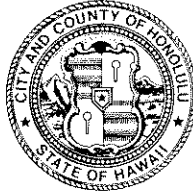


DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813



FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

IN REPLY REFER TO:

RE 91-074

November 7, 1991

MEMORANDUM

TO: THE HONORABLE FRANK F. FASI, MAYOR
CITY AND COUNTY OF HONOLULU

VIA: JEREMY HARRIS, MANAGING DIRECTOR

FROM: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

SUBJECT: RECYCLING REPORT PILOT PHASE
EVALUATION AND RECOMMENDATIONS

Attached is the Recycling Report Pilot Phase Evaluation and Recommendations, dated October 30, 1991, for your review and approval prior to submitting it to the City Council. We believe that the closing paragraph of the Executive Summary gives a concise statement of our view of recycling, as follows:

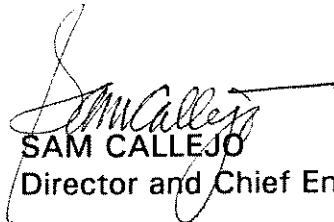
"The Department of Public Works views recycling as being in its infancy and believes that extensive support systems (collection, processing, transportation, marketing of recyclables and remanufactured materials) must be developed before the ambitious goals set by Ordinance 89-114 can be attained. Our enthusiasm and commitment to recycling are undiminished, but we believe that the City must proceed carefully in expanding recycling islandwide on a more realistic timetable.

The Honorable Frank F. Fasi, Mayor
Page 2
November 7, 1991

The City will be trying to stimulate local markets for materials, but the market situation world-wide will also have a major influence upon the success of recycling. Every decision made has to pass the scrutiny of economic feasibility."

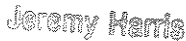
Much attention has been paid to residential recycling with numerous pilot projects implemented to test the feasibility of curbside and school recycling. The results of these pilots have not only measured the cost-efficiency of one to the other, but have also revealed the minimal impact islandwide residential recycling would have on reducing the waste stream. The Department estimates a 3% or less waste reduction. However, there seems to be a greater potential for recycling in the commercial sector, which currently contributes 70% of our waste stream, and in the recycling of special wastes such as tires, sewage sludge and possibly construction and demolition debris.

The Department recommends further investigation into the potentials and feasibility of various commercial sector projects as a means of achieving the legislated recycling goals. We also recommend the expansion of the School/Community Recycling Program which is developing a strong educational component for recycling and is the most cost-efficient residential system tested.


SAM CALLEJO
Director and Chief Engineer

Attach.

APPROVAL RECOMMENDED:



JEREMY HARRIS
Managing Director

APPROVED:



FRANK F. FASI, Mayor

RECYCLING REPORT

PILOT PHASE EVALUATION
AND
RECOMMENDATIONS

OCTOBER 30, 1991

PREPARED AND SUBMITTED BY:

DIVISION OF REFUSE COLLECTION AND DISPOSAL
DEPARTMENT OF PUBLIC WORKS
THE CITY AND COUNTY OF HONOLULU

EXECUTIVE SUMMARY

Recycling goals to divert portions of Oahu's solid waste away from incineration and landfilling were established under Ordinance 89-114 on October 4, 1989: 30% by the end of 1991; 50% by the end 1995; and 75% by the end of 2000. On that same day, Ordinance 89-115 authorized the Department of Public Works to create a pilot project to test the feasibility and cost-effectiveness of recycling and to evaluate the pilot project and make recommendations on future efforts to the City Council.

The Department initiated the first two of three residential curbside programs in Kailua in July 1990; the third was started in May 1991 in Kaneohe. In November 1990, the Department began a school/community program with 20 schools promoting campus recycling and serving as recycling drop off centers for surrounding communities. Also in November 1990, an office recycling program was started for City offices in the downtown area. In cooperation with motor oil retailers, the Department implemented a used oil collection program which integrated recycling and waste-to-energy. Attempts to introduce and encourage reuse/recycling of other specific wastes, such as yard trimmings, used tires, and sewage sludge, are ongoing, and the Department continues to advise and assist in the startup of programs for apartments and condominiums and for the commercial sector.

After well over a year designing, implementing, and running these programs, the Department's experiences mirror those of municipalities across the mainland. Except for aluminum and office paper, recyclable materials are very low value, and prices for them can fluctuate widely in a short time span. One problem appears to be inadequate markets for the vast amounts of materials being collected nationwide, although supply-and-demand factors are complex and interrelated. Industries using recycled feedstocks must be assured of stable markets for their products before they commit the capital to expand manufacturing capacity. Another major problem is the high cost of collecting the recyclables. Hawaii's cause is further hampered by its remoteness from existing markets and the added transportation costs. The shortage of available industrial land for recycling activities is a continuing problem.

Based on the pilot residential programs, the Department believes that an islandwide curbside system could be structured to collect recyclables once a month and be integrated with the existing refuse collection system. Such a system would foster the widest participation at minimum additional collection cost. However, \$12 to \$15 million in start-up costs are anticipated, and this must be weighed against the modest impact it would have on reducing the waste stream. Although the pilot programs achieved up to a 14% reduction in Kailua's waste, Oahu's total waste

stream includes a sizable component generated by the commercial sector. It is projected that an islandwide curbside residential program would reduce the total waste stream by 3% or less.

There appears to be a large, untapped potential for recycling in the commercial sector, which includes office buildings, hotels and restaurants, shopping centers and retail merchants, and which also encompasses apartments and condominiums serviced by private refuse collection companies. The Department's role in developing programs for this sector is to encourage and support private refuse collection companies' expansion of their services into recycling and to provide implementation guides and assistance to apartments/condominiums and business organizations. The Department's expenditures in this area cannot be allocated on a cost per ton basis because recovery quantities are not reported. However, the overall effectiveness of this assistance will eventually become evident in a reduction in total waste generation.

Recycling has a relationship to H-POWER, and the Department does not see it as an adversarial one. There is enough refuse generated on Oahu to satisfy contractual obligations at H-POWER and provide recycling with all the material it can handle. H-POWER may be viewed as the dominant partner for now because, without it, Oahu would be inundated with solid waste. H-POWER allows the City time to develop recycling in cost-effective ways. The Department believes that with widespread education, personal, corporate and government commitment, and development and nurturing of materials markets, that recycling can become an equal or dominant partner in this relationship over the next 10 to 20 years.

A one-year period for the development and implementation of a cost-efficient, widely-applicable, recycling program for the residential and/or commercial sectors is not sufficient. Nor is the goal of 30% recycling by the end of 1991, established by Ordinance 89-114, attainable. The Department estimates a recycling rate of about 12% at the end of 1991 and believes that 30% can be achieved by 1994, if local, national, and world markets continue to develop. Detailed examination of the waste stream is necessary to identify sources and quantities of recyclable materials and to further assess the costs of collection and processing alternatives. The infrastructure and local markets must also be developed to accommodate the increasing quantities of materials collected.

The Recycling Report makes these short-term recommendations:

- Complete the Integrated Solid Waste Management Master Plan due at the end of 1992. This plan will update the recycling alternatives available for local materials, including those not currently being collected, and attempt to quantify the impact of recycling on things like environmental pollution and energy conservation.

☉ Conduct a Recycling Potentials Assessment to determine the quantities and sources of recyclables. This will allow the Department to better focus its plans to capture materials from large generators.

☉ Conduct a Market Development Study to identify and recommend local end uses for recyclables and explore the viability of a waste exchange program. If demand for secondary materials increases, the collection of these materials will follow naturally. It is essential that private industry support government efforts by increasing remanufacturing capacity and expanding markets for recyclable materials. The land, capital, and manpower investments will be considerable and will require time to implement.

☉ Fine-tune curbside collection by implementing another pilot program incorporating all of the lessons learned thus far. If an economical system can be formulated, islandwide expansion will require modifications to existing transfer stations, stimulation of private industry to construct a materials recovery facility, and a possible volume-based refuse collection fee to encourage and maintain high levels of participation.

☉ Expand the School/Community Recycling Program to twenty-five to thirty strategically located schools to give more residents (and small businesses) recycling opportunities. The educational benefits and cost-efficiency of the program make it well worth continuing.

☉ Increase education and implementation assistance to the commercial sector.

☉ Continue development of the Backyard Composting Program and reevaluate the plans for a municipal composting facility utilizing sewage sludge, green waste, and H-POWER residue.

☉ Continue to seek recycling options for specialized wastes, such as used tires, white goods, incinerator ash, and construction debris. Ultimately, solutions will probably involve joint participation by government and private industry.

☉ Ban materials from landfills as recycling markets and collection systems develop.

☉ Adjust the timetable on recycling goals to coincide with the actual implementation schedule.

- Establish four permanent recycling positions in the Refuse Division.

The Department of Public Works views recycling as being in its infancy and believes that extensive support systems (collection, processing, transportation, . marketing of recyclable and remanufactured materials) must be developed before the ambitious goals set by Ordinance 89-114 can be attained. Our enthusiasm and commitment to recycling are undiminished, but we believe that the City must proceed carefully in expanding recycling islandwide on a more realistic timetable. The City will be trying to stimulate local markets for materials, but the market situation world-wide will also have a major influence upon the success of recycling. Every decision made has to pass the scrutiny of economic feasibility.

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I. Introduction/Background

The Department of Public Works contracted with the consulting team of R.W. Beck and Associates, Barrett Consulting Group, Inc. and M. Ross Sheldon to conduct a study of methods and costs for reducing solid waste by means of recycling. The recycling study, completed in July 1989 in conjunction with City recycling and waste legislation signed into effect in October 1989, gave initial direction to the development of recycling programs for Oahu.

A Recycling Office was created within the Division of Refuse Collection and Disposal, Department of Public Works. Staffing began with the Recycling Coordinator in January 1990 and has grown over the past twenty-one months to include a Recycling Specialist and two temporary contract positions. Other Division engineering staff have been utilized to head projects in composting, tire recycling, ferrous metal recycling, ash recycling and glasphalt.

During the months between January 1990 and July 1991, the Department designed and implemented numerous pilot and demonstration recycling projects in curbside collection, school/community drop-off centers, office recycling and used oil recovery. Projects currently in development include municipal and backyard composting; recycling of tires, ferrous metal, white goods and ash; market development for glass; and program implementation assistance to apartment buildings, office buildings, hotels, restaurants and bars.

Much has been learned in this short period of time, giving direction to the conclusions and recommendations presented in this report. The Department is confident that recycling can play a valuable role in managing solid waste. However, recycling is not yet ready to move into full-scale, islandwide program expansion either in the residential or commercial sectors. Residential programs need further development to fine-tune cost efficient systems, commercial recycling warrants further investigation and the infrastructure for recycling needs to be strengthened in order to support the City's expansion plans. Recycling is a process which begins with the recovery of used materials and ends when consumers purchase goods made with the recovered materials. The cycle of the process can go no faster than the slowest part.

This report evaluates the City's pilot and demonstration projects; estimates the impact of recycling on H-POWER and landfill; compares costs among recycling, H-POWER and landfill; and outlines the Department's preliminary recommendations for the future of recycling. This report presents short-

term recommendations only. Long-term recommendations and planning can be provided after the completion of the Integrated Solid Waste Management Master Plan, currently in development, a recycling potentials assessment, a market development study and further project investigation.

II. Pilot/Demonstration Projects

A. Curbside Recycling

The Department has implemented three different curbside collection systems in order to test the local impact of numerous collection options currently utilized in curbside programs across the country.

1. Operations: The first two programs began in Kailua in July of 1990 with a total of 7,406 households participating. The programs were designed with all the elements known to promote high levels of participation, such as weekly collection and the provision of attractive containers. Residents were instructed to set out recyclable material separately from refuse. However, penalties were not imposed for non-compliance.

