,400
Filters	(80 repl hrs)	(31 2 sets @	250 0	$JA/set		7,800
Prot. Gear	(1000 repl hrs)	(10 0 sets @	2000 0	$JA/ea		19,968
Other	(15% additional over above costs)					112,575
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						863,077
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc)		11% of capital cost of equipment				231,000
Annual Cost of Equipment Unit if implemented during		1993				2,555,814

Tonnes Handled per year

(10 8 tonnes/day 312 days/yr 80% available) 2,696

Cost per Tonne 948 11 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 224.94 $JA

EQUIPMENT COST	44 31%
PERSONNEL COST	12 88%
CONSUMABLE COSTS	33.77%
OTHER COSTS	9.04%
TOTAL COST	100 00%

Table RL - 10 - T — REAR LOADER

JAMAICA — Cost Comparisons

January 1993 — 30 SJA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	10 0 cubic meters		
Capital Cost of Equipment	2,100,000 SJA		70000 SUS/truck
Spare Parts	105,000	5 00% of Capital Cost	
Customs	110,250		
Total Capital Investment	2,315,250 SJA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.5 trips/shift		5 km one way
Complete Loads per Shift	2 29 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	11 5 tonnes/day		

			SJA	SJA
Annualized Capital Cost, when purchased in 1993 (2,315,250 @ int of	43.00% over life)			1,132,538
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
3 00 Workers	37,440	$JA/year		112,320
0 00 Attndts	31,200	$JA/year		0
0 50 Workshp Prsonnl	56,160	$JA/year		28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0 20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			57,252
Benefits	15% of above			42,939
Annual Personnel Costs/Shift				329,199
Annual Personnel Costs				329,199

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Table RL - 10 - T — REAR LOADER

JAMAICA — Cost Comparisons

					SJA
Consumables					
Fuel	(7 00 litres/hr) (	17,472 litres @	10 0	SJA/ltr	174,720
Engine Oil	(1 50 litres/hr) (	3,744 litres @	70 0	SJA/ltr	262,080
Trans Oil	(0 40 litres/hr) (	998 litres @	60 0	SJA/ltr	59,904
Hydric Oil	(0 30 litres/hr) (	749 litres @	60 0	SJA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs) (	13 6 tires @	7000 0	SJA/ea	95 302
Brake Lnng	(600 repl hrs) (	25 0 units @	1500 0	SJA/ea	37,440
Brake Drum	(1200 repl hrs) (	12 5 units @	2000 0	SJA/ea	24 960
Clutch Plt	(1600 repl hrs) (	1 6 units @	15000 0	SJA/ea	23 400
Filters	(80 repl hrs) (	31 2 sets @	250 0	SJA/set	7 800
Prot. Gear	(1000 repl hrs) (	10 0 sets @	2000 0	SJA/ea	19 968
Other	(15% additional over above costs)				112,575
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					863,077
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				231,000
Annual Cost of Equipment Unit if implemented during	1993				2,555,814

Tonnes Handled per year

(11 5 tonnes/day — 312 days/yr — 80% available) — 2,859

Cost per Tonne — 893 94 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) — 212.09 SJA

EQUIPMENT COST	44 31%
PERSONNEL COST	12.88%
CONSUMABLE COSTS	33.77%
OTHER COSTS	9.04%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	3,000,000 SJA		100000 $US/truck
Spare Parts	150,000	5.00% of Capital Cost	
Customs	157,500		
Total Capital Investment	3,307,500 SJA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	2,495 hours/year		
Number of Trips per Shift	1.4 trips/shift		30 km one way
Complete Loads per Shift	1 27 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	12 6 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(3,307,500 @ int of	43.00% over life)		1,617,912
Cost of Personnel/Shift			
1 00 Driver	62,400	$JA/year	62,400
3 00 Workers	37,440	$JA/year	112,320
0 00 Attndts	31,200	$JA/year	0
0 50 Workshp Prsonnl	56,160	$JA/year	28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0 20 Inspctn Peronnl	56,160	$JA/year	11,232
Administration	25% of above		57,252
Benefits	15% of above		42,939
Annual Personnel Costs/Shift			329,199
Annual Personnel Costs			329,199

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JAMAICA Cost Comparisons SJA

Consumables					
Fuel	(8 00 litres/hr).(	19,968 litres@	10 0	SJA/ltr	199,680
Engine Oil	(1 50 litres/hr).(	3,744 litres@	70 0	SJA/ltr	262,080
Trans Oil	(0 40 litres/hr).(	998 litres@	60 0	SJA/ltr	59,904
Hydric Oil	(0 30 litres/hr).(	749 litres@	60 0	SJA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	13 6 tires @	9100 0	SJA/ea	123,892
Brake Lnng	(600 repl hrs).(	25 0 units @	1500 0	SJA/ea	37,440
Brake Drum	(1200 repl hrs).(	12 5 units @	2000 0	SJA/ea	24,960
Clutch Plt	(1800 repl hrs).(	1 6 units @	15000 0	SJA/ea	23,400
Filters	(80 repl hrs).(	31 2 sets @	250 0	SJA/set	7,800
Prot. Gear	(1000 repl hrs).(	10 0 sets @	2000 0	SJA/ea	19,968
Other	(15% additional over above costs)				120,608
(seals, grease, battery, alternator, etc)					
Total Consumables/Year					924,660
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance - registration, customs, etc.)		11% of capital cost of equipment			330,000
Annual Cost of Equipment Unit If implemented during		1993			3,201,771

Tonnes Handled per year

(12.6 tonnes/day 312 days/yr 80% available) 3,145

Cost per Tonne 1,018 06 SJA

q
Aver. Cost per Person (0 24 tonnes/cap/yr) 241.54 SJA

EQUIPMENT COST	50.53%
PERSONNEL COST	10 28%
CONSUMABLE COSTS	28.88%
OTHER COSTS	10 31%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18.0 cubic meters		
Capital Cost of Equipment	3,000,000 SJA		100000 $US/truck
Spare Parts	150,000	5.00% of Capital Cost	
Customs	157,500		
Total Capital Investment	3,307,500 SJA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	1.6 trips/shift		20 km one way
Complete Loads per Shift	1.42 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	14.0 tonnes/day		

			SJA	SJA
Annualized Capital Cost, when purchased in 1993				
(3,307,500 @ int of	43.00% over life)			1,617,912
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year		62,400
3.00 Workers	37,440	$JA/year		112,320
0.00 Attndts	31,200	$JA/year		0
0.50 Workshp Prsonnl	56,160	$JA/year		28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0.20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			57,252
Benefits	15% of above			42,939
Annual Personnel Costs/Shift				329,199
Annual Personnel Costs				329,199

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(8.00 litres/hr	).(	19,968 litres@	10.0	SJA/ltr	199,680
Engine Oil	(1.50 litres/hr	).(	3,744 litres@	70.0	SJA/ltr	262,080
Trans Oil	(0.40 litres/hr	).(	998 litres@	60.0	SJA/ltr	59,904
Hydric Oil	(0.30 litres/hr	).(	749 litres@	60.0	SJA/ltr	44,928
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	13.6 tires @	9100.0	SJA/ea	123,892
Brake Lnng	(600 repl hrs	).(	25.0 units @	1500.0	SJA/ea	37,440
Brake Drum	(1200 repl hrs	).(	12.5 units @	2000.0	SJA/ea	24,960
Clutch Plt	(1600 repl hrs	).(	1.6 units @	15000.0	SJA/ea	23,400
Filters	(80 repl hrs	).(	31.2 sets @	250.0	SJA/set	7,800
Prot. Gear	(1000 repl hrs	).(	10.0 sets @	2000.0	SJA/ea	19,968
Other	(15% additional over above costs)					120,608
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						924,660
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment					330,000
Annual Cost of Equipment Unit If implemented during	1993					3,201,771

Tonnes Handled per year			
(14.0 tonnes/day	312 days/yr	60% available)	3,498
	Cost per Tonne	915.23 SJA	
q Aver. Cost per Person (	0.24 tonnes/cap/yr)	217.14 SJA	

EQUIPMENT COST	50.53%
PERSONNEL COST	10.28%
CONSUMABLE COSTS	23.88%
OTHER COSTS	15.31%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18 0 cubic meters		
Capital Cost of Equipment	3,000,000 SJA		100000 $US/truck
Spare Parts	150,000	5.00% of Capital Cost	
Customs	157,500		
Total Capital Investment	3,307,500 SJA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	1.7 trips/shift		10 km one way
Complete Loads per Shift	1.53 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	15 2 tonnes/day		

			$JA	SJA
Annualized Capital Cost, when purchased in 1993				
(3,307,500 @ int of	43.00% over life)			1,617,912
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year		62,400
3 00 Workers	37,440	$JA/year		112,320
0 00 Attndts	31,200	$JA/year		0
0 50 Workshp Prsonnl	56,160	$JA/year		28,080
0 20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0 20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25% of above			57,252
Benefits	15% of above			42,939
Annual Personnel Costs/Shift				329,199
Annual Personnel Costs				329,199

JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(8 00 litres/hr	).(	19,968 litres@	10 0	SJA/ltr	199,680
Engine Oil	(1.50 litres/hr	).(	3,744 litres@	70 0	SJA/ltr	262,080
Trans Oil	(0 40 litres/hr	).(	998 litres@	60 0	SJA/ltr	59,904
Hydric Oil	(0.30 litres/hr	).(	749 litres@	60 0	SJA/ltr	44,928
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	13 6 tires @	9100 0	SJA/ea	123,892
Brake Lnng	(600 repl hrs	) (	25 0 units @	1500 0	SJA/ea	37,440
Brake Drum	(1200 repl hrs	).(	12 5 units @	2000 0	SJA/ea	24,960
Clutch Plt	(1600 repl hrs	).(	1.6 units @	15000 0	SJA/ea	23,400
Filters	(80 repl hrs	).(	31.2 sets @	250 0	SJA/set	7,800
Prot. Gear	(1000 repl hrs	).(	10 0 sets @	2000 0	SJA/ea	19,968
Other	(15% additional over above costs)					120,608
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						924,660
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment					330,000
Annual Cost of Equipment Unit If implemented during	1993					3,201,771

Tonnes Handled per year			
(15.2 tonnes/day	312 days/yr	80% available)	3,782
Cost per Tonne			846 67 SJA
q Aver. Cost per Person (	0.24 tonnes/cap/yr)		200.87 SJA

EQUIPMENT COST	50.53%
PERSONNEL COST	10 28%
CONSUMABLE COSTS	28.88%
OTHER COSTS	10.31%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	18.0 cubic meters		
Capital Cost of Equipment	3,000,000 SJA		100000 $US/truck
Spare Parts	150,000	5.00% of Capital Cost	
	157,500		
Total Capital Investment	3,307,500 SJA		
Estimated Economic Life Based on Planned Use	5		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	1.8 trips/shift		5 km one way
Complete Loads per Shift	1.59 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.55 Tonnes/cubic meter		
Typical Productivity	15.8 tonnes/day		

			$JA	SJA
Annualized Capital Cost, when purchased in 1993				
(3,307,500 @ int of	43.00% over life)			1,617,912
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year	62,400	
3.00 Workers	37,440	$JA/year	112,320	
0.00 Attndts	31,200	$JA/year	0	
0.50 Workshp Prsonnl	56,160	$JA/year	28,080	
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976	
0.20 Inspctn Peronnl	56,160	$JA/year	11,232	
Administration	25% of above		57,252	
Benefits	15% of above		42,939	
Annual Personnel Costs/Shift			329,199	
Annual Personnel Costs				329,199

JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(8.00 litres/hr	).(	19,968 litres@	10.0	SJA/ltr	199,680
Engine Oil	(1.50 litres/hr	).(	3,744 litres@	70.0	SJA/ltr	262,080
Trans Oil	(0.40 litres/hr	).(	998 litres@	60.0	SJA/ltr	59,904
Hydric Oil	(0.30 litres/hr	).(	749 litres@	60.0	SJA/ltr	44,928
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	13.6 tires @	9100.0	SJA/ea	123,592
Brake Lnng	(600 repl hrs	).(	25.0 units @	1500.0	SJA/ea	37,440
Brake Drum	(1200 repl hrs	).(	12.5 units @	2000.0	SJA/ea	24,960
Clutch Plt	(1600 repl hrs	).(	1.6 units @	15000.0	SJA/ea	23,400
Filters	(80 repl hrs	).(	31.2 sets @	250.0	SJA/set	7,800
Prot. Gear	(1000 repl hrs	).(	10.0 sets @	2000.0	SJA/ea	19,968
Other	(15% additional over above costs)					120,608
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						924,660
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment					330,000
Annual Cost of Equipment Unit If implemented during	1993					3,201,771

Tonnes Handled per year				
(15.8 tonnes/day	312 days/yr	80% available)		3,941
Cost per Tonne			812.39 SJA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		192.74 SJA	

EQUIPMENT COST	50.53%
PERSONNEL COST	10.28%
CONSUMABLE COSTS	28.88%
OTHER COSTS	10.31%
TOTAL COST	100.00%

Table RP-9-DX
JAMAICA Cost Comparisons
ROTO PACKER

January 1993

30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	9.0 cubic meters		
Capital Cost of Equipment	1,950,000 SJA	65000 $JA	
Spare Parts	97,500	5.00%	of Capital Cost of Equipment
Customs	102,375		
Total Capital Investment	2,149,875 SJA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	1.7 trips/shift	30 km one way	
Complete Loads per Shift	1.56 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.50 Tonnes/cubic meter		
Typical Productivity	7.0 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993 (2,149,875 @ int. of	43.00%	over life utilized)	1,051,643

Cost of Personnel/Shift

1.00 Driver	62,400	$JA/year	62,400
3.00 Workers	37,440	$JA/year	112,320
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25%	of above	49,764
Benefits	15%	of above	37,323
Annual Personnel Costs/Shift			286,143
Annual Personnel Costs			286,143

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Table RP-9-DX
JAMAICA Cost Comparisons
ROTO PACKER

							SJA
Consumables							
Fuel	(7.00 litres/hr	).(	17,472 litres@	10.0	SJA/ltr		174,720
Engine Oil	(1.50 litres/hr	).(	3,744 litres@	70.0	SJA/ltr		262,080
Trans Oil	(0.40 litres/hr	).(	998 litres@	60.0	SJA/ltr		59,904
Hydric Oil	(0.30 litres/hr	).(	749 litres@	60.0	SJA/ltr		44,928
(Wheels per Equipment Unit)			6				
Tires	(1100 repl hrs	).(	13.6 tires @	7000.0	SJA/ea		95,302
Brake Lining	(600 repl hrs	).(	25.0 units @	1500.0	SJA/ea		37,440
Brake Drum	(1200 repl hrs	).(	12.5 units @	2000.0	SJA/ea		24,960
Clutch Plt	(1600 repl hrs	).(	1.6 units @	15000.0	SJA/ea		23,400
Filters	(80 repl hrs	).(	31.2 sets @	250.0	SJA/set		7,800
Prot. Gear	(1000 repl hrs	).(	10.0 sets @	2000.0	SJA/ea		19,968
Other	(15% additional over above costs)						112,575
(seals, grease, battery, alternator, etc.)							
Total Consumables							863,077
Special Costs Attributable to Storage and Containment at the Source							0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment						214,500
Annual Cost of Equipment Unit If implemented during	1993						2,415,363

Tonnes Handled per year

(7.0 tonnes/day 312 days/yr 80% available) 1,747

Cost per Tonne 1,382.42 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) refuse 327.98 SJA

EQUIPMENT COST	43.54%
PERSONNEL COST	11.85%
CONSUMABLE COSTS	35.73%
OTHER COSTS	8.88%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	9.0 cubic meters		
Capital Cost of Equipment	1,950,000 SJA	65000 SJA	
Spare Parts	97,500	5.00%	of Capital Cost of Equipment
Customs	102,375		
Total Capital Investment	2,149,875 SJA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.0 trips/shift	20 km one way	
Complete Loads per Shift	1.77 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.50 Tonnes/cubic meter		
Typical Productivity	8.0 tonnes/day		

				SJA
Annualized Capital Cost, when purchased in 1993 (2,149,875 @ int. of 43.00% over life utilized)				1,051,643
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year	62,400	
3.00 Workers	37,440	$JA/year	112,320	
0.00 Attndts	31,200	$JA/year	0	
0.20 Workshp Prsonnl	56,160	$JA/year	11,232	
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488	
0.10 Inspctn Peronnl	56,160	$JA/year	5,616	
Administration	25%	of above	49,764	
Benefits	15%	of above	37,323	
Annual Personnel Costs/Shift			286,143	
Annual Personnel Costs			286,143	

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JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(7.00 litres/hr).(	17,472 litres@	10.0	SJA/ltr	174,720
Engine Oil	(1.50 litres/hr).(	3,744 litres@	70.0	SJA/ltr	262,080
Trans Oil	(0.40 litres/hr).(	998 litres@	60.0	SJA/ltr	59,904
Hydric Oil	(0.30 litres/hr).(	749 litres@	60.0	SJA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	13.6 tires @	7000.0	SJA/ea	95,302
Brake Lnng	(600 repl hrs).(	25.0 units @	1500.0	SJA/ea	37,440
Brake Drum	(1200 repl hrs).(	12.5 units @	2000.0	SJA/ea	24,960
Clutch Plt	(1600 repl hrs).(	1.6 units @	15000.0	SJA/ea	23,400
Filters	(80 repl hrs).(	31.2 sets @	250.0	SJA/set	7,800
Prot. Gear	(1000 repl hrs).(	10.0 sets @	2000.0	SJA/ea	19,968
Other	(15% additional over above costs)				112,575
(seals, grease, battery, alternator, etc.)					
Total Consumables					863,077
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment				214,500
Annual Cost of Equipment Unit If implemented during	1993				2,415,363

Tonnes Handled per year

(8.0 tonnes/day 312 days/yr 80% available) 1,993

Cost per Tonne 1,211.75 SJA

Aver. Cost per Person (0.24 tonnes/cap/yr) refuse 287.49 SJA

EQUIPMENT COST	43.54%
PERSONNEL COST	11.85%
CONSUMABLE COSTS	35.73%
OTHER COSTS	8.88%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	9.0 cubic meters		
Capital Cost of Equipment	1,950,000 $JA	65000 $JA	
Spare Parts	97,500	5.00%	of Capital Cost of Equipment
Customs	102,375		
Total Capital Investment	2,149,875 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.2 trips/shift	10 km one way	
Complete Loads per Shift	1.96 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.50 Tonnes/cubic meter		
Typical Productivity	8.8 tonnes/day		

				$JA
Annualized Capital Cost, when purchased in		1993		
(2,149,875 @ int. of	43.00%	over life utilized)		1,051,643
Cost of Personnel				
1.00 Driver	62,400	$JA/year	62,400	
3.00 Workers	37,440	$JA/year	112,320	
0.00 Attndts	31,200	$JA/year	0	
0.20 Workshp Prsonnl	56,160	$JA/year	11,232	
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488	
0.10 Inspctn Peronnl	56,160	$JA/year	5,616	
Administration	25%	of above	49,764	
Benefits	15%	of above	37,323	
Annual Personnel Costs/Shift			286,143	
Annual Personnel Costs			286,143	

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JAMAICA Cost Comparisons

						SJA
Consumables						
Fuel	(7.00 litres/hr	).(	17,472 litres@	10.0	SJA/ltr	174,720
Engine Oil	(1.50 litres/hr	).(	3,744 litres@	70.0	SJA/ltr	262,080
Trans Oil	(0.40 litres/hr	).(	998 litres@	60.0	SJA/ltr	59,904
Hydric Oil	(0.30 litres/hr	).(	749 litres@	60.0	SJA/ltr	44,928
(Wheels per Equipment Unit)			6			
Tires	(1100 repl hrs	).(	13.6 tires @	7000.0	SJA/ea	95,302
Brake Lnng	(600 repl hrs	).(	25.0 units @	1500.0	SJA/ea	37,440
Brake Drum	(1200 repl hrs	).(	12.5 units @	2000.0	SJA/ea	24,960
Clutch Plt	(1600 repl hrs	).(	1.6 units @	15000.0	SJA/ea	23,400
Filters	(80 repl hrs	).(	31.2 sets @	250.0	SJA/set	7,800
Prot. Gear	(1000 repl hrs	).(	10.0 sets @	2000.0	SJA/ea	19,968
Other	(15% additional over above costs)					112,575
(seals, grease, battery, alternator, etc.)						
Total Consumables						883,077
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment					214,500
Annual Cost of Equipment Unit If implemented during	1993					2,415,363

Tonnes Handled per year

(8.8 tonnes/day 312 days/yr 80% available) 2,200

Cost per Tonne 1,097.97 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) refuse 260.49 $JA

EQUIPMENT COST	43.54%
PERSONNEL COST	11.85%
CONSUMABLE COSTS	35.73%
OTHER COSTS	8.88%
TOTAL COST	100.00%

Table RP 9 - T
JAMAICA Cost Comparisons
ROTO PACKER

January 1993 30 $JA per US Dollar

Type of Equipment	Rear Loader, Manually Loaded		
Capacity	9 0 cubic meters		
Capital Cost of Equipment	1,950,000 SJA	65000 SJA	
Spare Parts	97,500	5 00% of Capital Cost of Equipment	
Customs	102,375		
Total Capital Investment	2,149,875 SJA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2 3 trips/shift	5 km one way	
Complete Loads per Shift	2 07 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 50 Tonnes/cubic meter		
Typical Productivity	9 3 tonnes/day		

				SJA
Annualized Capital Cost, when purchased in 1993 (2,149,875 @ int of 43 00% over life utilized)				1,051,643
Cost of Personnel/Shift				
1 00 Driver	62,400	$JA/year	62,400	
3 00 Workers	37,440	$JA/year	112,320	
0 00 Attndts	31,200	$JA/year	0	
0 20 Workshp Prsonnl	56,160	$JA/year	11,232	
0 10 Suprvsry Prsonnl	74,880	$JA/year	7,488	
0 10 Inspctn Peronnl	56,160	$JA/year	5,616	
Administration	25% of above		49,764	
Benefits	15% of above		37,323	
Annual Personnel Costs/Shift			286,143	
Annual Personnel Costs			286,143	

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Table RP - 9 - T
JAMAICA Cost Comparisons
ROTO PACKER

					SJA
Consumables					
Fuel	(7 00 litres/hr).(	17,472 litres@	10 0	SJA/ltr	174,720
Engine Oil	(1 50 litres/hr).(	3,744 litres@	70 0	SJA/ltr	262,080
Trans Oil	(0 40 litres/hr).(	998 litres@	60 0	SJA/ltr	59,904
Hydric Oil	(0 30 litres/hr) (	749 litres@	60 0	SJA/ltr	44,928
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs).(	13 6 tires @	7000 0	SJA/ea	95,302
Brake Lnng	(600 repl hrs) (	25 0 units @	1500 0	SJA/ea	37,440
Brake Drum	(1200 repl hrs) (	12 5 units @	2000 0	SJA/ea	24,960
Clutch Plt	(1600 repl hrs) (	1 6 units @	15000 0	SJA/ea	23,400
Filters	(80 repl hrs) (	31 2 sets @	250 0	SJA/set	7,800
Prot Gear	(1000 repl hrs).(	10 0 sets @	2000 0	SJA/ea	19,968
Other	(15% additional over above costs)				112,575
(seals, grease battery, alternator, etc)					
Total Consumables					863,077
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs etc)	11% of capital cost of equipment				214,500
Annual Cost of Equipment Unit If implemented during	1993				2,415,363