In Program A, the Sorted Bin System involving 4,155 households, residents separate recyclable materials into three stackable bins (manufactured with 25% recycled plastic): plastics and aluminum cans in one, glass in another and newspaper in the third. The collection crew provided under private contract with Waste Management of Hawaii, Inc. picks up the recyclables on a weekly basis from each household and sorts these materials six ways at the truck into separate compartments, separating plastics, cans, three colors of glass and newspaper. The materials are then transported to the Kapaa Transfer Station where they are deposited into six separate 35-cubic-yard roll-off containers. When a roll-off container is filled, it is transported to the recycling facility by the contracted recycling company for compacting, baling and shipment to markets. Reynolds Aluminum Recycling Company is contracted for the aluminum cans, and Hawaii Environmental Transfer Inc. for all of the other materials.

The Sorted Bin System was designed to maximize the revenue return on the recyclable materials and to avoid the need for a centralized sorting facility, frequently referred to as a materials recovery facility (MRF).

In Program B, the Commingled Reusable Bag System involving 3,251 households, residents separate recyclable materials into two reusable plastic bags: plastics and newspaper in one, glass and aluminum cans in the other. The collection crew provided under contract with Waste Management picks up the bags on a weekly basis in a front end loading packer truck and leaves rubberbanded replacement bags at the curb. The bags of recyclable materials are transported directly to the recycling facility, Hawaii Environmental Transfer, where they are emptied and the material sorted into the six market groups before being compacted, baled and shipped. The recycler is also responsible for rolling and rubberbanding the emptied bags and returning them to the collector for redistribution.

The Commingled Reusable Bag System was designed to streamline collection at the curb and to look at the economics of centralized sorting.

Program C, the Commingled Grocery Bag System, began nine months later in May of 1991, involving about 4,230 Kaneohe households. The program incorporates lessons already learned from Kailua and tests some additional variables. Residents are asked to reuse plastic and paper grocery bags as containers, putting plastic, aluminum cans and glass into the plastic bag and newspaper into the paper bag. The City's refuse collectors working on overtime pick up the bags from each household twice per month in a new rear loading packer truck, which is allocated to the recycling program. The bags of collected material are transported directly to the recycling facility at Hawaii Environmental Transfer, where they are emptied and the materials sorted, processed and shipped to markets. The paper bags are recycled with the newspaper, and the plastic bags are baled separately for recycling.

The Commingled Grocery Bag System was designed to introduce recycling to the municipal refuse collectors and their labor union and to look at two possible areas to reduce costs: pickup frequency and provision of containers.

2. Public Awareness and Education

In all three programs, participating residents were notified and instructed by mail in the form of an attractive brochure. Additional instructions were delivered to Kailua residents with their containers. Many local retailers and public facilities in

both towns helped promote the program by putting up posters and distributing brochures. Kaneohe grocery stores went a step further by agreeing to print recycling instructions on their grocery bags and having their check-out cashiers wear "Reduce, Reuse, Recycle" buttons.

A recycling curriculum, developed later for the School/Community Recycling Program was distributed to elementary schools in Kailua and Kaneohe. The recycling show, also a part of that program, included Kailua schools in its tour around the island (Kaneohe's program had not yet begun). Sample public awareness and education materials are included in Exhibit I.

3. Findings and Observations

There are numerous sources which provide information about the effectiveness and efficiency of the three curbside systems being tested. The contractors and City crews provide daily and monthly operations reports, Kailua residents call in regularly with comments and suggestions, and the University of Hawaii conducted a survey of a random sampling of households in the Kailua project areas. An Operations and Cost Analysis is provided as Exhibit A. A copy of the survey is provided as Exhibit G.

The following observations highlight what has been learned thus far:

a. Sorted vs. Commingled

Commingled collection is more cost-efficient than sorting at the curb. Although the City receives revenues from the sale of the recyclables in the sorted program, the market value of most of the recyclables is low and has little impact on offsetting the higher collection costs. The commingled collection costs are significantly lower, even with the additional sorting charge incurred. The City is paid for the aluminum and glass and charged for the newspaper and plastic. Since newspaper comprises 70% of the recyclables by weight, the net result is a charge of approximately \$25/ton. The contractor currently uses a manual sorting system. The sorting and processing cost attributed to a more mechanized

and larger scale system, as in a materials recovery facility, is yet to be determined.

b. Pickup Frequency

Weekly collection is too frequent; twice per month is difficult to remember; monthly seems to be the right frequency and easy to remember. Kailua residents, especially those using the reusable bags, reported that they did not have enough material to put out every week and suggested twice-a-month or monthly collection. Kaneohe residents have reported difficulty remembering their pickup day at twice per month. The Kailua programs, which are achieving high participation levels, are capturing between 11% and 14% of the residential waste stream. Based on recovery weight and volume, no more than monthly collection is warranted, for which larger capacity containers would be required.

c. Recycling Containers

Residents overwhelmingly prefer the bins to the bags, and low participation levels in Kaneohe indicate the need to provide a container rather than relying upon householders to provide their own. Rigid plastic bins which remain at the household are preferred over bags which get dirty as they rotate through the collection process. Residents also ask if lids and wheels can be added to future containers.

d. Consolidation At Transfer Station

A low roof overhang at the Kapaa Transfer Station recycling area does not allow for efficient dumping of materials into the roll-off containers. The contractor reports that he is unable to utilize a state-of-the-art recycling vehicle that could better facilitate his collection at the curb. The station was designed long before the recycling programs began, and the roof and other features will have to be modified if the station is to be used in a large-scale program.

e. Brochure Distribution

The delivery of instructional brochures to targeted project areas in the future might be better accomplished door-to-door than by direct mail. Kailua's mailing list was developed in-house utilizing tax map key listings. The Department of Data Systems indicated it was a tedious process which they would prefer not to repeat. Kaneohe's mailing list was developed by a professional mailing house through the City's contracted recycling public awareness consultant. Many homes were missed in the initial mailing. It took weeks of investigation to identify the missed "pocket" areas. Follow-up mailings to larger sectors were necessary to reach the smaller areas missed. It seems that trying to target an area smaller than a zip code is an inaccurate science.

f. Private Collection vs. Municipal Collection

Both the private contractor crews, and the municipal crews which service Kaneohe, are providing satisfactory collection to the respective project areas. Complaints regarding noise, sloppy service and missed service are reported more frequently against the contractor. However, the scope of the Kailua project is larger and more complex than the Kaneohe project.

An advantage to private collection is the speed with which private haulers and recyclers can start up and expand recycling programs and their ability to make quick changes in operations and manpower. The disadvantage is that contracted collection costs are incurred in addition to the existing costs of collecting refuse.

The advantage to municipal collection lies in the possibility of integrating the collection of recyclables with the existing refuse collection system so that no additional labor costs are incurred. The disadvantage is the length of time the Department would need to develop this program, including negotiations with the labor

union, procurement of equipment and modifications to transfer stations.

g. Participation

Participation is high in both Kailua programs and low in the Kaneohe program. Based on recovery data, the Sorted Bin System, estimated at 85% participation, seems to have maintained a better public response than the Commingled Reusable Bag System, estimated at 68%. Feedback from the residents indicates that the type of container most likely accounts for the difference in participation. The bins are preferred, and the bags have generated numerous complaints with regard to their dirty condition and the contractor not leaving replacement bags.

Low participation in Kaneohe, estimated at 29% for the three-month-long project, is clearly attributable to the fact that no containers were provided. Of the eight collection routes in Kaneohe, two were given single bins. In these two areas, their recycling day coincided with their refuse collection day. Since recyclables are placed at the curb in grocery bags, there was concern that the collectors might confuse recyclables with refuse set out on the same day. The bin was provided to help the collectors easily differentiate between them. Set-out rates in the two areas where bins were distributed are significantly higher than the other six areas.

Set-out rates are based on the actual number of households that place recyclable material at the curb for pickup each day.

Participation rates are based on the recovery level and the assumption that an average household generates approximately 440 pounds of recyclable material each year. With this method, the degree of participation is more accurately measured than when based solely on set-out rates.

h. Cost-Efficiency

The cost to collect, sort, and market recyclable materials from the pilot curbside collection programs is higher than the cost to collect and dispose of refuse.

	<u>Cost/Ton</u>
Refuse: Collection and disposal	\$125.37
Refuse: Collection and disposal including transfer costs	\$147.40
Recyclables: Reusable Bag System including collection, sorting, revenue	\$265.79
Recyclables: Sorted Bin System including collection, revenue	\$463.13
Recyclables: Grocery Bag System including collection, sorting, revenue	\$389.58

The Department needs to develop an economical method for the collection of recyclables which is comparable with the collection of ordinary refuse in order for islandwide curbside recycling to make sense and to secure its longevity once implemented.

One possible way to make curbside recycling cost-efficient would be to integrate the collection of recyclable material with the collection of refuse by changing one refuse collection day per month to a recyclable collection day.

4. Conclusions

A one-year period for the planning and development of a cost-efficient, widely-applicable, curbside collection program is insufficient. The results of the pilot curbside collection programs thus far have significantly narrowed the field of possible variables and provided a general direction for further development. Additional time is needed to fine-tune a truly viable system which could be expanded with confidence around the island.

The Department is planning to further test a system which incorporates all the lessons learned thus far. The results point in the general direction of a system that would incorporate monthly commingled collection of

recyclables integrated into the existing refuse collection systems and utilizing 96-gallon wheeled carts and side-loading collection vehicles.

Although the system design would not incur any additional collection costs, there would be significant start-up costs for islandwide curbside collection, mostly attributed to the purchase of resident containers. At an estimated cost of \$70 per container, 170,000 containers would cost the City \$11,900,000. Amortizing these costs over the ten year life expectancy for the container at a 7% interest rate brings the annual cost to \$1,694,560. Additional costs would include modifying refuse transfer stations to accommodate the transfer of recyclables and sorting the commingled recyclables at a centralized sorting facility.

However, start-up costs can be estimated to range between \$12 and \$15 million dollars. The significance of this cost to the taxpayers should be weighed against the impact the program will have on reducing the waste stream. Kailua's curbside collection program reduced the residential waste stream by approximately 14% at an 85% participation rate. However, when Kailua's recovery rates are used to project islandwide curbside collection and measured against the total waste stream, the impact is diluted by the influx of commercial waste. The Department estimates that islandwide curbside collection from a total 170,000 households would reduce the total waste by no more than 3%. (See Exhibit A-2)

Given the low recovery potential in residential recycling, the Department concludes that:

- ☐ Curbside collection should be expanded only if it makes economic sense. Further investigation is needed.
- ☐ Drop-off recycling centers, as discussed in this report's section on School/Community Recycling, could provide sufficient collection service to residential communities.

- Future efforts should concentrate more on the commercial sector, as discussed in this report's section on Commercial Recycling.

B. School/Community Recycling

The Department implemented recycling programs at twenty schools around the island beginning in November and December of 1990. The program is designed to develop a strong educational component for recycling, as well as establish recycling centers for Oahu communities.

1. Operations

The City provides each selected school with a large 20' long campus recycling container, a custom-designed roll-off container divided into four compartments for the individual deposit of glass, newspaper, plastic and aluminum cans. The aluminum section has a theft-resistant deposit door designed similar to a mailbox chute. Reusable bags and stands are provided in sufficient number to set up recycling stations in each classroom, office area, library and cafeteria. Additional reusable bags (without stands) are provided for distribution to participating community residents in sets of four (one for each type of material collected).

Students, faculty and staff sort white and colored paper for recycling in classrooms and office areas. When the bags are full, the entire bag is deposited into the newspaper section of the campus container. Other recyclables are collected in strategically located bags/stands around campus. When these bags are full, they are emptied into their appropriate sections of the container.

Participating residents utilize the reusable bags to sort recyclables at home and transport them to the school. The bags are emptied into the appropriate sections of the container and brought back home for reuse. Many residents also use their own grocery bags, trash bags and boxes.

Small businesses that want to recycle office paper, but do not generate sufficient volumes to warrant pickup by a recycling company, can tie in with the school's system and donate their paper. The schools can provide these businesses with bags and a bag stand.

When the campus recycling container reaches capacity, the school's recycling coordinator calls the contractor, Hawaii Environmental Transfer, for a pickup. A roll-off truck arrives, off-loads the replacement container and picks up the full container for transport to Hawaii Environmental Transfer's recycling facility.

The contractor mails a monthly check to each school for the revenue generated from the sale of their recyclable material. The schools use this money to fund various needs, including the purchase of playground equipment and computers, and community service, environmental and educational projects.

2. Public Awareness and Education

The City provided the schools with recycling curriculum, posters, "how to participate" brochures, a press kit, a recycling show and implementation guides. The first edition of a quarterly school recycling newsletter has been distributed. Samples of these materials are included in Exhibit H.

A team of teachers was brought together to develop a pilot recycling curriculum for grades K-6 and 9-12 under the direction of the Department, Janie Deuser, Executive Director for the Recycling Association of Hawaii and Colleen Murakami, Environmental Education Specialist for the Department of Education. The resulting "Recycle Hawaii for Kids" was distributed to teachers in the project schools and to schools in Kailua and Kaneohe. Additional copies are sent to schools around the island upon request. An outline of the curriculum, exclusive of the actual lessons, is included in Exhibit I.

The City also commissioned a recycling show to tour the twenty project schools (and six Kailua Schools) to educate and motivate students, teachers and community residents. "Willie's Remarkable Recycling Flight," produced and performed by the Honolulu Theater for Youth, toured the schools giving three performances at each school: two daytime shows for the students and one evening show for the community. This original stage production was written by Ray Bumatai, with music by Henry Kaponu. A music tape from the show is included in Exhibit I.

A half-day workshop was conducted before the start of the program to detail the program's operations; to provide

implementation guides and to review the use of the curriculum with teachers and school coordinators. The workshop outline and implementation guide are included in Exhibit I.

The Department has started a school recycling newsletter, which will be published quarterly to update the schools on recycling tips, program changes, relevant news, and to allow the schools to share creative educational ideas and solutions to operational problems encountered. A copy of the newsletter is included in Exhibit I.

3. Findings and Observations

The School/Community Recycling Program requires evaluation on two levels:

- ☐ As an educational component with long-range benefits to the development of recycling programs for Oahu; and
- ☐ As a viable recycling system for the collection of recyclable material in communities.

There are numerous sources which provide information about the effectiveness and efficiency of the program. Hawaii Environmental Transfer submits monthly operations reports on the number of container hauls, program costs and school recovery levels. The school coordinators, teachers and community participants call in regularly with questions, comments, suggestions and problems. The University of Hawaii conducted a survey of a random sampling of households in three school areas. A copy of the survey is attached as Exhibit H. An operations and cost analysis is presented in Exhibit B.

The following observations highlight what has been learned thus far:

a. Education and Motivation

Education is a key element to any type of recycling program, and the schools are the logical focus to insure the immediate as well as the future success of recycling. The students we educate today about the importance of

recycling are our future adults. They are also in the best position to motivate the participation of their parents in current programs.

The impact of the development of this recycling education component is difficult to assess in the short term. However, participating schools and teachers report that they are successfully using the curriculum and that the program provides an excellent hands-on learning experience for the students. In addition, there is a growing waiting list of schools wanting to join the program. Currently, about twenty-five schools are on the list.

b. Campus Recycling Container

The customized roll-off container is designed with four compartments. Originally, three four-foot-long sections were designated for glass, plastic and aluminum cans, and one eight-foot-long section for newspaper and bags of school and office paper. Most schools reported the newspaper section was filling much sooner than the other sections so the container required pickup service before it had reached capacity overall. After a six-month evaluation, recovery levels confirmed that over 70% by weight of the materials collected is newspaper. The Department changed the container by designating a second section for newspaper and commingling the plastics with the aluminum cans. However, the solution to one problem created another. The plastic and aluminum section now fills before the others. A solution may be to re-emphasize the need to flatten plastic bottles and aluminum cans as suggested in the initial instructions. The Department is currently looking into the effectiveness of this solution.

c. Classroom/Resident Recycling Containers

The reusable recycling bags used in the school for school paper and office paper work well. The bags are easy to handle, keep the different paper grades (white, colored, newspaper) separated in the campus container, and rotate back to the school fairly clean, as they are only used for dry, clean paper. However, since the volume of paper collected in the schools is low, a system using on-hand boxes might be just as successful in the future and

would eliminate the cost of the bags. Another program cost reduction alternative is to have participating schools purchase the replacement bags as current bags wear out.

Although bags were provided to the schools for distribution to community participants, it does not seem that the provision of these bags is necessary to generate participation. Examination of the recyclable material deposited in containers reveals that many participants use their own bags and boxes.

d. Participation

It is not possible to get an accurate measure of individual household participation in this type of system. Data on the population base for each school are not available, and the boundary lines are vague. Also, participants frequently do not reside within the school's community. The Department attempted to track bag distribution as a possible indicator of participation, but most of the schools had difficulty in administering and completing the bag distribution log form, and subsequent observations indicate that many participants never picked up bags from the schools. The University of Hawaii survey reports that 32% of the respondents participate in the school drop-off recycling centers. However, this measurement is likely to be skewed because residents who are recycling and have strong positive attitudes towards recycling and the environment are more likely to respond to the survey.

e. Cost-Efficiency

The School/Community Recycling Program currently demonstrates greater cost-efficiency than curbside collection and has the potential to further reduce costs as the container design is fine-tuned and recovery levels increase. During the first six months, the overall program costs averaged \$191/ton, with per school costs ranging between \$78/ton and \$811/ton. However, during the next four months cost-efficiency improved, with overall costs of \$136/ton and per school costs ranging between \$68/ton and \$518/ton, which is less than the cost to collect and dispose of refuse, currently at \$147/ton including transfer.

4. Conclusions

The educational benefits and cost-efficiency of the School/Community Recycling Program make it well worth continuing and expanding at this time. Twenty-five to thirty, strategically located school recycling centers could service Oahu's residents (and small businesses) while residential curbside collection undergoes further investigation and development. The school program could also supplement a future islandwide, once-a-month, curbside collection system.

C. City and County Government Office Recycling

The Department developed an office recycling program for City government buildings in two phases. The program was designed to provide an efficient system for City government agencies and serve as a model program for other offices in Honolulu to follow.

1. Operations

Many agencies in City Hall, Honolulu Municipal Building (HMB), Board of Water Supply (BWS) and the Prosecuting Attorney's Office began recycling about January 1990 with minimal assistance from the Department of Public Works. Between January and October 1990, employees recovered approximately 43 tons of used paper, earning about \$13,000 for the City. Although employees were enthusiastic about recycling, the program was hampered by an inefficient collection system. The contracted recycling company provided pickup service to each floor and agency, and paper was not properly sorted by grade.

At the end of November 1990, the City implemented a state-of-the-art desktop recycling system for all offices in the City Hall Complex, HMB, Pawaa Annex and BWS, involving an estimated 2,300 employees. The prosecuting Attorney's Office decided not to participate for reasons of confidentiality, and terminated their prior recycling activity.

The new system is designed to make recycling easy for employees, labor efficient for the custodial staff and the recycling company and cost-effective for the City. The City's office recycling program collects four grades of paper (computer printout/white ledger, colored ledger, newspaper and corrugated cardboard) and commingled containers (aluminum cans, glass and plastic bottles).

Each employee saves recyclable paper in a special desktop

folder printed with the list of papers that can and cannot be recycled. The folder has a tabbed divider designed to keep the white paper and colored paper/newspaper separate. When the folder is full, papers are deposited in central collection containers (manufactured with 15% recycled plastic), usually located near copy machines.

At the central collection site, a set of three stackable bins accommodates white paper and computer paper in the top bin, colored paper in the middle bin and newspaper in the bottom bin. Flattened cardboard boxes are left alongside the bins. In heavy paper-generating areas such as computer centers and print shops, paper is deposited directly into larger 96-gallon containers. In some computer centers, the computer paper is collected separately from the white ledger because it commands a higher market price. This is not feasible in general office areas where the generation of computer printout is low. In addition, computer paper generated on laser printers downgrades it to the white ledger category.

The City's custodial staff transports the paper from the central collection stations to a central storage area, where it is stored in 96-gallon wheeled carts (manufactured with 15% recycled plastic). The contracted recycling company, Hawaii Environmental Transfer, picks up the full carts and leaves empty carts in their place.

Employees can deposit bottles and cans in public recycling areas located on the ground floor in each building except City Hall, where it is on the second floor. The City's custodial staff also services these containers. Preliminary building surveys indicated that there were insufficient amounts of bottles and cans to warrant floor collection. Most employees and offices already recycled their cans privately or through the custodians. The public recycling area, a cluster of three containers, allows City employees and the public to sort newspaper in one, cans and bottles in another, and trash in the third.

2. Public Awareness and Education

Employee training sessions were scheduled for each building. Each session included a 15-minute slide show on the why's and how's of the recycling program and about 10 minutes for questions. The desktop folders and an educational brochure were distributed at the sessions. Posters listing the Do's and

Don'ts of office paper recycling were placed on walls near the central collection bins throughout the participating buildings. A sample brochure and poster are included in Exhibit I.

Custodians were provided with training similar to other employees, but with specific emphasis on the collection and transportation of the paper from the floor containers to the central storage area.

The highly visible public recycling containers located in each participating building also function to alert the general public to the City's recycling efforts and to help promote the ethic of recycling. The containers are made, in part, of 100% recycled plastic lumber.

3. Findings and Observations

Desktop office recycling systems have been implemented successfully across the country for years. Therefore, the City's program did not require a pilot phase, and a full-scale system could be established fairly quickly. The City and County of Honolulu's Office Recycling Program provides the only building-wide program model in the state at this time. The program is operating well and will require few changes. A cost/benefit analysis is attached as Exhibit C.

a. Participation

Based on paper recovery levels since the implementation of the desktop system in November of 1990, participation is estimated at 46%. Calculations are based on EPA studies which estimate that each day the average employee generates 0.16 lbs. of computer paper, 0.51 lbs. of white ledger, 0.09 lbs. of colored ledger, 0.25 lbs. of newspaper and 0.14 lbs. of corrugated cardboard, totalling 1.15 lbs. of used paper.

b. Recycling Containers

The desktop folders, central collection bins and public recycling containers are working well in the system. However, program adjustments are needed with regard to the 96-gallon wheeled storage carts. The carts were quickly dirtied and damaged as they rotated through the recycling company's facility. Investigations revealed that the emptied carts were being used for other purposes while at the recycling facility. This poses the question of

responsibility for equipment owned by the City and handled by both City employees and the contractor. Rather than struggle with the question, the City resolved to avoid this situation in the future by requiring the contractor to provide and maintain the storage containers. To solve the immediate problem, the City will be reimbursed for the full purchase of the carts by the contractor, and the current contract will be amended to include provisions for proper maintenance of storage carts.

This lesson learned carries over to other programs where equipment or containers will be utilized by the contractor.

c. Cost-Efficiency

The Department expended approximately \$30,000 in program start-up costs for the desktop folders, central collection containers, 96-gallon storage carts, public recycling containers, employee educational brochure, poster and slide show. Based on current recovery levels and market prices, the Department expects to amortize these costs in about 34 months. Thereafter, the revenues generated by the sale of the recyclable materials collected will be profit to the City.