Tonnes Handled per year

(9 3 tonnes/day 312 days/yr 80% available) 2 320

Cost per Tonne 1,041.08 SJA

Aver Cost per Person (0 24 tonnes/cap/yr) refuse 247.00 SJA

EQUIPMENT COST	43 54%
PERSONNEL COST	11 85%
CONSUMABLE COSTS	35 73%
OTHER COSTS	8 88%
TOTAL COST	100 00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,[illegible]0	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	[illegible]496 hours/year		
Number of Trips per Shift	2.1 trips/shift		20 km one way
Complete Loads per Shift	1.78 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	4.3 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,323,000 @ int of	43.00% over life)		647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00% of above		59,124
Benefits	15.00% of above		44,343
Annual Personnel Costs/Shift			339,963
Annual Personnel Costs			339,963

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JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(5.00 litres/hr),(	12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr),(	3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr),(	799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr),(	275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs),(	9.1 tires @	7000.0	$JA/ea	63,535
Brake Lnng	(600 repl hrs),(	16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs),(	8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(1600 repl hrs),(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs),(	31.2 sets @	250.0	$JA/set	7,800
Pnot. Gear	(1000 repl hrs),(	12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)				91,886
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					704,457
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				132,000
Annual Cost of Equipment Unit If implemented during	1993				1,823,585

Tonnes Handled per year

(4.3 tonnes/day 312 days/yr 80% available) 1,064

Cost per Tonne 1,713.95 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 406.63 $JA

EQUIPMENT COST	35.49%
PERSONNEL COST	18.64%
CONSUMABLE COSTS	38.63%
OTHER COSTS	7.24%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.1 trips/shift		20 km one way
Complete Loads per Shift	1.78 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	4.3 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,323,000 @ int of	43.00%	over life)	647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00%	of above	59,124
Benefits	15.00%	of above	44,343
Annual Personnel Costs/Shift			339,063
Annual Personnel Costs			339,963

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(5.00 litres/hr).(	12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr).(	3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr).(	799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr).(	275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs).(	9.1 tires @	7000.0	$JA/ea	33,535
Brake Lnng	(600 repl hrs).(	16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs).(	8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(1600 repl hrs).(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs).(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs).(	12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)				91,866
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					704,457
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% on capital cost of equipment				132,000
Annual Cost of Equipment Unit if implemented during	1993				1,823,585

Tonnes Handled per year

(4.3 tonnes/day 312 days/yr 80% available) 1,064

Cost per Tonne 1,713.95 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 406.63 $JA

EQUIPMENT COST	35.49%
PERSONNEL COST	18.63%
CONSUMABLE COSTS	38.63%
OTHER COSTS	7.24%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.3 trips/shift		10 km one way
Complete Loads per Shift	1.97 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	4.7 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,323,000 @ int of	43.00% over life)		647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00% of above		59,124
Benefits	15.00% of above		44,343
Annual Personnel Costs/Shift			339,663
Annual Personnel Costs			339,963

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JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(5.00 litres/hr),(	12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr),(	3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr),(	799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr),(	275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs),(	9.1 tires @	7000.0	$JA/ea	63,535
Brake Lnng	(600 repl hrs),(	16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs),(	8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(800 repl hrs),(	3.1 units	15000.0	$JA/ea	46,800
Filters	(80 repl hrs),(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs),(	12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)				95,396
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					731,367
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment				132,000
Annual Cost of Equipment Unit if implemented during	1993				1,850,495

Tonnes Handled per year

(4.7 tonnes/day 312 days/yr 80% available) 1,182

Cost per Tonne 1,566.18 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 371.58 $JA

EQUIPMENT COST	34.97%
PERSONNEL COST	18.37%
CONSUMABLE COSTS	39.52%
OTHER COSTS	7.13%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	50,000	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.3 trips/shift		10 km one way
Complete Loads per Shift	1.97 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	4.7 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,323,000 @ int of	43.00% over life)		647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00% of above		59,124
Benefits	15.00% of above		44,343
Annual Personnel Costs/Shift			339,963
Annual Personnel Costs			339,963

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JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(5.00 litres/hr)	(12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr)	(3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr)	(799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr)	(275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs)	(9.1 tires @	7000.0	$JA/ea	63,535
Brake Lnng	(600 repl hrs)	(16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs)	(8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(800 repl hrs)	(3.1 units	15000.0	$JA/ea	46,800
Filters	(80 repl hrs)	(31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	(12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)				95,396
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					731,367
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment				132,000
Annual Cost of Equipment Unit If implemented during	1993				1,850,495

Tonnes Handled per year

(4.7 tonnes/day 312 days/yr 80% available) 1,182

Cost per Tonne 1,566.18 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 371.58 $JA

EQUIPMENT COST	34.97%
PERSONNEL COST	18.37%
CONSUMABLE COSTS	39.52%
OTHER COSTS	7.13%
TOTAL COST	100.00%

Table SL-8-DX SIDE LOADER
JAMAICA Cost Comparisons
January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	1.8 trips/shift		30 km one way
Complete Loads per Shift	1.5 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	3.7 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,323,000 @ int of	43.00% over life)		647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00% of above		59,124
Benefits	15.00% of above		44,343
Annual Personnel Costs/Shift			339,963
Annual Personnel Costs			339,963

16-Jan-94

Table SL-8-DX SIDE LOADER
JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(5.00 litres/hr	).(	12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr	).(	3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr	).(	799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr	).(	275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)			4			
Tires	(1100 repl hrs	).(	9.1 tires @	7000.0	$JA/ea	63,535
Brake Lnng	(600 repl hrs	).(	16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs	).(	8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(1600 repl hrs	).(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs	).(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs	).(	12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)					91,888
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						704,457
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment					132,000
Annual Cost of Equipment Unit If implemented during	1993					1,823,585

Tonnes Handled per year			
(3.7 tonnes/day	312 days/yr	80% available)	926
Cost per Tonne		1,969.76 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)	467.33 $JA	

EQUIPMENT COST	35.49%
PERSONNEL COST	18.64%
CONSUMABLE COSTS	38.63%
OTHER COSTS	7.24%
TOTAL COST	100.00%

Table SL-8-DX SIDE LOADER

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	1.8 trips/shift		30 km one way
Complete Loads per Shift	1.5 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	3.7 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993 (1,323,000 @ int of 43.00% over life)			647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00% of above		59,124
Benefits	15.00% of above		44,343
Annual Personnel Costs/Shift			339,963
Annual Personnel Costs			339,963

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Table SL-8-DX SIDE LOADER

JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(5.00 litres/hr)	,(12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr)	,(3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr)	,(799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr)	,(275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs)	,(9.1 tires @	7000.0	$JA/ea	63,535
Brake Lnng	(600 repl hrs)	,(16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs)	,(8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(1600 repl hrs)	,(1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs)	,(31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	,(12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)				91,886
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					704,457
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				132,000
Annual Cost of Equipment Unit If implemented during 1993					1,823,585

Tonnes Handled per year

(3.7 tonnes/day 312 days/yr 80% available) 926

Cost per Tonne 1,969.76 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 467.33 $JA

EQUIPMENT COST	35.49%
PERSONNEL COST	18.64%
CONSUMABLE COSTS	38.63%
OTHER COSTS	7.24%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.5 trips/shift		5 km one way
Complete Loads per Shift	2.1 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	5.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,323,000 @ int of	43.00%	over life)	647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	53,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00%	of above	59,124
Benefits	15.00%	of above	44,343
Annual Personnel Costs/Shift			339,963
Annual Personnel Costs			339,963

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(5.00 litres/hr)	(12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr)	(3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr)	(799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr)	(275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)		4			
Tires	(1100 repl hrs)	(9.1 tires @	7000.0	$JA/ea	63,535
Brake Lnng	(600 repl hrs)	(16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs)	(8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(1600 repl hrs)	(1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs)	(31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	(12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)				91,886
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					704,457
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment				132,000
Annual Cost of Equipment Unit If implemented during	1993				1,823,585

Tonnes Handled per year

(5.0 tonnes/day 312 days/yr 80% available) 1,251

Cost per Tonne 1,458.14 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 345.94 $JA

EQUIPMENT COST	35.49%
PERSONNEL COST	18.64%
CONSUMABLE COSTS	38.63%
OTHER COSTS	7.24%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Side Loader Non-Compactor Tipping Truck		
Capacity	8.0 cubic meters		
Capital Cost of Equipment	1,200,000 $JA		40000 $US/truck
Spare Parts	60,000	5.00% of Capital Cost	
Customs	63,000		
Total Capital Investment	1,323,000 $JA		
Estimated Economic Life Based on Planned Use	5 years		
Number of Shifts per Day	1.00 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	2.5 trips/shift		5 km one way
Complete Loads per Shift	2.: loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.30 Tonnes/cubic meter		
Typical Productivity	5.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(1,323,000 @ int of	43.00% over life)		647,165
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
4.00 Workers	37,440	$JA/year	149,760
0.00 Attndts	31,200	$JA/year	0
0.20 Workshp Prsonnl	56,160	$JA/year	11,232
0.10 Suprvsry Prsonnl	74,880	$JA/year	7,488
0.10 Inspctn Peronnl	56,160	$JA/year	5,616
Administration	25.00% of above		59,124
Benefits	15.00% of above		44,343
Annual Personnel Costs/Shift			339,963
Annual Personnel Costs			339,963

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(5.00 litres/hr	),(	12,480 litres@	10.0	$JA/ltr	124,800
Engine Oil	(1.50 litres/hr	),(	3,744 litres@	70.0	$JA/ltr	262,080
Trans Oil	(0.32 litres/hr	),(	799 litres@	60.0	$JA/ltr	47,923
Hydric Oil	(0.11 litres/hr	),(	275 litres@	60.0	$JA/ltr	16,474
(Wheels per Equipment Unit)			4			
Tires	(1100 repl hrs	),(	9.1 tires @	7000.0	$JA/ea	63,535
Brake Lnng	(600 repl hrs	),(	16.6 units @	1500.0	$JA/ea	24,960
Brake Drum	(1200 repl hrs	),(	8.3 units @	2000.0	$JA/ea	16,640
Clutch Plt	(1600 repl hrs	),(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs	),(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs	),(	12.5 sets @	2000.0	$JA/ea	24,960
Other	(15% additional over above costs)					91,886
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						704,457
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment					132,000
Annual Cost of Equipment Unit If implemented during	1993					1,823,585

Tonnes Handled per year

(5.0 tonnes/day 312 days/yr 80% available) 1,251

Cost per Tonne 1,458.14 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 345.94 $JA

EQUIPMENT COST	35.49%
PERSONNEL COST	18.64%
CONSUMABLE COSTS	38.63%
OTHER COSTS	7.24%
TOTAL COST	100.00%

Table TT-50-DL TRANSFER TRK

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 10000 $US/trailer+eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	4.0 trips/shift		20 km one way
Complete Loads per Shift	3.6 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	54.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(5,292,000 @ Int of	43.00% over life)		2,588,659
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
0.00 Workers	37,440	$JA/year	0
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	56,160	$JA/year	11,232
Administration	25.00% of above		29,172
Benefits	15.00% of above		17,503
Annual Personnel Costs/Shift			163,363
Annual Personnel Costs			163,363