4. Conclusions

The Office Recycling Program is a profitable endeavor for the City and provides an excellent model for promoting similar programs to other Honolulu office buildings.

D. Used Oil Recycling

The Department was faced with developing a system to capture the estimated one million gallons of used oil improperly dumped by do-it-yourselfers each year. The first strategy was to establish collection sites at participating service stations. However, after months of meetings with industry members and the State Used Oil Advisory Committee, the final result was no industry support or service station participation.

The Department was forced to reevaluate the situation and develop a new strategy giving consideration to the following:

- ☐ If the establishment of a service station or City facility collection program were further pursued, public

participation might at best reach 50%, which would still leave approximately 500,000 gallons of used oil improperly dumped annually. Assessments and incentives supporting the program could be raised to motivate higher levels of participation, but at a significant increase in the cost of motor oil to the public.

- ☉ The predominant method for recycling used oil on Oahu and across the country is to burn it as industrial fuel. Locally, Hawaiian Cement is a large consumer of used oil. The costs of re-refining it back into lubricating oil are too high to compete with virgin oil.
- ☉ Oahu's waste-to-energy facility, H-POWER, also could burn used oil as fuel to produce electricity, if a way were found to feed it into the boilers.

In July of 1991, the Department implemented a used oil collection program which integrated recycling and waste-to-energy.

1. Operations

The Department worked cooperatively with motor oil retailers to promote the sale of a special absorbent oil change box. Used oil can be drained directly into the box and then deposited with the regular trash. The box filled with used oil is collected with the trash and transported to H-POWER within the existing refuse collection service.

The oil change boxes are sold at most motor oil retailers islandwide, including NAPA dealers, GEM, Costco, Sears, Carquest dealers, and Longs Drugs. To keep the price of the box low to encourage its use, the Department asked distributors and retailers to minimize their profit margins on the box, possibly using it as a promotional item to sell more oil. Also, the two manufacturers, Kafko and Stand Out, are cooperating to promote the box by offering manufacturer rebates.

2. Public Awareness and Education

The Department developed and produced posters for display at retail stores and flyers for distribution to the do-it-yourself customer. A press release resulted in media coverage by two network news stations. Hawaiian Electric agreed to include a

brief article in their "Consumer Line," which is mailed out with the electric bills. Also the distributors and retailers are developing their own promotions and advertisements, such as Carquest's radio campaign. A sample poster and flyer are included in Exhibit I.

3. Findings and Observations

During the three months of the program, reports from distributors, retailers and the general public indicate that all is working well. Box sales are good, and the public's response is positive. The Department plans to monitor box sales in order to measure the effectiveness of the program. The first count will be taken at 6 months; the second at twelve.

4. Conclusions

The convenience, efficiency and common sense design of this used oil collection and recycling system will likely result in an effective program. The Department is hopeful that the evaluations at six and twelve months will confirm its success. At that time the Department recommends reevaluating Ordinance No. 89-118, which provides guidelines for the establishment of a used oil recycling program and a collection center at a City facility. Assuming the used oil box system provides a workable solution to the problem of improper dumping by do-it-yourselfers, the establishment of a City collection center with its start-up and operations expenses, would no longer be necessary.

III. Projects in Development

A. Commercial Recycling

Since the past year's pilot projects have indicated that curbside residential recycling can provide the opportunity to reduce the total waste stream by only 3%, the Department plans to further investigate the potentials and feasibility of various commercial sector projects as a means of achieving the legislated recycling goals. Preliminary investigations indicate that the potential for recycling may be greater in the commercial sector than in the residential sector.

However, this assumption is based on the limited data available to the Department at this time. In order for the Department to strategically plan collection systems to meet goals and to develop local market opportunities, more information is needed regarding the quantities of the recyclable materials in the waste stream and, more importantly,

the sources of generation for these materials. For example, how much glass, cardboard, or aluminum comes from the residential sector, from condominiums, from hotels, from restaurants.

Almost all apartment buildings and commercial facilities contract private refuse haulers for the collection of their trash. The Department's major role in developing recycling programs for apartments and in the commercial sector is to:

- ☐ Support and encourage the private haulers to expand their services to include recycling, and
- ☐ Provide implementation guides/assistance and educational materials.

Businesses are beginning to realize that incorporating recycling into their waste management systems can significantly reduce their disposal costs and possibly earn them additional revenues. Apartment buildings may also have the opportunity to reduce costs through recycling. The Department expects that this economic incentive, combined with the environmental benefits of recycling, will provide sufficient motivation. However, apartment buildings and businesses need assistance in getting started: how to make decisions on the type of program that will work best for their particular building or facility, what services are available, how to educate their residents or employees. In response, the Department plans to develop implementation guides, videos and educational materials specific to each industry. Thus far, the Department has completed an office recycling implementation guide and employee education video and is currently working on guides for apartment buildings and hotels, restaurants and bars.

The Department has established the beginnings of a strong foundation to support commercial recycling. The Department has networked with major industry associations, including the Building Owners and Managers Association (BOMA), the Hawaii Food Industries Association (HFIA), the Hawaii Restaurant Association (HRA), the Hawaii Hotel Association (HHA), the Hawaii Automotive and Retail Gasoline Dealers (HARGD), the Community Associations Institute (CAI) and the Hawaii Publishers Association (HPA). Department representatives have conducted presentations and workshops and provided design and implementation assistance to many companies and organizations. However, the results of the City's assistance in the commercial sector are not measurable. The City's efforts to

promote recycling have prompted and assisted many companies to establish recycling programs for which the tonnage is not trackable. Therefore, the City's expenditures in commercial recycling cannot be allocated to program recovery to provide a cost per ton estimate.

The waste and recycling industries are changing. Private haulers and recycling companies are beginning to maneuver for new positions and possible market shares of an industry in flux. Many private refuse haulers are already offering recycling services to their clients. Recycling companies are in growing competition with the haulers as they offer recycling services that reduce the volume of waste requiring collection by the refuse hauler.

B. Municipal Composting

The City issued a Request for Proposals (RFP) for the Financing, Design, Engineering, Construction, Testing and Operation/Maintenance of a Compost Facility on July 25, 1990.

The offerors were to propose a facility to compost 180 tons of sewage sludge, 50 tons of green waste and 50 tons of H-POWER residue daily on a site they provided. The offerors would finance, design, and construct the facility. They would also be responsible for operations and marketing of the end product.

The RFP was two-phased, the first being a qualification phase and the second the actual bidding. Six offerors submitted documents for review on September 10, 1990. None of the six offerors were found qualified. Some offerors could not provide a site for their operations. Others did not qualify because they were unable to show their involvement in a successfully operating facility similar to the proposed Honolulu facility, which was to compost sludge and green waste.

The Department is looking into other methods to divert these wastes from the landfill. Technologies have progressed with sludge processing which may give it other end uses. Particularly promising is a patented process which adds an alkaline reagent to pasteurize the sludge and turns it into a soil-like material which can be used in agriculture. The green waste stream can be burned at H-POWER or composted by commercial operations of green waste compost. The H-POWER residue, which consists primarily of non-combustible materials, including dirt, glass, limited putrescible matter, and green waste will continue to be landfilled until a use can be developed for the materials.

Although there are some who believe composting will divert a major portion of the waste stream from the landfill, there are numerous operating problems involved with producing compost, which other municipalities have encountered. Major concerns include odors during processing, the length of process time, the land requirements, and operations costs. There are also concerns about heavy metals, which are not removed by the process, and the marketability of the end product. Other municipalities have indicated that product sales offset a very small portion of the production costs.

C. Backyard Composting

The Department is planning a program that will provide training in backyard composting techniques to interested Oahu residents. Backyard composting has advantages in that it eliminates the collection and market development needed in a centralized municipal composting facility. Participating residents can reduce waste at its source and create a beneficial soil amendment for their yards and gardens.

The Department is working cooperatively with the University of Hawaii Agricultural Extension Program to develop a workshop manual, instructional brochure and an initial demonstration site to evaluate various composting containers. Numerous organizations and individuals knowledgeable in composting will be asked to contribute their ideas to the final workshop manual and brochure and to assist in establishing additional workshop/demonstration sites around the island. Master composters will conduct workshops biannually at these sites.

The Department is unsure as to the amount of interest Oahu residents will have in backyard composting. Avid gardeners and environmentalists will probably embrace the project, but the majority of the residents may not take to the idea. Therefore, the first phase of the program will be developed at minimal cost to test the waters. The Department can expand the project if sufficient interest and support is indicated.

D. Tire Recycling

Approximately 6,000 tons of used tires are disposed of on Oahu annually.

H-POWER cannot process tires unless they are shredded. These tires are currently landfilled whole, creating numerous problems, including a greater potential for landfill fires, breeding grounds for mosquitos as the tires work their way to the surface, and simply occupying space.

The Department looked into options for diverting the tires from the landfill to recycling, including rubberized asphalt, various rubber products and burning tires for fuel. Preliminary investigations revealed that the manufacturing of rubberized asphalt and rubber products could only be done with non-steel belted tires. This was certainly an obstacle since most tires today are made with steel belting. Shredding tires to be burned at H-POWER was possible but was moderately expensive. However, energy recovery still seemed to be the most viable approach in order to develop a local end use.

Through further investigations, the Department learned that Hawaiian Cement was making plans to burn tires as a supplemental fuel for manufacturing cement in a system which provides an excellent second use for used tires. In their process, all components of the tire will be utilized either to provide fuel or to contribute to the cement production. The petroleum-based components of the tire will be burned to fuel the manufacturing process and the steel belting and sulfur are needed elements in cement production. There will be no residue requiring disposal from this process; all of the material in the used tires goes into the cement. The Scrap Tire Management Council supports the burning of tires in cement kilns as a most technically sound process.

Hawaiian Cement is permitted to burn 8,000 tons of tires per year, which is sufficient to handle all of the tires discarded on Oahu now and in the foreseeable future, and has indicated that they will be ready to begin by the end of 1991 calendar year.

E. Ferrous Metal Recycling

Approximately 19,240 tons per year of ferrous metal (iron/steel), including steel cans, coat hangers, fasteners and strapping, are separated from the waste stream at H-POWER prior to burning. This metal is currently landfilled because marketing has been a problem. The costs to process and ship the ferrous metal to mainland markets is greater than its market value, and the local market has significantly narrowed with the recent shut down of Hawaiian Western Steel. The operating contract for H-POWER calls for the contractor to market the ferrous metals from H-POWER.

F. Ash Recycling

H-POWER is currently processing refuse at a rate of approximately 588,000 tons per year from which approximately 34,300 tons of dry ash is disposed of in a dedicated, plastic-lined monofill. This ash has two constituents, bottom ash and fly ash. The bottom ash is made

up of ash and pieces of non-burnable metals which fall to the bottom of the furnace. The fly ash is a fairly uniform, powdery ash from the electrostatic precipitators. The Department is investigating and actively encouraging others to investigate several alternative uses. All of the alternatives being considered require the cleanup of the bottom ash to free it of metals. The Department and ABB are reviewing means of accomplishing this cleanup.

The ash recycling alternatives that are being investigated are:

1. Pelletize the ash and use the pellets for road base or find other uses for the pellets.
2. Use ash as an additive in concrete.
3. Use ash for clay soil stabilization.
4. Use ash mixed with wastewater sludge as landfill cover material.

A large amount of ash will also be generated by a coal-fired powerplant being built by Applied Energy Services, Inc. (AES), which is scheduled to be operational in about one year. Since the plant operator is responsible for his own ash disposal, he has been cooperating with the City to find a mutually beneficial use for the ash.

G. White Goods Recycling

"White Goods" is a waste industry term referring to items such as refrigerators, washers, dryers, stoves, water heaters, and other large metal appliances. Currently, large volumes of white goods are being dumped in landfills by residents, businesses and the Department in its bulky item collection system.

However, numerous commercial businesses dealing in these appliances have found that recycling is an economically preferable alternative to disposal. A company called Refrigerant Recycling of Hawaii arranges for quantity pickups of white goods from dealers. They prepare the discards for recycling at their facility in Pearl City, removing motors, capacitors and freon. They then recycle and sell the freon, channel the capacitors to Unitek for proper hazardous waste disposal as some capacitors contain PCBs, and sell the metal to Hawaii Metals Recycling (formerly Flynn-Leaner). Refrigerant Recycling charges \$6.00 per appliance for this service, assuming quantity pickups of twenty or more.

The Department is investigating numerous options for expanding

white goods recycling, including ways the Department can modify its bulky item collection system and utilize the services of Refrigerant Recycling.

IV. Marketability of the Recyclable Materials Collected

The Department has been carefully assessing the strengths and weaknesses of the markets for the recyclable materials currently being collected in City programs and other materials that might be included in the future. Recycling is a generations-old business which was market driven, meaning that the secondary materials collected were in demand to supply manufacturers with needed feedstock to make new products. Now the industry is being driven instead by the need to reduce waste. The expansion of existing markets and the creation of new markets are necessary to support the volumes of materials that will be diverted from municipal waste streams to recycling. In the meantime, the City should be careful not to overload existing markets. The Department should weigh both the environmental impact and the economics of recycling specific to Oahu in order to determine which materials should be recycled or composted and which should be channeled to H-POWER.

The City currently collects aluminum cans, newspaper, glass, and plastic in its curbside and school/community recycling programs, and all of the materials have been successfully marketed. With higher volumes of material expected in an islandwide expansion of recycling collection systems, the following market observations are presented:

A. Aluminum

Aluminum cans have a consistently strong high market value, which would easily support expansion. Other aluminum products, such as foil and pie tins, could be included in future programs.

B. Newspaper

Newspaper has experienced episodes of market flooding in the past. However, projections are for a stable, low-valued market growth, which would support expansion.

C. Plastic

Only plastic soda bottles and milk jugs are being collected in the City's programs to test the viability of plastics recycling for Oahu. Local recycling companies were not collecting plastics with any consistency or volume prior to this. Unfortunately, there have been problems with contamination, processing and

economics. Hawaii Environmental Transfer reports that the most common form of contamination in the City's residential programs is unacceptable plastics thrown in by well-meaning participants. The City pays to have this material sorted out of the recyclable plastics and disposed of. Trying to differentiate among different types of plastic is difficult for the general public, and additional education may likely be unsuccessful. Furthermore, the recycling company reports that the 40 to 1 compaction rate for plastic makes processing for shipment labor intensive and the mainland market value barely supports the shipping and handling. The establishment of local remanufacturing of mixed plastics into products like plastic lumber may be necessary before the collection of plastics can be expanded.

D. Glass

Glass recycling has been supported by the glass incentive program, which levies an assessment on all glass containers imported to Oahu and uses those funds to pay incentives to support and encourage glass recycling. Glass bottles and jars sorted by color (clear, brown, green) have been shipped to California for remanufacture into new glass containers. However, California's glass market is currently being flooded with glass from California and surrounding states and will probably not be available to Hawaii for much longer. Hawaii does not generate sufficient volumes of glass to warrant a glass plant, nor does Hawaii have the other necessary support industries. In response, the Department is investigating numerous local end uses for crushed glass, including glasphalt, a mixture of glass and asphaltic concrete. A pilot glasphalt project is currently being developed in a public/private partnership between the City and Alpac Corp., with the paving tentatively scheduled for November 1991.

E. Office Paper/Cardboard

The City currently collects the following paper products in its office recycling program: computer printout, white ledger, colored ledger and cardboard. Future markets for these paper grades are projected to be strong. The markets for other grades of paper, such as magazines and mixed paper (which includes junk mail and cereal boxes), are inconsistent and unreliable at this time.

V. Mandatory vs. Voluntary

Mandatory measures can be applied to recycling at varying degrees and levels.

Mandatory may or may not involve enforcement with penalties and can focus on the generator, the collector or the disposal site. Without enforcement, a mandatory program has no teeth and is likely to be ineffective. However, enforcement requires additional manpower and expenditures.

The Department has not implemented any mandatory measures for recycling as yet due to manpower and cost factors and because the Department believes such strong measures are premature and unwarranted at this time. The infrastructure for recycling (including industry expansion, market development and cost-efficient collection systems) needs further development to support the flow of materials that would be generated if mandatory measures were implemented. Kailua's curbside programs are already achieving high participation levels without mandatory enforcement, and economic incentives are beginning to motivate the commercial sector. Moreover, Oahu is not faced with the solid waste disposal crisis which has directed other municipalities and states in desperation toward mandatory recycling. The incorporation of waste-to-energy into Oahu's waste management system has precluded such a crisis.

The Department's perspective is that funds required to support a team of trash police would be better spent on recycling program development. Once the infrastructure is strengthened and the opportunity to recycle is readily available to residents and businesses, a schedule for mandatory enforcement can be established. At the current stage of program development, the Department's priority is to establish measures for conserving landfill space and to encourage the recycling and refuse industries to continue movements towards recycling. To these ends, the Department is planning to implement landfill bans on specific materials. The first list will include materials which are both recyclable and combustible, such as newspaper, cardboard, office paper, green waste and tires. Subsequent lists will be developed as recycling programs expand.

VI. Attainment of Legislated Recycling Goals

Ordinance No. 89-114 RELATING TO SOLID WASTE establishes recycling goals of 30% by the end of 1991, 50% by the end of 1995 and 75% by the end of 2000. Based on the information presented in this evaluation report, the Department finds that the timetable for attaining the set goals does not allow sufficient time for planning and development. Starting with a pre-

existing recycling rate of 7.65%, numerous comprehensive programs need to be in place in order to reach the first 30% goal. The Department projects a 12% recycling rate can be achieved by the end of 1991 and that 30% could be achieved by 1994, assuming aggressive recycling plans are approved and funded, and local, national and world markets continue to develop. Exhibit D provides a breakdown of recovery estimates and projections by material for Oahu.

VII. Cost Comparison: Recycling, H-POWER, Landfill

The cost study for the Division of Refuse Collection and Disposal for Fiscal Year 1990-91 showed the following costs (Exhibit E).

<u>COST OF REFUSE ACTIVITIES</u>	
<u>Activity</u>	<u>Cost Per Ton</u>
H-Power	\$ 50.87
Landfill - City Operated	\$ 27.89
Landfill - Contractor Operated	\$ 21.98
Waipahu Incinerator	\$ 72.21
Transfer Station	\$ 22.03
Convenience Center	\$ 63.81
Residential Collection	\$ 71.37

The study relates the cost of a program to the tonnage the activity processed. It includes direct costs, administrative support costs, capital recovery costs, and equipment costs. When the costs for the Recycling Activity are calculated in the same manner, the cost for recycling appears very high at \$469.58 per ton (Exhibit E-8). For the most part this is due to the fact that these costs represent a year of planning and development. Recycling is just starting out and cost-efficient systems must be developed, whereas a cost-efficient system for refuse handling has already been developed and been operational for years. Another reason for the high cost per ton is that there are program and start-up costs for various projects for which tonnages cannot be quantified as in program development for commercial recycling and the development of general public awareness.

The following costs for specific programs within the Recycling Activity have been calculated similarly to those above in that they include direct costs, administrative support costs, capital recovery costs, and equipment costs. However, these costs should be considered estimates due to the difficulty in isolating specific costs to specific programs.

COST OF RECYCLING PROGRAMS

<u>Program</u>	<u>Cost Per Ton Including Collection/Sorting and Marketing Costs</u>	<u>Cost Per Ton After Deducting Refuse Collection/Transfer/ Disposal Cost Avoidance of \$144.27</u>
Curbside Sorted Bin System	\$463.13	\$318.86
Curbside Reusable Bag System	\$265.79	\$121.52
Curbside Grocery Bag System	\$389.58	\$245.31
School/Community (See Exhibits A and B for cost details)	\$161.78	\$ 17.51

A Solid Waste Integrated Master Plan study, required by a new State law, has been commissioned by the Department. This study will assist in the determination of an integrated plan for Oahu for the next five years. It will determine the best ways to dispose of various materials in light of the existing alternatives on Oahu.

VIII. Recycling Impact on Landfill Space

The tonnages of materials collected from the various City recycling programs have been converted to cubic yards of landfill volume:

<u>MATERIAL</u>	<u>TOTAL TONS</u>	<u>TONS/CU.YD</u>	<u>CU. YD.</u>
Newspaper	1221	0.3	4070
Cardboard	4	0.375	0
Color Ledger	9	0.37	24
White Ledger	21	0.37	56
Computer	5	0.37	13
Mixed Glass	412	1.4	294
Records/Files	24	0.37	64
Aluminum	57	0.125	456
Plastic	19	0.178	106
TOTAL CU. YDS.			5097

If H-Power were not operating, the recycled materials collected would use about 5100 cubic yards of landfill space. However, H-POWER is operating. If this material were collected in the waste stream rather than recycled, it would be disposed of at H-POWER. The glass and aluminum would be removed as part of the noncombustible stream and landfilled, occupying about 750 cubic yards of space.

The potential landfill space savings if islandwide recycling were implemented would be about 13,715 cubic yards of space for 8000 tons of glass and 1000 tons of aluminum.

IX. Recycling Impact on H-POWER

The following materials were collected from the various City recycling programs:

<u>Materials</u>	<u>Tons</u>
Newspaper:	1221
Cardboard:	4
Color-Ledger:	9
White-Ledger:	21
Computer:	5
Mixed Glass:	412
Records/Files:	24
Aluminum:	57
Plastic:	<u>19</u>
Total Tons:	1772 tons

The combustible portion of this total, consisting of paper and plastic, is 1303 tons. The combustible recycling tonnage collected during FY 1990-91 by the various pilot programs could be burned in one day of H-POWER operations.

To assess the potential impact of islandwide recycling, consider that the total refuse generated on Oahu during FY90-91 is estimated at 1,122,600 tons. The City is contractually obligated to dispose of 561,600 tons annually at H-POWER. Approximately 116,640 tons are being recycled; the remaining 444,360 tons give recycling much to work with.

The tonnage obligation to H-POWER does not increase over time, but the amount of refuse generated on Oahu continues to rise each year. The recycling potential, then, will also continue to grow.

X. Recommendations and Discussion

Recommendations presented in this report are for the short-term. More information is still needed before the Department can provide a long-range plan for recycling. Three key studies are required:

- ☐ The City's Integrated Solid Waste Management Master Plan;

- A Recycling Potentials Assessment; and
- A Market Development Study.

The perspectives discussed in this section are presented to stimulate the reader's thought with regard to the challenges and realities facing the City in designing and implementing an environmentally and economically sound recycling program.