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Table TT-50-DL TRANSFER TRK

JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(15.0 litres/hr)	,(37,440 litres@	10.0	$JA/ltr	374,400
Engine Oil	(1.70 litres/hr)	,(4,243 litres@	70.0	$JA/ltr	297,024
Trans Oil	(0.04 litres/hr)	,(100 litres@	60.0	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr)	,(100 litres@	60.0	$JA/ltr	5,990
(Wheels per Equipment Unit)		14			
Tires	(1500 repl hrs)	,(23.3 tires @	10500.0	$JA/ea	163,072
Brake Lnng	(600 repl hrs)	,(58.2 units @	1500.0	$JA/ea	87,360
Brake Drum	(1200 repl hrs)	,(29.1 units @	2000.0	$JA/ea	58,240
Clutch Plt	(1600 repl hrs)	,(1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs)	,(31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	,(2.5 sets @	2000.0	$JA/ea	4,992
Other	(15% additional over above costs)				154,240
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,182,509
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				528,000
Annual Cost of Equipment Unit If implemented during	1993				4,462,531

Tonnes Handled per year

(54.0 tonnes/day 312 days/yr 80% available) 13,478

Cost per Tonne 331.09 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 78.55 $JA

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

Table TT-50-DL TRANSFER TRK
JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer+eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	4.0 trips/shift		20 km one way
Complete Loads per Shift	3.6 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	54.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(5,292,000 @ int of	43.00% over life)		2,588,659
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
0.00 Workers	37,440	$JA/year	0
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	56,160	$JA/year	11,232
Administration	25.00% of above		29,172
Benefits	15.00% of above		17,503
Annual Personnel Costs/Shift			163,363
Annual Personnel Costs			163,363

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Table TT-50-DL TRANSFER TRK
JAMAICA Cost Comparisons $JA

Consumables					
Fuel	(15.0 litres/hr),(	37,440 litres@	10.0	$JA/ltr	374,400
Engine Oil	(1.70 litres/hr),(	4,243 litres@	70.0	$JA/ltr	297,024
Trans Oil	(0.04 litres/hr),(	100 litres@	60.0	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr),(	100 litres@	60.0	$JA/ltr	5,990
(Wheels per Equipment Unit)		14			
Tires	(1500 repl hrs),(	23.3 tires @	10500.0	$JA/ea	163,072
Brake Lnng	(600 repl hrs),(	58.2 units @	1500.0	$JA/ea	87,360
Brake Drum	(1200 repl hrs),(	29.1 units @	2000.0	$JA/ea	58,240
Clutch Plt	(1600 repl hrs),(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs),(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs),(	2.5 sets @	2000.0	$JA/ea	4,992
Other	(15% additional over above costs)				154,240
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,182,509
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				528,000
Annual Cost of Equipment Unit If implemented during	1993				4,462,531

Tonnes Handled per year				
(54.0 tonnes/day	312 days/yr	80% available)		13,478
Cost per Tonne			331.09 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		78.55 $JA	

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

Table TT-50-DS TRANSFER TRK

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer + eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	4.9 trips/shift		10 km one way
Complete Loads per Shift	4.4 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	66.7 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(5,292,000 @ int of	43.00% over life)		2,588,659
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
0.00 Workers	37,440	$JA/year	0
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	56,160	$JA/year	11,232
Administration	25.00% of above		29,172
Benefits	15.00% of above		17,503
Annual Personnel Costs/Shift			163,363
Annual Personnel Costs			163,363

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Table TT-50-DS TRANSFER TRK

JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(15.0 litres/hr).(	37,440 litres@	10.0	$JA/ltr		374,400
Engine Oil	(1.70 litres/hr).(	4,243 litres@	70.0	$JA/ltr		297,024
Trans Oil	(0.04 litres/hr).(	100 litres@	60.0	$JA/ltr		5,990
Hydric Oil	(0.04 litres/hr).(	100 litres@	60.0	$JA/ltr		5,990
(Wheels per Equipment Unit)		14				
Tires	(1500 repl hrs).(	23.3 tires @	10500.0	$JA/ea		163,072
Brake Lnng	(600 repl hrs).(	58.2 units @	1500.0	$JA/ea		87,360
Brake Drum	(1200 repl hrs).(	29.1 units @	2000.0	$JA/ea		58,240
Clutch Plt	(1600 repl hrs).(	1.6 units	15000.0	$JA/ea		23,400
Filters	(80 repl hrs).(	31.2 sets @	250.0	$JA/set		7,800
Prot. Gear	(1000 repl hrs).(	2.5 sets @	2000.0	$JA/ea		4,992
Other	(15% additional over above costs)					154,240
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,182,509
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)		11% of capital cost of equipment				528,000
Annual Cost of Equipment Unit If implemented during		1993				4,462,531

Tonnes Handled per year

(66.7 tonnes/day 312 days/yr 80% available) 16,650

Cost per Tonne 268.02 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 63.59 $JA

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer+eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	4.9 trips/shift		10 km one way
Complete Loads per Shift	4.4 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	66.7 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(5,292,000 @ int of	43.00% over life)		2,588,659
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
0.00 Workers	37,440	$JA/year	0
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	56,160	$JA/year	11,232
Administration	25.00%	of above	29,172
Benefits	15.00%	of above	17,503
Annual Personnel Costs/Shift			163,363
Annual Personnel Costs			163,363

16-Jan-94

JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(15.0 litres/hr),(	37,440 litres@	10.0	$JA/ltr	374,400
Engine Oil	(1.70 litres/hr),(	4,243 litres@	70.0	$JA/ltr	297,024
Trans Oil	(0.04 litres/hr),(	100 litres@	60.0	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr),(	100 litres@	60.0	$JA/ltr	5,990
(Wheels per Equipment Unit)		14			
Tires	(1500 repl hrs),(	23.3 tires @	10500.0	$JA/ea	163,072
Brake Lnng	(600 repl hrs),(	58.2 units @	1500.0	$JA/ea	87,360
Brake Drum	(1200 repl hrs),(	29.1 units @	2000.0	$JA/ea	58,240
Clutch Plt	(1600 repl hrs),(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs),(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs),(	2.5 sets @	2000.0	$JA/ea	4,992
Other	(15% additional over above costs)				154,240
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,182,509
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, customs, etc.)	11% of capital cost of equipment				528,000
Annual Cost of Equipment Unit If implemented during	1993				4,462,531

Tonnes Handled per year				
(66.7 tonnes/day	312 days/yr	80% available)		16,650
Cost per Tonne			268.02 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		63.59 $JA	

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer+eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	3.1 trips/shift		30 km one way
Complete Loads per Shift	2.8 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	42.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(5,292,000 @ int of	43.00% over life)		2,588,659
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
0.00 Workers	37,440	$JA/year	0
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	56,160	$JA/year	11,232
Administration	25.00%	of above	29,172
Benefits	15.00%	of above	17,503
Annual Personnel Costs/Shift			163,363
Annual Personnel Costs			163,363

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(15.0 litres/hr)	,(37,440 litres@	10.0	$JA/ltr	374,400
Engine Oil	(1.70 litres/hr)	,(4,243 litres@	70.0	$JA/ltr	297,024
Trans Oil	(0.04 litres/hr)	,(100 litres@	60.0	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr)	,(100 litres@	60.0	$JA/ltr	5,990
(Wheels per Equipment Unit)		14			
Tires	(1500 repl hrs)	,(23.3 tires @	10500.0	$JA/ea	163,072
Brake Lnng	(600 repl hrs)	,(58.2 units @	1500.0	$JA/ea	87,360
Brake Drum	(1200 repl hrs)	,(29.1 units @	2000.0	$JA/ea	58,240
Clutch Plt	(1600 repl hrs)	,(1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs)	,(31.2 sets @	250.0	$JA/set	7,800
Prot Gear	(1000 repl hrs)	,(2.5 sets @	2000.0	$JA/ea	4,992
Other	(15% additional over above costs)				154,240
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,182,509
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				528,000
Annual Cost of Equipment Unit If implemented during	1993				4,462,531

Tonnes Handled per year				
(42.0 tonnes/day	312 days/yr	80% available)		10,483
Cost per Tonne			425.68 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		100.99 $JA	

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

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JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer+eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	3.1 trips/shift		30 km one way
Complete Loads per Shift	2.8 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	42.0 tonnes/day		

			$JA
Annualized Capital Cost, when purchased in 1993			
(5,292,000 @ int of	43.00% over life)		2,588,659
Cost of Personnel/Shift			
1.00 Driver	62,400	$JA/year	62,400
0.00 Workers	37,440	$JA/year	0
0.00 Attndts	31,200	$JA/year	0
0.50 Workshp Prsonnl	56,160	$JA/year	28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976
0.20 Inspctn Peronnl	56,160	$JA/year	11,232
Administration	25.00% of above		29,172
Benefits	15.00% of above		17,503
Annual Personnel Costs/Shift			163,363
Annual Personnel Costs			163,363

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JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(15.0 litres/hr)	(37,440 litres@	10.0	$JA/ltr	374,400
Engine Oil	(1.70 litres/hr)	(4,243 litres@	70.0	$JA/ltr	297,024
Trans Oil	(0.04 litres/hr)	(100 litres@	60.0	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr)	(100 litres@	60.0	$JA/ltr	5,990
(Wheels per Equipment Unit)		14			
Tires	(1500 repl hrs)	(23.3 tires @	10500.0	$JA/ea	163,072
Brake Lnng	(600 repl hrs)	(58.2 units @	1500.0	$JA/ea	87,360
Brake Drum	(1200 repl hrs)	(29.1 units @	2000.0	$JA/ea	58,240
Clutch Plt	(1600 repl hrs)	(1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs)	(31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs)	(2.5 sets @	2000.0	$JA/ea	4,992
Other	(15% additional over above costs)				154,240
(seals, grease, battery, alternator, etc.)					
Total Consumables/Year					1,182,509
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment				528,000
Annual Cost of Equipment Unit If implemented during	1993				4,462,531

Tonnes Handled per year				
(42.0 tonnes/day	312 days/yr	80%	available)	10,483
Cost per Tonne			425.68 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		100.99 $JA	

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

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JAMAICA Cost Comparisons

January 1993 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer + eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	5.6 trips/shift		5 km one way
Complete Loads per Shift	5.0 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	75.6 tonnes/day		

			$JA	$JA
Annualized Capital Cost, when purchased in 1993				
(5,292,000 @ int of	43.00% over life)			2,588,659
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year	62,400	
0.00 Workers	37,440	$JA/year	0	
0.00 Attndts	31,200	$JA/year	0	
0.50 Workshp Prsonnl	56,160	$JA/year	28,080	
0.20 Suprvsry Prsonnl	74,880	$JA/year	14,976	
0.20 Inspctn Peronnl	56,160	$JA/year	11,232	
Administration	25.00% of above		29,172	
Benefits	15.00% of above		17,503	
Annual Personnel Costs/Shift			163,363	
Annual Personnel Costs				163,363

16-Jan-94

JAMAICA Cost Comparisons $JA

Consumables						
Fuel	(15.0 litres/hr	),(	37,440 litres@	10.0	$JA/ltr	374,400
Engine Oil	(1.70 litres/hr	),(	4,243 litres@	70.0	$JA/ltr	297,024
Trans Oil	(0.04 litres/hr	),(	100 litres@	60.0	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr	),(	100 litres@	60.0	$JA/ltr	5,990
(Wheels per Equipment Unit)			14			
Tires	(1500 repl hrs	),(	23.3 tires @	10500.0	$JA/ea	163,072
Brake Lnng	(600 repl hrs	),(	58.2 units @	1500.0	$JA/ea	87,360
Brake Drum	(1200 repl hrs	),(	29.1 units @	2000.0	$JA/ea	58,240
Clutch Plt	(1600 repl hrs	),(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs	),(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs	),(	2.5 sets @	2000.0	$JA/ea	4,992
Other	(15% additional over above costs)					154,240
(seals, grease, battery, alternator, etc.)						
Total Consumables/Year						1,182,509
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc.)	11% of capital cost of equipment					528,000
Annual Cost of Equipment Unit If implemented during	1993					4,462,531

Tonnes Handled per year

(75.6 tonnes/day 312 days/yr 80% available) 18,870

Cost per Tonne 236.49 $JA

Aver. Cost per Person (0.24 tonnes/cap/yr) 56.11 $JA

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

Table TT-50-T — TRANSFER TRK

JAMAICA — Cost Comparisons

January 1993 — 30 $JA per US Dollar

Type of Equipment	Tractor Trailer Long Haul Truck to Transfer Large Trailers to Disposal Site		
Capacity	50.0 cubic meters (useable space – minus ejection system)		
Capital Cost of Equipment	4,800,000 $JA		80000 $US/truck tractor 40000 $US/trailer+eject
Spare Parts	240,000	5.00% of Capital Cost	
Customs	252,000		
Total Capital Investment	5,292,000 $JA		
Estimated Economic Life Based on Planned Use	5 years (replace trailer mid-way)		
Number of Shifts per Day	1.0 shifts/day		
Hours of Operation/Year	2,496 hours/year		
Number of Trips per Shift	5.6 trips/shift		5 km one way
Complete Loads per Shift	5.0 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0.35 Tonnes/cubic meter		
Typical Productivity	75.6 tonnes/day		

			$JA	$JA
Annualized Capital Cost, when purchased in 1993				
(5,292,000 @ int of	43.00%	over life)		2,588,659
Cost of Personnel/Shift				
1.00 Driver	62,400	$JA/year		62,400
0.00 Workers	37,440	$JA/year		0
0.00 Attndts	31,200	$JA/year		0
0.50 Workshp Prsonnl	56,160	$JA/year		28,080
0.20 Suprvsry Prsonnl	74,880	$JA/year		14,976
0.20 Inspctn Peronnl	56,160	$JA/year		11,232
Administration	25.00%	of above		29,172
Benefits	15.00%	of above		17,503
Annual Personnel Costs/Shift				163,363
Annual Personnel Costs				163,363

16-Jan-94

Table TT-50-T — TRANSFER TRK

JAMAICA — Cost Comparisons — $JA

Consumables						
Fuel	(15.0 litres/hr	).(	37,440 litres@	10.0	$JA/ltr	374,400
Engine Oil	(1.70 litres/hr	).(	4,243 litres@	70.0	$JA/ltr	297,024
Trans Oil	(0.04 litres/hr	).(	100 litres@	60.0	$JA/ltr	5,990
Hydric Oil	(0.04 litres/hr	).(	100 litres@	60.0	$JA/ltr	5,990
(Wheels per Equipment Unit)			14			
Tires	(1500 repl hrs	).(	23.3 tires @	10500.0	$JA/ea	163,072
Brake Lnng	(600 repl hrs	).(	58.2 units @	1500.0	$JA/ea	87,360
Brake Drum	(1200 repl hrs	).(	29.1 units @	2000.0	$JA/ea	58,240
Clutch Plt	(1600 repl hrs	).(	1.6 units	15000.0	$JA/ea	23,400
Filters	(80 repl hrs	).(	31.2 sets @	250.0	$JA/set	7,800
Prot. Gear	(1000 repl hrs	).(	2.5 sets @	2000.0	$JA/ea	4,992
Other	(15% additional over above costs)					154,240
(seals, grease, battery, alternator, etc)						
Total Consumables/Year						1,182,509
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc)	11% of capital cost of equipment					528,000
Annual Cost of Equipment Unit If implemented during	1993					4,462,531

Tonnes Handled per year				
(75.6 tonnes/day	312 days/yr	80% available)		18,870
Cost per Tonne			236.49 $JA	
Aver. Cost per Person (	0.24 tonnes/cap/yr)		56.11 $JA	

EQUIPMENT COST	58.01%
PERSONNEL COST	3.66%
CONSUMABLE COSTS	26.50%
OTHER COSTS	11.83%
TOTAL COST	100.00%

ANNEX C

LANDFILL EQUIPMENT COSTS:

Landfill Bulldozer data for a Caterpiller D7H WDA Series II, or equivalent (price includes ripper attachment and all options for landfill operation)

Capital Cost: $US 301,000

Spare Parts: n/a (should purchase maint. contract as an alternative)

Number of shifts per day: 1 avg. work 2hrs. per day with 1 6 hour day per week when new cut is made.

Hours of operation per year: est. 832

Productivity: 43 tons/hr

Typical Productivity: 350 tons per day

Consumables:
Fuel: 28 liters per hour
estimate 15,000 liters per year (includes maint. hours and movement to and from operation plus emergency work) at $JA 10 per liter= $JA 150,000
Engine oil: .109 liters per hour
Trans oil: .070 liters per hour
Hydrlc oil: .045 liters per hour
Final drives: .068 liters per hour
Filters change interval
Engine: 250 hours
Transmission: 500 hours
Hydraulic: 500 hours
Fuel Primary: 2000 hours
Final: 500 hours
Air Primary: 2000 hours
Secondary: 1000 hours
Total # of filters changed over 2000 hours = 27 at a cost of $US 240

SITE DEVELOPMENT

A site development plan for the near term operation of the Retirement Dump or any other operation would normally consider the degree of environmental protection required, or desired, and the available resources to accomplish these goals. In addition the plan would consider the long term requirements for site operation and development.

In the absence of much of this type of information it is useful to develop a set of assumptions which will be utilized in the preparation of a minimal site development plan. A set of assumptions for this project are outlined below:

a) The site must remain in operation for 6 days a week 10 hours per day while the site development plan is implemented.
b) The operating tonnage will remain between 80 and 100 tons per day for the next 4 years.
c) The site consists of approximately 25 acres of useable land.
d) An immediate goal of the plan is to eliminate the ongoing health hazards related to fires; vectors, such as flies, rodents and dogs; and to minimize the formation of leachate. Any methane generation must be controlled to prevent explosion.
e) Financial resources will be made available to develop the site as a cut and cover landfill as a near term operating practice.
f) Management will adhere to the implementation of this site development plan without modification and will implement the operating procedures subsequently.
g) Jamaica will ultimately adopt a set of procedures for the permitting and operation of landfills which closely approximate the guidelines currently being reviewed (Procedures and Requirements for Permitting and Operation of Waste Disposal Facilities) by the NRCA and the Underground Water Authority.

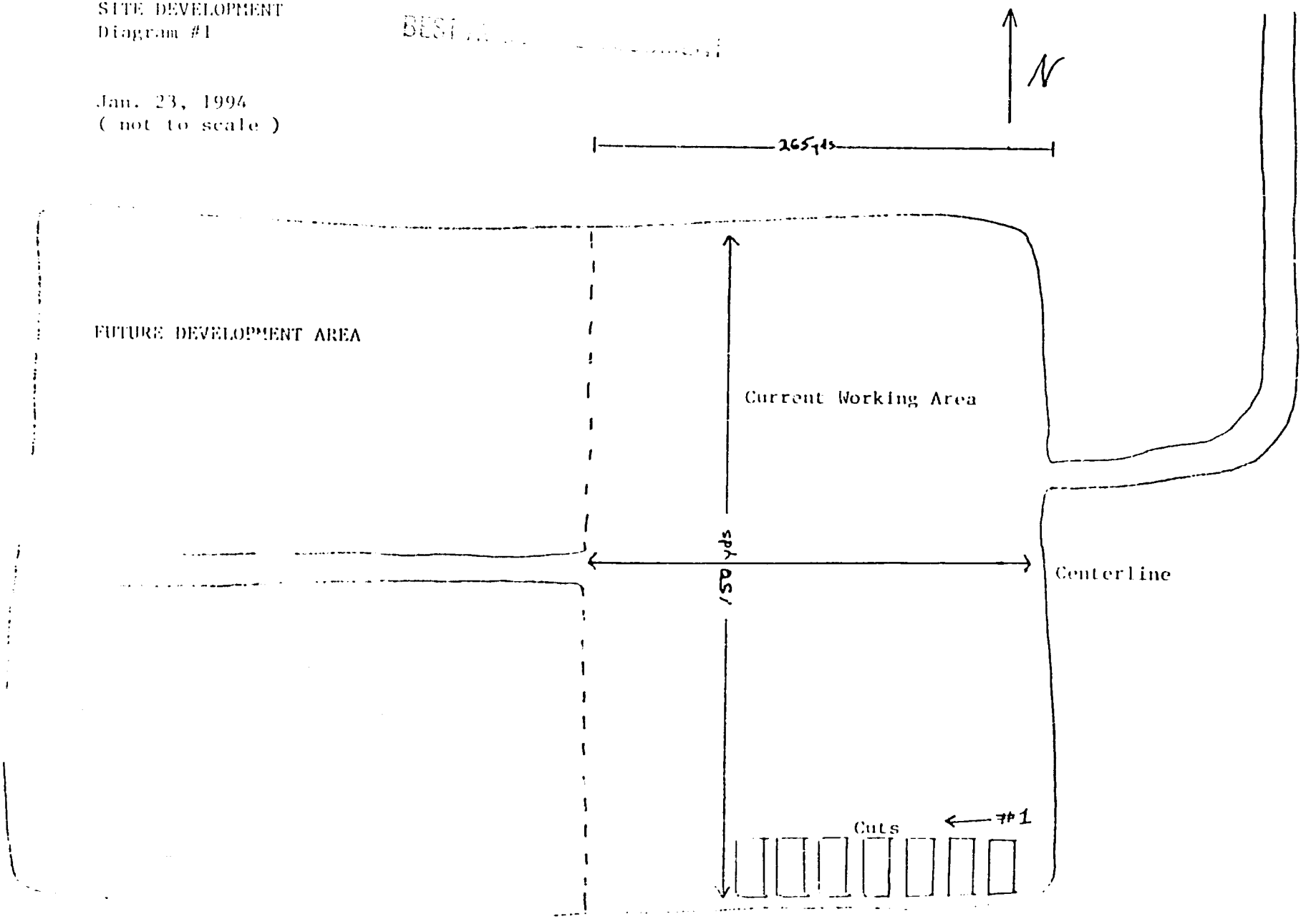
In an effort to gain the most utility from the site and to position the facility for future development as required by whatever procedures are ultimately adopted by the national government it would be useful to divide the site into two components. These components will be referred to as section 1, the 8 and 1/2 acres currently in operation, and section 2, that portion set aside for future development, the 16 and 1/2 acres which are unused at this time (see diagram no.1).