Conservation of landfill space is the priority for solid waste management in Hawaii and across the country. Municipalities are working diligently to implement measures to reduce the volumes of waste going to landfill as the availability of such space rapidly dwindles. On Oahu H-POWER and recycling function similarly in that they both reduce the amounts of waste that would be landfilled. A balance between H-POWER and recycling is yet to be determined and will be more fully discussed in the forthcoming Integrated Solid Waste Master Plan for Oahu. However, it is obvious that economics and environmental impact are the key issues. The design of the City's recycling program should weigh the economics and environmental impact between waste-to-energy and recycling and use common sense judgement. For example, consider the best method for managing green waste. Approximately 20% of the waste stream is comprised of tree trimmings, leaves, grass clippings and general yard debris. Diverting this material to a composting facility would impact significantly on achieving the City's recycling goals. However, the costs of constructing and operating such a facility are also significant, and marketing the end product is difficult. On the other hand, green waste does not represent a dwindling natural resource such as oil, minerals, or forests. Green waste is cuttings from ever-growing trees and lawns and can be efficiently burned at H-POWER as fuel to produce valuable electrical energy. Both methods reduce the volume of material to landfill. H-POWER results in ash which requires landfilling. However, due to lack of markets, some communities and consultants have proposed using the compost for landfill cover.

Another example of balancing H-POWER and recycling lies in construction and demolition (C/D) waste. Approximately 20% of the City's total waste is C/D waste, and approximately 25% of that is wood waste. The largest end-use market on the mainland for C/D wood is wood fuel. The question then is: should the City require the diversion of C/D wood from the waste stream and H-POWER to be used as fuel elsewhere? On the other hand, 50% of C/D waste is estimated to be rubble-based material which includes asphalt and concrete. The Department plans to further investigate the recycling options for these materials. Recycled asphalt pavement is currently allowed in the repaving of City and County roads.

Certainly when material is both combustible and recyclable, the City should look closely at the economics and environmental impact of each. However, in determining the intensity or level of recycling to be planned for Oahu, other considerations have also presented themselves.

Based on actual recovery data from Kailua's pilot program, the Department projects that islandwide curbside collection involving approximately 170,000 households would reduce the total waste stream by only 2.75%. Start-up costs to establish such a program are estimated between 12 and 15 million dollars, depending upon container and vehicle selections.

Much attention has been focused on residential recycling during this past year. However, given the high costs attributed to implementing curbside collection and the minimal impact on waste reduction, the Department recommends the following:

- ☐ Expand the School/Community Recycling program to a limited number of strategically located schools, while further investigating and discussing the viability of curbside collection.
- ☐ Conduct a Recycling Potentials Assessment to determine the volumes of recyclables entering the waste stream and their sources of generation. This will enable the Department to better focus its plans for capturing recyclable material from large quantity generators. (Recycling Potentials and Recovery for Oahu are estimated in Exhibit D).
- ☐ Conduct a Market Development Study to research and develop local end uses for secondary materials and a waste exchange program. Significantly more effort must be expended on market development. The City must work aggressively to identify and develop local end uses for secondary materials, such as the glasphalt project which will substitute crushed glass for 10% of the aggregate in asphaltic concrete. Also, legislation should encourage and possibly insist on recycled content in various products and applications. Some governments have implemented what are called "set asides," where a specified percentage of the governments' purchasing budget is set aside and designated for recycled content purchases. If the City creates the demand for secondary materials, the collection of these materials would follow naturally.

Before the City can begin an islandwide recycling campaign, the infrastructure for recycling must be strengthened. The existing recycling and refuse industries need to expand their operations to support the City's plans for islandwide collection.

The capital and manpower investments are significant and will require time to implement. In addition, the availability of land space for such expansion is quite limited. Cost-efficient collection systems for both the residential and commercial sectors must be fine-tuned. The City needs to develop programs which minimize collection costs and do not artificially inflate recycling market values in order to pay for collection.

- ☐ The Department recommends further investigation into the viability of curbside collection by implementing an additional pilot program which incorporates all of the lessons learned from Kailua and Kaneohe. The Department recommends a system which integrates collection of recyclables with the existing manual refuse collection system and with the planned automated refuse collection system.

If curbside is determined viable, then the Department would recommend the following:

- ☐ Modify refuse transfer stations to accommodate the consolidation and transfer of recyclables for the municipal curbside collection.
- ☐ Stimulate private industry to construct a materials recovery facility by issuing a Request for Proposals for a service contract to sort, process and market recyclable materials to be collected in curbside programs.
- ☐ Develop a volume-based residential refuse fee to encourage and maintain high levels of recycling participation.

The Department also recommends the following:

- ☐ Increase implementation and educational assistance to the commercial sector.
- ☐ Further investigate the potentials and feasibility of commercial sector recycling projects.
- ☐ Continue to seek recycling options for special wastes, such as used tires, white goods, incinerator ash, and construction debris. Ultimately, solutions will probably involve joint participation by government and private industry.
- ☐ Continue the development of the Backyard Composting Program; re-evaluate municipal composting facility plans.

- ☐ Ban material from landfills as recycling markets and collection systems develop.
- ☐ Adjust the timetable on recycling goals to coordinate with the actual implementation schedule.
- ☐ Establish four permanent recycling positions:
 1. Recycling Coordinator
 2. Recycling Specialist - Residential programs
 3. Recycling Specialist - Commercial programs
 4. Recycling Assistant - Administrative support

Current staffing consists of the Recycling Coordinator, Suzanne Jones, and one Recycling Specialist, vacant since May 1991. Temporary contract hire positions include a Recycling Specialist, Anastasia Moulos and a Recycling Assistant, Catherine Andres.

In order for recycling to become an integral component of Oahu's solid waste management system and to insure its longevity, cost-efficiency and convenience must be built into the programs at the very beginning. Although numerous recycling programs may be up and running in many communities across the country, Honolulu still must carefully progress through the necessary planning and development phases to create recycling programs tailored to the local needs and circumstances.



EXHIBIT A-1

CURBSIDE RECYCLING OPERATIONS AND COST ANALYSIS

	KAILUA Aug'90-July'91 (12 Months)				KANE OHE May'91-July'91 (3 Months)	
	REUSEABLE BAGS 3251		BINS 4155		GROCERY BAGS 4230	
Households:						
Recovery/Revenue	Pounds	Rev/Sort Cost	Pounds	Rev/Sort Cost	Pounds	Rev/Sort Cost
Aluminum:	36490	\$5,473.50	49032	\$15,397.85	4925	\$738.75
Newspaper:	725465	(\$13,239.74)	1047380	\$2,618.47	102625	(\$1,872.91)
PET & HDPE:	22670	(\$453.40)	8330	\$20.62	2840	(\$56.80)
Glass-Clear:	88613	\$443.07	236860	\$4,755.60	26445	\$132.24
Brown:	53854	\$269.28	107300	\$2,169.40	0	\$0.00
Green:	51928	\$259.64	112470	\$2,249.40	0	\$0.00
Trash/Contam:	81498	(\$4,324.90)	22570	(\$5,781.34)	12545	(\$627.25)
Total Recyclable Recovery (Tons):	489.51		780.69		68.42	
Total Rev/Sort Cost:		(\$11,572.55)		\$21,430.00		(\$1,685.97)
Cost/Household/Pick-up:		(\$0.43)		(\$1.48)		(\$0.78)
Collection Cost:(a)		(\$72,692.36)		(\$348,283.96)		(\$19,753.29)
Container Cost:(b)		(\$29,421.60)		(\$16,483.00)		(\$360.00)
Administrative Cost:		(\$9,820.00)		(\$9,820.00)		(\$2,730.00)
Public Awareness Cost:		(\$6,600.00)		(\$8,400.00)		(\$2,125.00)
Net Cost:		(\$130,106.51)		(\$361,556.96)		(\$26,654.26)
Cost/Ton:		(\$265.79)		(\$463.13)		(\$389.58)
Avg Wkly Set Out:	1007.98		2298.90		96.03 (e)	
Set Out Rate:	31.01%		55.32%		2.27%(f)	
Participation Rate:	68.44%		85.40%		29.41%	
Percent of Potential Recyclables Recovered:(c)	68.44%		85.40%		29.41%	
Percent of Residential Waste Reduced:(d)	11.32%		14.13%		1.22%	

(a) Labor, collection vehicle, O&M, overhead and supervisory staff

(b) Initial equipment investment depreciated over the life of the equipment (5 yrs for bins and bag stands, 2 yrs for b

(c) Estimated recycling potential = 440lbs/Household/Year

(d) Calculated by determining Average Waste/Household

(e) Avg Wkly Set Out For Bins (1159 Hous 267.61

Avg Wkly Set Out For Bags (3071 Hous 83.11

(f) Set Out Rate For Bins: 23.09%

Set Out Rate For Bags: 2.71%

EXHIBIT A-2

PROJECTIONS FOR ISLAND-WIDE CURBSIDE COLLECTION
BASED ON KAILUA ACTUAL RECOVERY DATA

KAILUA RECOVERY (12 MONTHS)

OAHU RECOVERY PROJECTIONS

Households: 7406

~~150000~~
170000

Newspaper: 886.42

20347.24

Glass: 325.51

7471.89

Aluminum: 42.76

981.53

Plastic: 15.5

355.79

Total Recyclable
Recovery (Tons): 1270.19

~~25,122.38~~
29156.45

Percent of Total Waste:

~~2.75%~~

1.7%

EXHIBIT B-1

SCHOOL/COMMUNITY RECYCLING OPERATIONS AND COST ANALYSIS

NOVEMBER 1990-AUGUST 1991	NO. HAULS	CHG/HAUL	LEASE CHG	TOTAL CHG	GLASS	ONP	PET/HDPE	A/C	W/L	C/L	WT./SCHOOL	REV/SCHOOL	COST/TON
				10									
Aliiolani	25	\$210.00	\$361.20	\$8,862.00	34270	199050	1180	6310	1310	460	242580	\$3,175.90	\$73.06
Blanche Pope	4	\$210.00	\$361.20	\$4,452.00	1880	18020	440	460	80	0	20880	\$244.30	\$426.44
Haleiwa	10	\$295.00	\$361.20	\$6,562.00	13420	60465	570	1930	400	160	76945	\$983.93	\$170.56
Hauula	2	\$265.00	\$361.20	\$4,142.00	1720	11400	180	500	0	0	13800	\$200.60	\$600.29
Honolulu Wal	9	\$210.00	\$361.20	\$5,502.00	20740	57200	840	2320	0	0	81100	\$1,163.50	\$135.68
Wilson	19	\$210.00	\$361.20	\$7,602.00	35200	128710	1130	7292	655	165	173152	\$3,113.20	\$87.81
Kaaawa	9	\$240.00	\$361.20	\$5,772.00	16820	41280	680	2460	0	0	61240	\$1,029.50	\$188.50
Kahala	28	\$210.00	\$361.20	\$9,492.00	40660	159310	2320	6220	265	605	209380	\$2,997.00	\$90.67
Kahuku	4	\$295.00	\$361.20	\$4,792.00	6730	17800	200	500	0	200	25430	\$293.95	\$376.88
Kaneoelani	18	\$245.70	\$361.20	\$8,034.60	21020	112560	2230	4570	285	360	141025	\$2,085.70	\$113.95
Laie	7	\$285.00	\$361.20	\$5,607.00	5400	31420	540	2000	80	250	39690	\$775.60	\$282.54
Manoa	38	\$210.00	\$361.20	\$11,592.00	57440	204310	2510	8200	960	290	273710	\$3,989.35	\$84.70
Mauka Lanii	15	\$220.00	\$361.20	\$6,912.00	20580	71020	1860	4960	45	200	98665	\$1,957.30	\$140.11
McKinley	4	\$210.00	\$361.20	\$4,452.00	4040	26760	180	520	1300	0	32800	\$330.20	\$271.46
Pearlridge	15	\$210.00	\$361.20	\$6,762.00	17120	105980	1330	6370	620	0	131420	\$2,574.40	\$102.91
Punahou	41	\$210.00	\$361.20	\$12,222.00	57930	260420	2790	10620	3005	2070	336835	\$4,994.75	\$72.57
Roosevelt	17	\$210.00	\$361.20	\$7,182.00	37840	109360	1940	4060	280	20	153500	\$2,127.60	\$93.58
Sunset	17	\$300.00	\$361.20	\$8,712.00	34040	49920	1510	4640	380	300	90790	\$1,907.90	\$191.92
Waihiawa	30	\$225.00	\$361.20	\$10,362.00	28180	147270	2360	3080	1990	1680	184560	\$1,987.25	\$112.29
Waimalu	14	\$212.10	\$361.20	\$6,581.40	12720	100415	740	3990	1930	950	120745	\$1,795.38	\$109.01