The first major step in site development will require the commitment of financial resources to accomplish the following activities:

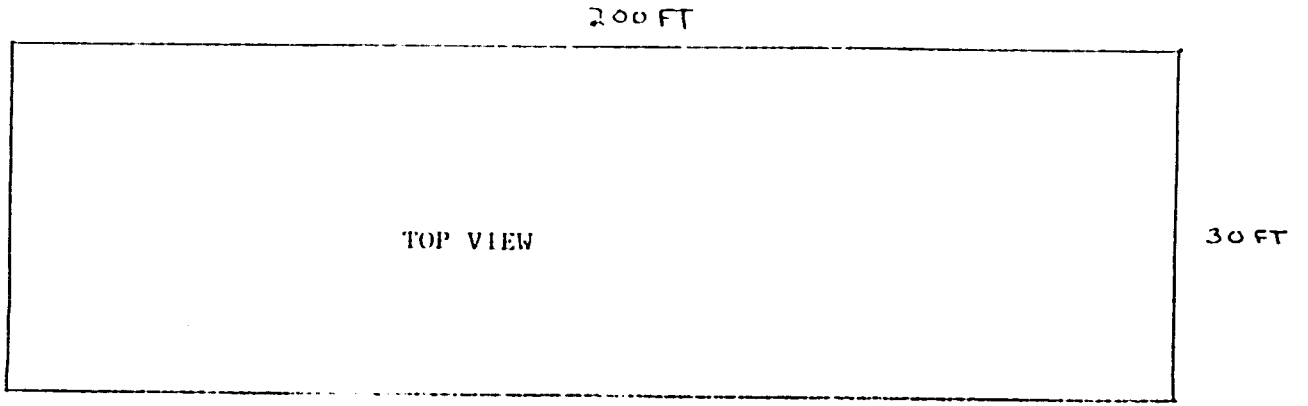
a) A bulldozer with ripper attachment must be purchased. The size of this equipment should be equivalent to a Caterpiller

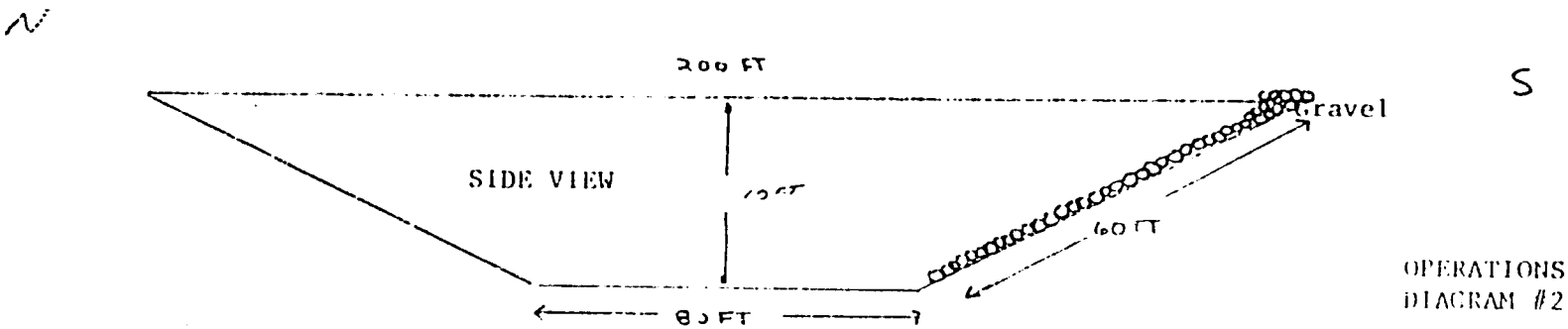
SITE DEVELOPMENT
Diagram #1

Jan. 23, 1994
(not to scale)



800 yds





OPERATIONS
DIAGRAM #2

JANUARY 23, 1994
(not to scale)

BEST AVAILABLE DOCUMENT

D7H. Although this piece of equipment can push considerably greater tonnage than required it will allow for the ripping of cuts and pushing the resultant dirt without an undue strain on the equipment. The equipment should be purchased with a maintenance contract which can be negotiated with the individual dealer of the selected hardware. This equipment should be purchased with a negotiated residual value schedule that will allow it to be traded at year four, five or six with a certain residual value. It can be traded for equipment which will be required to operate under an operating plan as required under the aforementioned future legislation. Money must be made available to hire a fulltime operator for this equipment. This operator should be paid to operate the equipment and perform the required operator maintenance. The existing position for a site attendant should be upgraded to an operator position to allow for an operator to be on site at all times yet still allow for illness, vacation scheduling and a 60 hour per week operating schedule.

b) Money must be spent to survey and stake the existing 8 and 1/2 acre site. The 8 and 1/2 acres should be surveyed and staked to allow for a 1 percent slope from the approximate centerline (see line a on diagram 1). Survey crews should also stake 100 ft by 30 ft cuts as outlined on diagram 1. This survey work should not be undertaken until the bulldozer is on the site to do the required earthmoving.

c) A contractor should be hired to move the refuse lining both sides of the entry road onto the site for burial. This will require a contractor with a bucketloader, with at least a 5 cubic yard bucket, and 3 to 5 end dump type trucks of 20 to 40 yard capacity. This phase of the development plan should occur after the bulldozer is on site and the site has been staked, graded and the first cuts have been made to allow for burial of the material.

d) A contract must be let to have gravel delivered to the site for methane venting. Contract will require 1300 cubic yards per year at a rate of 25 cubic yards per week usage.

Once a bulldozer and operators are available surveyors must be brought in to accomplish the survey as outlined above. After site drainage is established and sufficient gravel has been delivered cuts should be made which are 100 ft by 30 ft and the refuse and ashes on the site should be compacted and buried (for cut and burial detail see Operating Procedures).

After the site has been cleaned the contractor responsible for cleaning the access road should be brought on site and the material from the access road should be moved, compacted and buried. At this juncture it would be worth exploring the possibility of having a ditch, of approximately 4 ft depth and 4 ft width dug on both sides of the access road from the main road onto the site. These ditches could be constructed with the idea of limiting mobility of

vehicles to the road surface and making it difficult if not impossible for large trucks to dump their loads anywhere but on the fill itself. As this is not critical to stop illegal dumping on the road, if dump attendants perform their duties, it is mentioned for consideration only. Extra money would be required to hire a backhoe and dump trucks to construct the barriers and they should be considered only after critical site development functions have been funded.

Money should be made available to provide a gate, at the dump entrance, to stop illegal dumping on the site at night. Additional fencing should also be considered to minimize unauthorized access to the facility. As a minimum a lockable shelter for the bulldozer should be constructed to insure it is not stolen or vandalized.

The successful implementation of this plan should not hamper the daily operation of the dump. As a starting point all on site refuse should be pushed to the southwest portion of the site. As shown on diagram 1 initial grading for drainage and initial cuts will be made on the east side of the facility. After the east side is graded and all refuse on the site is buried grading for drainage can be continued on the west portion of the fill. Traffic can be routed around the development on the eastern portion, while development is ongoing, by an actively involved landfill attendant.

The existing condition of the site can be at least partially attributed to lack of adequate management. In implementing this plan the operators of the site must be well briefed on what is occurring on the facility and contractors must be coordinated and performance monitored. A landfill manager should be added to the Western Parks and Markets staff to perform these and other required management functions. Ultimate success or failure of this plan as well as the success of future operations will largely depend on quality management. Perhaps the most important single recommendation that can be made would be to hire a site manager and provide that person with the training and support required to move this operation from a "dump" to an operating landfill. A person with a construction background should be recruited in the absence of any existing landfill managers. This person should be enrolled in the 4 day seminar "Manager of Landfill Operations Training and Certification", sponsored by the Solid Waste Association of North America. Upon completion of that training the individual should be given the responsibility to generate and operating budget for the facility and manage it's day to day operations. This person should also be charged with keeping the facility in compliance with regulatory processes as they are developed and refined. In an effort to avoid conflicts with collection staff this person should report directly to the Parks and Markets board of directors.

As a starting point for a site manager the following site development budget is recommended. All costs are estimated in Jamaican dollars. All estimates are at the high end of the scale based on quotes from available Jamaican suppliers of goods and

services except where noted. (note exchange rate of $30 J = $1 U.S.)

Capital Expenditures: (value of land was not included based on lack of available market rate)

Bulldozer (with Ripper and Landfill Equipment Package= $8,220,000 amortized over 10 years= $822,000 per year

Facility for Bulldozer storage and repair= $1,050,000 (no local est. available) amortized over 20 years= $52,500 per year

Gates and fence= $30,000 approx. minimal amount amortized over 20 years= $1,500 per year

Survey Work: $150,000 est. amortized over 5 years= $30,000

Total Capital= $9,450,000
Per year= $906,000 for the first 5 years

Operating Budget:

Salaries:
Manager: $50,000
Operators (2ea): $70,000)
Attendent: $30,000
Fringes (20%): $30,000
Total: $180,000

Contractual:
Bulldozer Maint.: $600,000 based on similar U.S. contract no local est. available

Contract to deliver gravel: $390,000 no local est available

Commodities:
Fuel: $150,000
Bulldozer Catastrophic Parts Failure: $180,000
Office Supplies: $1000
Postage: $500
Phone: $2000 est. depends on long distance
Misc: $5,000

Total Annual: $2,414,500 for the first 5 years

Rate would equal $2,414,500 per year/24,960 tons per year or $96.73 per ton Jamaican

Recovery of the landfill costs can begin by institution of a landfill permit fee. Based on the recognized cost per ton operators can be charged a disposal permit based on their truck size and estimated number of trips to the fill on an annual basis. A permanent sticker can be affixed to their windshield to indicate they have paid for the permit for that vehicle. In order to mitigate rate shock and minimize illegal dumping it might be prudent to institute the rate at a first year 25% of actual cost.

The rate could be increased as required for the next three years until a full recovery fee is realized.

OPERATING PROCEDURES

An operations plan for the Retirement Dump must of necessity be a relatively simple. This operating procedure will be divided into two major sections:

a) construction and closure of a cut
b) basic dump operating procedures

The operation of a cut and fill landfill should be viewed as an interim measure during which time improved landfill construction procedures are developed and funded.

The dimensions of each cut were chosen to allow disposal of six days worth of refuse. The math for the cut dimensions is as follows:

a) length top= 200 ft
b) length bottom= 80 ft
c) width= 30 ft
d) depth= 10 ft

area= 1/2x(sum of the parallel sides)x height
1/2x (200 ft + 80 ft) x 10 ft
1/2x (280 ft) x 10 ft
2800 sqft divide by 2
1400 sqft

volume= area x width
volume= 1400 sqft x 30 ft
volume= 42,000 cubic ft

volume in cubic yds= cubic ft divide by 27
volume in cubic yds= 42,000 sqft divided by 27
volume in cubic yds= 1555.55 cubic yds

Incoming volume at 80 tons per day is estimated in cubic yards at:

a) Since garbage comes in compacted and uncompacted the average density is estimated as 400 lbs per cubic yard.
b) 80 tons x 2000 lbs per ton= 160,000 lbs
c) compaction can be increased by making three passes of the bulldozer over the refuse spread in the pit to 700 lbs per cubic yd.
d) pit capacity for refuse alone = 160,000 lbs divided by 700 lbs per cubic yd= 229 cubic yds per day
e) 229 cubic yds per day x six days of operation=1371 cubic yards of required space for refuse.
f) 1 ft of daily cover over each days refuse adds 22 cubic yards per day for 5 days or 110 cubic yards.
g) cover for day six must fill the remaining volume of the pit to prevent ponding of water on the surface. The amount of cover will vary based on actual disposal but in no case should be less than 2 ft of compacted soil.

The basic construction of the cut should be undertaken in the manner described:

a) The survey team, discussed in the landfill development plan, will have staked areas (see diagram 1) which are 200 ft long and 30 ft wide. The portion 40ft on either side of the center of the 200 ft dimension will be 10 ft in depth. The bulldozer will rip this section and develop it to the dimension shown in diagram 2.

b) An additional two feet of dirt should be ripped out and recompacted. The dirt should be cleared from the pit and then spread over the floor in 6 inch lifts. These lifts should be compacted with several passes of the bulldozer. This process will hamper leacnate migration to groundwater.

c) The tail edge, in this case the south slope, of the cut will be lined with 5 to 6 inches of gravel over the entire surface. This gravel will allow any methane generated to vent to the surface.

d) Dirt removed from the cut should be situated to the northeast side of the cut to facilitate daily cover. Excess dirt will be utilized to maintain drainage of the site for filling low areas and for the final cap which will be placed on the cut when it is filled at the end of the week.

e) Each cut should be constructed in order to allow a 10 foot wide dividing wall between it and the preceding cut.