Totals (Tons):

(%)

Total Revenue:

Equipment Cost:

Operations Cost:

Administrative Cost:

Public Awareness Cost:

Total Cost:

Avg Cost/Ton:

Avg Cost-Rev/Ton:

\$37,727.30
 (\$24,260.00)
 (\$145,597.00)
 (\$16,366.70)
 (\$16,670.00)
 (\$202,893.70)
 (\$161.78)
 (\$131.70)

233.88
 18.65%

12.77
 1.02%

40.50
 3.23%

6.79
 0.54%

3.86
 0.31%

1254.12

SCHOOL/COMMUNITY RECYCLING OPERATIONS AND COST ANALYSIS

NOVEMBER 1990-APRIL 1991 NUMBER OF MO. 6

SCHOOLS	NO. HAULS	CHG/HAUL	LEASE CHG	TOTAL CHG	GLASS	ONP	PET/HDPE	A/C	W/L	C/L	WT./SCHOOL	REV/SCHOOL	COST/TON
Aliiolani	12	\$210.00	\$361.20	\$4,687.20	15300	99960	440	3620	760	310	120390	\$1,476.00	\$77.87
Blanche Pope	2	\$210.00	\$361.20	\$2,587.20	800	8080	160	280	0	0	9320	\$110.00	\$555.19
Haleiwa	6	\$295.00	\$361.20	\$3,937.20	7400	37785	350	790	160	60	46545	\$465.23	\$169.18
Hauula	1	\$265.00	\$361.20	\$2,432.20	680	6300	60	160	0	0	7200	\$74.30	\$675.61
Honolulu Wal	3	\$210.00	\$361.20	\$2,797.20	7320	23980	280	940	0	0	32520	\$420.50	\$172.03
Wilson	8	\$210.00	\$361.20	\$3,847.20	4340	59700	440	4572	655	165	69872	\$1,297.15	\$110.12
Kaawa	3	\$240.00	\$361.20	\$2,887.20	4660	17100	220	720	0	0	22700	\$301.60	\$254.38
Kahala	11	\$210.00	\$361.20	\$4,477.20	15440	59400	900	3120	265	605	79730	\$1,172.95	\$112.31
Kahuku	1	\$295.00	\$361.20	\$2,462.20	4510	1320	40	0	0	200	6070	\$76.65	\$811.27
Kanoelani	10	\$245.70	\$361.20	\$4,624.20	10020	60080	860	2620	285	360	74225	\$992.60	\$124.60
Laie	4	\$285.00	\$361.20	\$3,307.20	3340	17520	220	1280	80	250	22690	\$400.00	\$291.51
Manoa	22	\$210.00	\$361.20	\$6,787.20	29300	109130	1440	4190	660	290	145010	\$1,853.65	\$93.61
Mauka Lani	7	\$220.00	\$361.20	\$3,707.20	7920	33580	680	2800	45	100	45125	\$855.40	\$164.31
McKinley	1	\$210.00	\$361.20	\$2,377.20	440	5640	80	40	0	0	6200	\$43.60	\$766.84
Pearlridge	8	\$210.00	\$361.20	\$3,847.20	7940	52420	760	4880	320	0	66320	\$1,371.20	\$116.02
Punahou	22	\$210.00	\$361.20	\$6,787.20	30420	137760	1480	5910	1675	1360	178605	\$2,389.00	\$76.00
Roosevelt	7	\$210.00	\$361.20	\$3,637.20	14040	52440	1000	1760	0	0	69240	\$834.80	\$105.06
Sunset	9	\$300.00	\$361.20	\$4,867.20	17620	24280	440	1940	260	200	44740	\$785.30	\$217.58
Waihiawa	15	\$225.00	\$361.20	\$5,542.20	9100	73760	700	1320	1310	940	87130	\$811.90	\$127.22
Waimalu	7	\$212.10	\$361.20	\$3,651.90	4100	49375	440	2490	1230	650	58285	\$841.88	\$125.31

Totals (Tons):

(%)

Total Revenue:

Equipment Cost:

Operations Cost:

Administrative Co

Public Awareness Cost:

Total Cost:

Avg Cost/Ton:

Avg Cost-Rev/Ton:

SCHOOL/COMMUNITY RECYCLING OPERATIONS AND COST ANALYSIS

NUMBER OF MO.

4

SCHOOLS	NO. HAULS	CHG/HAUL	LEASE CHG	TOTAL CHG	GLASS	ONP	PET/HDPE	A/C	W/L	C/L	WT./SCHOOL	REV/SCHOOL	COST/TON
Aliiolani	13	\$210.00	\$361.20	\$4,174.80	18970	99090	740	2690	550	150	122190	\$1,337.90	\$68.33
Blanche Pope	2	\$210.00	\$361.20	\$1,864.80	1080	9940	280	180	80	0	11560	\$106.30	\$322.63
Haleiwa	4	\$295.00	\$361.20	\$2,624.80	6020	22680	220	1140	240	100	30400	\$439.70	\$172.68
Hauula	1	\$265.00	\$361.20	\$1,709.80	1040	5100	120	340	0	0	6600	\$110.30	\$518.12
Honolulu Wal	6	\$210.00	\$361.20	\$2,704.80	13420	33220	560	1380	0	0	48580	\$649.00	\$111.35
Wilson	11	\$210.00	\$361.20	\$3,754.80	30860	69010	690	2720	0	0	103280	\$1,358.85	\$72.71
Kaaawa	6	\$240.00	\$361.20	\$2,884.80	12160	24180	460	1740	0	0	38540	\$655.90	\$149.70
Kahala	17	\$210.00	\$361.20	\$5,014.80	25220	99910	1420	3100	0	0	129650	\$1,512.05	\$77.36
Kahuku	3	\$295.00	\$361.20	\$2,329.80	2220	16480	160	500	0	0	19360	\$217.30	\$240.68
Kaneoelani	8	\$245.70	\$361.20	\$3,410.40	11000	52480	1370	1950	0	0	66800	\$831.10	\$102.11
Laie	3	\$285.00	\$361.20	\$2,299.80	2060	13900	320	720	0	0	17000	\$247.60	\$270.56
Manoa	16	\$210.00	\$361.20	\$4,804.80	28140	95180	1070	4010	300	0	128700	\$1,716.70	\$74.67
Mauka Lani	8	\$220.00	\$361.20	\$3,204.80	12660	37440	1180	2160	0	100	53540	\$821.90	\$119.72
McKinley	3	\$210.00	\$361.20	\$2,074.80	3600	21120	100	480	1300	0	26600	\$282.60	\$156.00
Pearlridge	7	\$210.00	\$361.20	\$2,914.80	9180	53560	570	1490	300	0	65100	\$715.20	\$89.55
Punahou	19	\$210.00	\$361.20	\$5,434.80	27510	122660	1310	4710	1330	710	158230	\$2,014.75	\$68.69
Rosevelt	10	\$210.00	\$361.20	\$3,544.80	23800	56920	940	2300	280	20	84260	\$1,116.80	\$84.14
Sunset	8	\$300.00	\$361.20	\$3,844.80	16420	25640	1070	2700	120	100	46050	\$928.60	\$166.98
Waihiawa	15	\$225.00	\$361.20	\$4,819.80	19080	73510	1660	1760	680	740	97430	\$1,043.35	\$98.94
Waimalu	7	\$212.10	\$361.20	\$2,929.50	8620	51040	300	1500	700	300	62460	\$704.50	\$93.80

Totals (Tons):

(%)

Total Revenue:

Equipment Cost:

Operations Cost:

Administrative Co

Public Awareness Cost

Total Cost:

Avg Cost/Ton:

Avg Rev-Cost/Ton:

\$16,810.40

(00-702-65)
(\$9.704.00)

(42,704.00)
(\$66,346.30)

(\$6,546.68)

(\$6,668.00)

(\$89,264.98)

(\$135.63)

(\$110.09)

EXHIBIT C

CITY AND COUNTY OFFICE
RECYCLING PROGRAM

Contract Periods-	10 MONTHS 8/89-6/90 (\$.22/lb)	8 MONTHS 8/90-3/91 (\$.01/lb)	5 MONTHS 4/91-8/91 (Market Price/lb)
MATERIAL COLLECTED-			
(Pounds)			(Pounds) (Mkt Price) (Revenue)
Commingled Paper:	102924	154900	
Computer:			10870 @\$.095/lb \$1,032.65
White:			47340 @\$.066/lb \$3,430.29
Colored:			8595 @\$.02/lb \$171.90
Newspaper:			22605 @\$.005/lb \$113.03
Commingled Containers:(a)			1245 @\$.02/lb \$24.90
Cardboard:			9230 @\$.006/lb \$55.38
Shredded Mixed Ledger:			23685 @\$.0075/lb \$177.64
RECOVERY (TONS):	51.46	77.45	61.79
REVENUE:	\$22,211.73	\$1,549.00	\$5,005.78

PHASE I August 1989-October 1990 (15 MONTHS) Office recycling activity prior to implementation of desk-top system		PHASE II November 1990-August 1991 (10 MONTHS) Implementation of desk-top system involving house custodial transfer of paper and commingled containers to central storage areas	
TOTAL RECOVERY:	128.91		118.87
TOTAL REVENUE:	\$23,760.73		\$6,147.53
START UP COSTS:(b)	\$0.00		\$30,000.00
OPERATIONS COSTS:(c)	\$0.00		\$0.00
ESTIMATED EQUIPMENT AMORTIZATION PERIOD:	0.00		34 months

(a) Includes: glass, aluminum and plastic beverage containers.

(b) Includes: desk-top folders, central collection containers, storage and transportation containers and educational materials.

(c) No additional labor costs are attributed to the program. Collection and transport of recyclable material incorporated into regular custodial routine.

EXHIBIT D

ESTIMATED RECYCLING POTENTIAL AND RECOVERY FOR OARU

1991

1988

	PERCENT OF MW	EST. RECYCLING POTENTIAL	ESTIMATED RECOVERY	PERCENT OF POTENTIAL	EST. RECYCLING POTENTIAL	ESTIMATED RECOVERY	PERCENT OF POTENTIAL	EST. RECYCLING POTENTIAL	ESTIMATED RECOVERY	PERCENT OF POTENTIAL
Aluminum	1.60%	12379	3468	28.02%	13577	4671	34.40%	14432	4700	32.57%
Glass	8.30%	64215	17	0.03%	70433	2913	4.14%	74867	6000	8.01%
Plastic (PET & HDPE)	0.50%	3868	0	0.00%	4243	0	0.00%	4510	100	2.22%
Newspaper	5.25%	40618	5832	14.36%	44551	9288	20.85%	47356	10000	21.12%
Ledger Paper	3.00%	23210	2940	12.67%	25458	3840	15.08%	27060	4000	14.78%
Mixed Paper(a)	19.00%	146999	3100	2.11%	161232	5010	3.11%	171382	2800	1.63%
Cardboard	6.25%	48355	17220	35.61%	53037	19250	36.30%	56376	20000	35.48%
Non-Ferrous	NDA	NDA	3300	NDA	NDA	6501	NDA	NDA	6500	NDA
Ferrous- Auto	5.13%	39690	35040	50.72%	43533	45776	60.41%	46273	70776	87.87%
Other	3.80%	29400			32246			34276		
Auto Batteries (b)	NDA	NDA	3075	NDA	0	2350	NDA	0	2500	NDA
Electronic Scrap (c)	NDA	NDA	0	NDA	0	810	NDA	0	5000	NDA
Tires	0.70%	5416	0	0.00%	5940	0	0.00%	6314	500	7.92%
TOTAL OF MW:	34.53%	267151	73992	27.70%	293018	100409	34.27%	311465	132876	42.66%
TOTAL OF TW:	.27.62%									
TOTAL WASTE (TW): (d)			967096			1060736			1127515	
CONSTRUCTION/DEMOLITION: (WASTE EST @ 20%)			193419.2			212147.2			223503	
MUNICIPAL WASTE (MW):			773676.8			848588.8			902012	
PERCENT OF TOTAL WASTE (TW) RECYCLED:			7.65%			9.47%			11.78%	

(a) Waste percentage/tonnage for mixed paper is not included in total potential figures because current markets for these paper grades are too weak and inconsistent to support recovery beyond existing levels.