Basic Landfill Operations:

a) The site should open for operations at approximately 6 a.m.. This timing seems to be consistent with the time the first loads are currently entering the site for disposal. Some loads have come in as early as 5:30 a.m. and this might be a useful alternative.

b) As vehicles enter the site the site attendant should check to see that they have a disposal permit affixed to their vehicle. (see site development presented below).

c) Vehicles should be routed to the tipping area of the active cut and allowed to dump at the north side of the cut. After refuse has been tipped and the truck has cleared the tipping face 15 to 30 min. should be made available for scavengers to recycle any material from the load. The 30 ft wide tipping face should allow at least two loads to be tipped at the same time.

d) After each load has been checked by the scavengers the bulldozer operator should push the load into the cut spreading it across the cut to as uniform a thickness as possible. Once the refuse has been spread at least 3 passes but no more than 5 should be made by the bulldozer over the refuse to maximize in place compaction.

This operation should continue until the last load of the day is taken.

e) At 3 p.m. or 3:30 p.m., dependent on starting time, daily cover should be placed. Utilizing some of the material stockpiled to the northeast of the cut the operator should push one foot of dirt cover over the refuse in the pit. Again, several passes should be made over the dirt to compact it and maximize the site life. This cover should be complete enough that very little if any refuse is exposed. The site manager should personally inspect cover as often as possible to insure it is being accomplished properly. This operation should consume approximately 1/2 hr and complete a full 10 hour day of facility operation.

f) The next business day the first loads will be pushed on top of the previous days compacted cover and operations will start again.

At the end of each week final cover will be placed on the pit. This will be accomplished at the close of business Saturday and will be performed essentially in the same manner as daily cover. In the case of final cover however a minimum of two feet of dirt will be spread and compacted. In no case however will any space be left in the pit. Enough dirt must be pushed to completely fill the pit and allow for a cap which will carry water off of the pit. Care must be taken to leave the gravel exposed at the tail of the pit to insure proper methane venting. Gravel fill should be added to the tail, if required. to insure that a water catchment basin is not formed which will aggravate the formation of leachate.

In addition to the above basic operations procedures it would be useful to develop additional criteria for the management of the scavenger population. As to the management of populations, a social scientist might be included in the IDB study to provide additional recommendations for the organization and management of this group. It is optimistic to assume that the site attendant will be able to exert any real control over this population. In fact the site attendant had been rather seriously injured, just prior to our investigation, by a scavenger who was unwilling to follow the guidance of the site attendant.

The manager should undertake to develop clear and concise job descriptions for each of the personnel on the site. This person should also be prepared to expand these operating procedures to include :

a) Emergency procedures
b) Wet weather operations
c) Load inspection procedures
d) Site drainage maintenance plan
e) Road maintenance plan

In order to accomplish the above tasks the person selected should be enrolled in the previously mentioned SWANA landfill course immediately upon hire.

ANNEX D

NEGRIL LANDFILL

REPORT

BY

ROBERT J. DONOVAN

For

USAID Jamaica

29 December 1993

PURPOSE:

This report reviews two sites in the Negril area, these are the Orange Bay Dump and the proposed Cousins Mountain Landfill site. Due to the available time to review the disposal situation in the Negril area a detailed study of the Orange Bay site and a comprehensive feasibility study of the Cousins Mountain site were not possible. What I will attempt to do in this report is cover general impressions of the problems with the Orange Bay Site and provide impressions of the feasibility of the Cousins Mountain site to include questions, which have not been addressed, regarding the viability of Cousins Mountain as a landfill site.

ORANGE BAY BACKGROUND:

The Orange Bay Dump is located in a mangrove swamp some 500 to 1000 yards from the shore of the bay. It consists of about five acres of open land bisected by a road with material deposited on both sides. The material is largely deposited directly in the waters of the swamp itself. Trucks can access the site only because aggregate material is periodically deposited to provide a roadbed. Traffic on this surface quickly causes the material to be submerged and more material must be deposited to allow the dump to be used. It would appear that there are some 8000 to 10000 cubic yards of refuse on the surface at this time. Several small fires were burning during our visit but the fact that most of the garbage was at least partially submerged and wet made the probability of any large fire very remote. Material at the site appears to be residential and commercial refuse from the surrounding area.

ORANGE BAY DISCUSSION:

The fact that the refuse site is submerged in water causes two immediate problems. Large amounts of leachate are formed on an ongoing basis. According to an interview with Katie Thacker, president of the Orange Bay Coral Reef Society, a large plum of leachate can be seen migrating from the dump site

into the water of the bay. This leachate plum is reported to have caused damage to the bay and continues to destroy both the coral and the habitat it provides. It would appear likely that the leachate and any related sedimentation will eventually prove to have a negative environmental effect on the area immediately surrounding the dump site and degradation of the mangroves may occur over time. Since the leachate is flowing into the bay it is unlikely that any contamination inland would occur. Problems from leachate which are likely to affect the surrounding area include:

a) depletion of dissolved oxygen

b) bacterial and viral contamination

c) increased mineral content in the bay to include (chloride, sulfate, bicarbonate, sodium, and potassium)

d) nutrient enrichment

c) hazardous substances (e.g. heavy metals) entering the food chain, in the bay, and affecting human health.

The second immediate problem would be the generation of large amounts of landfill gas. Decomposition of garbage forms landfill gas which is primarily composed of the following:

a) methane (CH_4), nearly 50%

b) carbon dioxide (CO_2), nearly 50%

c) nitrogen .4%

d) trace amounts of volatile organic compounds

e) trace amounts of hydrogen

f) trace amounts of hydrogen sulfide

g) trace amounts of carbon monoxide

Generally in the situation in place in Orange Bay we would expect that due to the fact that the refuse in sitting primarily above the water, and is decomposing in an aerobic condition, that higher volumes of CO_2 are being formed than CH_4. CO_2 will increase water hardness and decrease pH. CH_4 when

concentrated at levels of 5% to 15% poses an explosive hazard. The combination of CO_2 and CH_4 may displace soil oxygen and interfere with plant growth.

Orange Bay Dump is certainly an environmental hazard. Given the amount of time we had available under the scope of work and the lack of hard data on leachate concentration and composition it is difficult to accurately predict what impacts the dump will have on the environment in the near and long term. As mentioned earlier the immediate impact would appear to be to the coral reef and this has occurred after the dump has been in operation for approxiametly ten years according to officials from the municipality of Luce. Dumping continues at the site despite the fact that Western Parks and Markets management indicated it was closed and loads were being taken to other dumps in the area.

ORANGE BAY RECOMMENDATION:

There should be no question regarding the fact that this site should be closed immediately. Damage to the coral reef, aquatic life and the surrounding vegetation is almost certain to be occurring. There appears to be no significant level of scavenging ongoing at the site which would require consideration of the social problem of removing the economic basis for a population as a closure consideration. During our visit we met one individual who identified himself only as the dump attendant and dump closure should not affect his livelihood if he were transfered to another location. Recommendations for the site would be to close the site immediately and reroute trucks to other dumps in the area. This should be done by placing a fence across the road with no gate other than a small gate for people to pass. An environmental consultant familiar with landfills should be hired to make a determination as to alternatives. Methane and leachate studies should be conducted to determine constituents of the leachate being generated and its potential impact. Gas generation studies should also be conducted to determine gas generation patterns and their potential impacts. Based on these tests a decision should be made regarding the ultimate disposition of the site. The

possibility of moving the in place refuse at a reasonable cost seems remote. The requisite equipment is not available in the area and a viable alternative site has not been developed. Some on site mitigation strategy might be considered based on testing results.

COUSINS MOUNTAIN BACKGROUND:

As an alternative to the Orange Bay dump WPM is attempting to develop the Cousins Mountain site (CMS). Paul Carrol and I toured this site to look at its potential as a landfill. It is my understanding that approxiametly $700,000 J is available for site development specifically for development of an access road and gate facilities for the dump attendent.

COUSINS MOUNTAIN DISCUSSION:

The most immediate and obvious problem with this site is accessibility. This site is approxiametly 1 1/4 miles from the hardsurface road supporting access. The last 1 1/4 miles is impassable to any vehicle but a pickup truck at this time. In fact the last 200 yards must be traversed on foot to gain access to the location. Clearly if vehicles cannot reach the site they will dump at any of the numerous places on the road rather than go on to the actual dump site. Without the benefit of some study of the subgrade required and the time to perform an engineering estimate of the amount of material that requires removal to create a reasonable two lane, unpaved, access to the site, it is difficult to determine the ultimate cost of the access road. An educated guess would be about three to four times the amount of money budgeted for the entire site development.

The actual dump site is an area estimated to be about 20 acres total of which only five acres are clear of trees. This site sits at the base of a fairly steep slope. Depth to bedrock at the site has not been determined. No drainage plan has been developed and no site clearing plan has been envisioned. Public Works staff in Luce indicate that the operations plan for the site will be a

basic cut and cover landfill operation. Yet, no data has been developed regarding the depth to bedrock and no determination has been made regarding the availability, either on site or off site, of cover material. For a sanitary landfill, there should be enough soil over bedrock to provide a minimum depth of 1.5 meters of undisturbed soil plus at least 2 meters more of soil for cover. (assuming a ratio of 1:4 soil :refuse) It is difficult to envision that this facility will not be operated in the manner that Retirement site in Montego Bay is operated which basically consists of dumping material and burning it. No operating budget is available and no plans have been made for the availability of a bulldozer with required attachments to support a cut and cover operation.

The Underground Water Authority has determined that this would be an acceptable landfill site based on regional geology and surficial studies of the site. There appears to have been little consideration given to leachate formation on the site and the potential for it to be washed down the slope onto land currently used for grazing cattle. The nature of the bedrock in the area suggests fracturing could be a problem and groundwater contamination could result over time. Apparently the process of permit application being reviewed by the Natural Resource Conservation Authority and sponsered by the Underground Water Authority was not utilized to evalute the site conditions. This is most probably due to the fact this process has not been approved for implementation by the agencies.

COUSINS MOUNTAIN RECOMMENDATION:

The major problem with the selection and potential operation of this site is systemic to the disposal system in the country as a whole. Given the lack of co-ordinated solid waste management planning at the national level and little or no solid waste management expertise in the system it appears that this site will come on line as another of the many dump sites already in existence. In an effort to short circuit this the following recommendations should be considered:

a) a minimal site study should be conducted to develop a plan for development which is consistent with the geology and physical makeup of the site. This study should be conducted by a consulting firm which has the personnel to develop local contacts for lab work and to develop local contracts for whatever well drilling and other tasks are required to develop data required to produce an intelligent and environmentally sound recommendation. The study should look at the availability of cover material, to include alternative sources; cubic yards of material expected to be deposited; site life expected; potential for the site to meet criteria outlined in the proposed permitting and operating criteria for landfills currently being considered; and a closure plan for final site disposition when it has reached capacity.

b) additionally planning and budgeting should be conducted in an effort to develop a road into the site which will ensure accessibility even in times of inclement weather.

c) a budget should be developed to insure that the equipment, specifically a bulldozer equivalent to a D7 Caterpiller, is available for full time operations. This should include a budget for staffing and an on site refueling facilities. Staffing should include an equipment operator and a landfill attendant with a backup person to allow for vacations and illness etc. A maintenance contract for the equipment should be included in the budget to insure operability and longevity of the investment.

A cost estimate for the above would fall into the following range: (all estimates are in US dollars)

a) site study to include engineered plans $100,000-$200,000

b) road construction into site $40,000 to $60,000

c) site clearing and development would depend on findings of study.

d) purchase of bulldozer and fueling facility to include first year maintenance plan $300,000-$370,000

e) gate and gate house $10,000-$12,000

A total cost of $450,000 to $642,000 plus site development dollars is

considerable by Jamacian standards. However, it is an extremely inexpensive project by any measure which recognizes the importance environmental concerns in disposal planning.

SUMMARY:

As I indicated the problem with CMS siting relates largely to inexperience at all levels of involvement with any type of landfilling operation. Should a siting study be funded, it would be useful to require that the consultants work with staff from the Natural Resources Conservation Authority (NRCA), the Underground Water Authority (UWA), the Ministry of Local Governments, and Western Parks and Markets to familiarize them with all facets of the process. Staff from these agencies should be dedicated to the project fulltime. These personnel could then form a task force to work with the IDB in their forthcoming study to further broaden their expertise and provide them with an overview of all solid waste disposal issues related to the island. This group could then form the core of an interagency task force which would review existing regulations and anticipated regulations for their respective agencies. This process could be beneficial as they could both bring a positive understanding of environmental disposal issues to the table in addition to and understanding of their agencies internal policies and procedures. Should a group like this be formed it might be very useful to introduce them to the concepts of TQM (Total Quality Management) to enhance their ability to work together as a team. TQM is a management philosophy which recognizes that employees at all levels of the organization should be empowered in developing process and in decision making.

This team concept might be expanded to have the siting consultants outline closure options for the Orange Bay facility. Having this team work on both projects would provide an incountry group which would be capable of implementing any closure decisions and siting requirements identified by the IDB study. Although the initial cost of this program would be high in terms of near term dollars and agency manpower it would greatly reduce the future cost

of bringing in outside experts to perform this type of work on the other dumpsites in the system. The net effect would be to develop a Jamacian team capable cf managing the dumps and new landfill sitings who are interactive with the respective agencies involved. The long term savings in terms of dollars and the positive net effect on decisions related to the environment make this an option worth considering.

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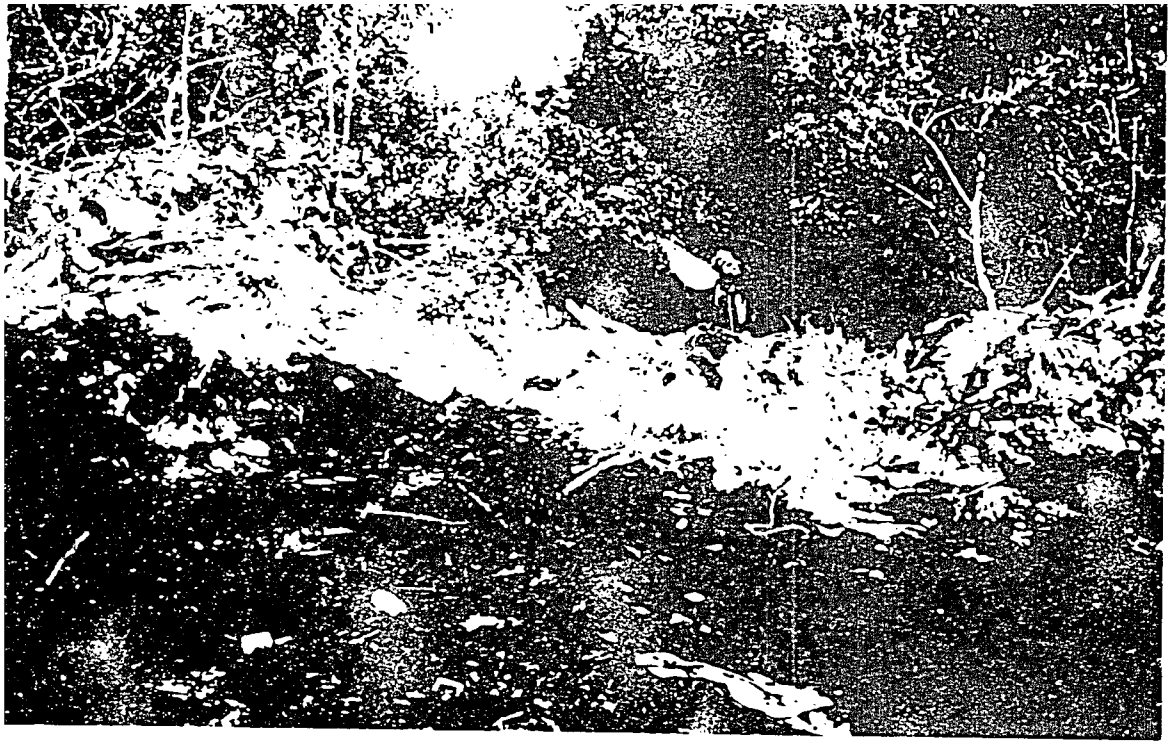
BEST AVAILABLE DOCUMENT



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BEST AVAILABLE DOCUMENT

204

BEST AVAILABLE DOCUMENT

JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Front End Loader Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25 0 cubic meters		
Capital Cost of Equipment	20,508,621 SJA	125000	
		4000	
Spare Parts	1 025,431	5%	of Capital Cost of Equipment
Customs	9,690 323		
Total Capital Investment	31,224,375 SJA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid-way)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	3 7 trips shift	10 km one way	
Complete Loads per Shift	3 35 loads shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	42 tonnes/day		

				SJA
Annualized Capital Cost when purchased in		1993		
(31 224,375 @ int of	60 00%	over life utilized)		19,794 325
Cost of Personnel Shift				
1 00 Driver	62 400	SJA/year		62,400
1 00 Workers	37 440	SJA/year		37,440
8 46 Attndts	31 200	SJA/year		264 075
1 00 Workshp Prsonnl	56 160	SJA/year		56,160
0 50 Suprvsry Prsonnl	74 880	SJA/year		37,440
0 50 Inspctn Peronnl	0	SJA/year		0
Administration	30%	of above		137,255
Benefits	5%	of above		29,738
Annual Personnel Costs/Shift				624,508
Annual Personnel Costs				624 508

09 -Jan-94

JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(10 00 litres/hr)	(31,200 litres@	10 0	SJA/ltr	312,000
Engine Oil	(1 50 litres/hr)	(4 680 litres@	70 0	SJA/ltr	327 600
Trans Oil	(0 40 litres/hr)	(1 248 litres@	60 0	SJA/ltr	74 880
Hydric Oil	(0 30 litres/hr)	(936 litres@	60 0	SJA/ltr	56 160
(Wheels per Equipment Unit)		6			
Tires	(1100 repl hrs)	(17 0 tires @	10500 0	SJA/ea	119 127
Brake Lnng	(600 repl hrs)	(31 2 units @	1500 0	SJA/ea	46 800
Brake Drum	(1200 repl hrs)	(15 6 units @	2000 0	SJA/ea	31 200
Clutch Plt	(1600 repl hrs)	(0 0 units	15000 0	SJA/ea	0
Filters	(80 repl hrs)	(39 0 sets @	250 0	SJA/set	9 750
Prot Gear	(1000 repl hrs)	(6 2 sets @	2000 0	SJA/ea	12 480
Other	(15% additional over above costs)				148 500
(seals, grease, battery, alternator, etc)					
Total Consumables					1 138 497
Special Costs Attributable to Storage and Containment at the Source					0
Miscellaneous Costs (taxes, insurance, registration, etc)	21%	of capital cost of equipement			4 306,810
Annual Cost of Equipment Unit If implemented during	1993				25 864 140

Tonnes Handled per year				
(41 9 tonnes/day	312 days/yr	90% available)		11,765
	Cost per Tonne		2 198 48 SJA	
Aver Cost per Person (	0 24 tonnes/cap/yr)		521 59 SJA	

EQUIPMENT COST	76 53%
PERSONNEL COST	2 41%
CONSUMABLE COSTS	4 40%
OTHER COSTS	16 65%
TOTAL COST	100 00%

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JAMAICA Cost Comparisons

January 1993 30 SJA per US Dollar

Type of Equipment	Front End Loader, Totally Mechanically Loaded from 5 cm Mechanically Liftable Containers		
Capacity	25 0 cubic meters		
Capital Cost of Equipment	21,750,000 SJA	125000	
		4000	
Spare Parts	1,087,500	5% of Capital Cost of Equipment	
Customs	10,276,875		
Total Capital Investment	33,114,375 SJA		
Estimated Economic Life Based on Planned Use	5 years (containers replaced mid - way through truck life)		
Number of Shifts per Day	1 00 shifts/day		
Hours of Operation/Year	3,120 hours/year		
Number of Trips per Shift	4 0 trips/shift	5 km one way	
Complete Loads per Shift	3 60 loads/shift		
Typical Density of Solid Waste in Loaded Vehicle	0 55 Tonnes/cubic meter		
Typical Productivity	45 tonnes/day		

			SJA
Annualized Capital Cost, when purchased in 1993 (33 114 375 @ int of 60 00% over life utilized)			20,992,468
Cost of Personnel/Shift			
1 00 Driver	62,400	SJA/year	62,400
1 00 Workers	37,440	SJA/year	37,440
9 09 Apprnts	31,200	SJA/year	283,636
1 00 Workshp Prsonnl	56,160	SJA/year	56,160
0 50 Suprvsry Prsonnl	74,880	SJA/year	37,440
0 50 Inspctn Peronnl	0	SJA/year	0
Administration	30% of above		143,123
Benefits	5% of above		31,010
Annual Personnel Costs/Shift			651,209
Annual Personnel Costs			651,209

JAMAICA Cost Comparisons SJA

Consumables						
Fuel	(10 00 litres/hr)	(31 200 litres/@	10 0	SJA/ltr		312,000
Engine Oil	(1 50 litres/hr)	(4 680 litres/@	70 0	SJA/ltr		327,600
Trans Oil	(0 40 litres/hr)	(1 248 litres/@	60 0	SJA/ltr		74,880
Hydric Oil	(0 30 litres/hr)	(936 litres/@	60 0	SJA/ltr		56,160
(Wheels per Equipment Unit)		6				
Tires	(1100 repl hrs)	(17 0 tires @	10500 0	SJA/ea		119,127
Brake Lnng	(600 repl hrs)	(31 2 units @	1500 0	SJA/ea		46,800
Brake Drum	(1200 repl hrs)	(15 6 units @	2000 0	SJA/ea		31 200
Clutch Plt	(1600 repl hrs)	(0 0 units	15000 0	SJA/ea		0
Filters	(80 repl hrs)	(39 0 sets @	250 0	SJA/set		9,750
Prot Gear	(1000 repl hrs)	(6 2 sets @	2000 0	SJA/ea		12 480
Other	(15% additional over above costs)					148,500
(seals, grease, battery, alternator, etc)						
Total Consumables						1,138,497
Special Costs Attributable to Storage and Containment at the Source						0
Miscellaneous Costs (taxes, insurance, registration, etc)	21% of capital cost of equipement					4,567,500
Annual Cost of Equipment Unit If implemented during	1993					27,349,674

Tonnes Handled per year

(45 0 tonnes/day 312 days/yr 90% available) 12,636

Cost per Tonne 2,164 42 SJA

Aver Cost per Person (0 24 tonnes/cap/yr) 513 51 SJA

EQUIPMENT COST	76 76%
PERSONNEL COST	2 38%
CONSUMABLE COSTS	4 16%
OTHER COSTS	16.70%
TOTAL COST	100 00%