(b) Potential estimates for auto batteries would be included in non-ferrous metal; however non-ferrous data is not available.

(c) Electronic scrap includes transformers, computers, telephones, machinery. The potentials estimates would be split between ferrous and non-ferrous; however non-ferrous data is not available.

(d) Total waste is calculated using 1990 actual tonnages as the baseline and factoring an average 3.5% increase/decrease per year to estimate 1988 and project 1991.

NDA- No Data Available

ESTIMATES AND PROJECTIONS PRESENTED HERE WERE DERIVED FROM A COMPILATION OF NUMEROUS LOCAL AND NATIONAL SOURCES AND ARE INTENDED TO PROVIDE A GENERAL PERSPECTIVE ONLY.

EXHIBIT E

DIVISION OF REFUSE COLLECTION AND DISPOSAL
COST STUDY FISCAL YEAR 1990-1991

CONTENTS

E-1	COLLECTION
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E-4	LANDFILL-CONTRACTOR OPERATED
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DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse COLLECTION Operating Costs
Actual for the Fiscal Year 1990-91

COLLECTION EXPENSES:

Direct Salaries and Wages	11,246,067
Labor Fringe Costs - Salaries and Wages	3,199,506
Indirect Costs - Refuse Division	1,978,988
Current Expenses	728,006
	<hr/>
	17,152,567

Road Maintenance Division - Support on
Collection Activities:

Salaries and Wages	148,612
Labor Fringe Costs - Salaries and Wages	42,280
Indirect Costs - Road Division	45,342
	<hr/>
	236,234

Vehicle/Equipment Maintenance:

Labor Costs	370,265
Labor Fringe Costs - Salaries and Wages	105,340
Indirect Costs - AES Division	236,673
Other Operating and Maintenance Costs	1,103,642
	<hr/>
	1,815,920

Capital Cost Recovery
Equipment

1,767,552

TOTAL REFUSE COLLECTION

20,972,274Tons Collection (Including Business)
Cost per Ton

293,857
\$71.37

INSPECTION AND INVESTIGATION:

Salaries and Wages	30,312
Labor Fringe Costs - Salaries and Wages	8,624
Indirect Costs - Refuse Division	5,335
Current Expense	3,106
Capital Recovery - Equipment	23

TOTAL INSPECTION AND INVESTIGATION

47,400Tons Collection (Business)
Cost per Ton

3,550
\$13.35COMBINED COLLECTION AND INSPECTION -
INVESTIGATION COSTS:

Collection Cost per Ton	\$71.37
Inspection - Investigation Cost per Ton	\$13.35

TOTAL BUSINESS COLLECTION COST PER TON

\$84.72

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse INCINERATION Operating Costs
Actual for the Fiscal Year 1990-91

INCINERATION EXPENSES:

Direct Salaries and Wages	1,483,709
Labor Fringe Costs - Salaries and Wages	422,115
Indirect Costs - Refuse Division	261,091
Current Expenses	737,566
	<hr/>
	2,904,480
	<hr/>
Vehicle/Equipment Maintenance:	
Labor Costs	8,775
Labor Fringe Costs - Salaries and Wages	2,496
Indirect Costs - AES Division	5,609
Other Operating and Maintenance Costs	26,530
	<hr/>
	43,410
	<hr/>
Capital Cost Recovery	
Equipment	124,591
Facilities	1,522,582
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	1,647,173
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TOTAL REFUSE INCINERATION	4,595,063
	<hr/>

Tons Incineration	63,637
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Cost per Ton	\$72.21
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Note: These costs reflect a high cost per ton since a major portion of the municipal solid waste has been diverted to H-Power for conversion to energy since June 1990. The incinerator must remain operational for foreign rubbish and special wastes.

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse LANDFILL-CITY OPERATED Operating Costs
Actual for the Fiscal Year 1990-91

LANDFILL OPERATION EXPENSES:

Direct Salaries and Wages	195,249
Labor Fringe Costs - Salaries and Wages	55,548
Indirect Costs - Refuse Division	34,358
Current Expenses	1,736,812

2,021,967

Vehicle/Equipment Maintenance:

Labor Costs	19,166
Labor Fringe Costs - Salaries and Wages	5,453
Indirect Costs - AES Division	12,251
Other Operating and Maintenance Costs	59,197

96,068

Capital Cost Recovery

Equipment	345,677
Facilities	95,167

440,844

Inspection And Investigation:

Salaries and Wages	13,262
Labor Fringe Costs - Salaries and Wages	3,773
Indirect Costs - Refuse Division	2,334
Current Expense	481
Capital Recovery - Equipment	10

19,860

TOTAL LANDFILL-CITY OPERATION

2,578,739

Tons Disposal

92,455

Cost per Ton

\$27.89

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse LANDFILL-CONTRACTOR OPERATED Operating Costs
Actual for the Fiscal Year 1990-91

LANDFILL-CONTRACTOR OPERATION EXPENSES:

Direct Salaries and Wages	60,793
Labor Fringe Costs - Salaries and Wages	17,296
Indirect Costs - Refuse Division	10,698
Current Expenses	4,989,971
	<hr/>
	5,078,758

Capital Cost Recovery
Facilities

826,468

826,468

Inspection And Investigation:

Salaries and Wages	13,262
Labor Fringe Costs - Salaries and Wages	3,773
Indirect Costs - Refuse Division	2,334
Current Expense	481
Capital Recovery - Equipment	10

19,860

TOTAL LANDFILL-CONTRACTOR OPERATION

5,925,086

Tons Disposal

269,564

Cost per Ton

\$21.98

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse TRANSFER STATION Operating Costs
Actual for the Fiscal Year 1990-91

TRANSFER STATION EXPENSES:

Direct Salaries and Wages	1,385,482
Labor Fringe Costs - Salaries and Wages	394,170
Indirect Costs - Refuse Division	243,805
Current Expenses	135,474

2,158,931

Vehicle/Equipment Maintenance:

Labor Costs	110,597
Labor Fringe Costs - Salaries and Wages	31,465
Indirect Costs - AES Division	70,694
Other Operating and Maintenance Costs	269,474

482,230

Capital Cost Recovery

Equipment	469,425
Facilities	1,340,832

1,810,257

TOTAL REFUSE TRANSFER STATION

4,451,418

Tons Transfer

202,095

Cost per Ton

\$22.03

DEPARTMENT OF PUBLIC WORKS

EXHIBIT E-(

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse CONVENIENCE CENTER Operating Costs
Actual for the Fiscal Year 1990-91

CONVENIENCE CENTER EXPENSES:

Direct Salaries and Wages	20,013
Labor Fringe Costs - Salaries and Wages	5,694
Indirect Costs - Refuse Division	3,522
Current Expenses	1,605,096
	<hr/>
	1,634,324
	<hr/>
Capital Cost Recovery	
Facilities	110,616
	<hr/>
	110,616
	<hr/>
	<hr/>
TOTAL REFUSE CONVENIENCE CENTER	1,744,940
	<hr/>
	<hr/>
Tons Transfer	27,344
Cost per Ton	\$63.81
	<hr/>
	<hr/>

DEPARTMENT OF PUBLIC WORKS

EXHIBIT E-7

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse H-POWER Operating Costs
Actual for the Fiscal Year 1990-91

H-POWER EXPENSES:	
Direct Salaries and Wages	129,151
Labor Fringe Costs - Salaries and Wages	36,743
Indirect Costs - Refuse Division	22,727
Current Expenses	50,891,934
	<hr/>
	51,080,554
<hr/>	
Inspection And Investigation:	
Salaries and Wages	6,314
Labor Fringe Costs - Salaries and Wages	1,796
Indirect Costs - Refuse Division	1,111
Current Expense	241
Capital Recovery - Equipment	5
	<hr/>
	9,467
	<hr/>
Subtotal	51,090,021
<hr/>	
Less Revenue:	
Materials	347,653
Electrical	21,087,375
	<hr/>
	21,435,028
	<hr/>
TOTAL REFUSE H-POWER	29,654,993
	<hr/>
Tons	583,009
Cost per Ton	\$50.87
	<hr/>

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse GENERAL RECYCLING Operating Costs
Actual for the Fiscal Year 1990-91

GENERAL RECYCLING EXPENSES:	
Direct Salaries and Wages	74,712
Labor Fringe Costs - Salaries and Wages	21,256
Indirect Costs - Refuse Division	13,147
Current Expenses *	708,414
	<hr/>
	817,530
	<hr/>
Capital Cost Recovery	
Equipment	33,879
	<hr/>
	33,879
	<hr/>
Subtotal	851,409
	<hr/>
Less Revenue:	
Sale of Recycled Materials	19,306
	<hr/>
TOTAL GENERAL RECYCLING	832,103
	<hr/> <hr/>
Tons Recycled	1,772
Cost per Ton	\$469.58
	<hr/> <hr/>

* Includes curbside collection and sorting costs, school/community container lease and hauling costs, public education and administration.

DIVISION OF REFUSE COLLECTION AND DISPOSAL

Refuse GLASS RECYCLING Operating Costs
Actual for the Fiscal Year 1990-91

GLASS RECYCLING EXPENSES:

Current Expenses

736,793736,793

TOTAL GLASS RECYCLING

736,793

Tons Recycled

4,554

Cost per Ton

\$161.79

EXHIBIT F

Table 43

SUMMARY OF DENSITY FACTORS FOR LANDFILLED MATERIALS

	Density (lb/cuyd)	References*
DURABLE GOODS**	520	32
NONDURABLE GOODS		
Nondurable Paper	800	23
Nondurable Plastic	315	23
Diapers	400	24
Rubber	345	25
Textiles	435	26
Misc. Nondurables (mostly plastics)	390	31
PACKAGING		
Glass Containers		
Beer & soft drink	2,800	25, 29
Other containers	2,800	25, 29
Steel Containers		
Beer & soft drink	560	25
Food cans	560	25
Other packaging	560	25
Aluminum		
Beer & soft drink	250	29, 30
Other packaging	550	29
Paper and Paperboard		
Corrugated	750	23
Other paperboard	820	23
Paper packaging	740	23
Plastics		
Film	670	23
Rigid containers	355	23
Other packaging	185	23, 31
Wood Packaging	800	26
Other Misc. Packaging	1,015	23
Food Wastes	2,000	25
Yard Wastes	1,500	27, 28

* References are listed at the end of this report.

** No measurements were taken for durable goods or plastic coatings.

Source: Characterization of Municipal Solid Waste in
the United States: 1990 Update. EPA/530-SW-
90-042 June 1990