

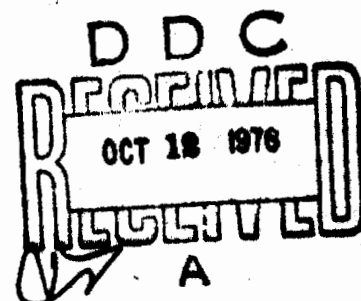
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IMPROVED EFFICIENCY FOR KIRTLAND AIR FORCE BASE SOLID WASTE COLLECTION

JANUARY 1976



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AIR FORCE CIVIL ENGINEERING CENTER

(AIR FORCE SYSTEMS COMMAND)

**TYNDALL AIR FORCE BASE
FLORIDA 32091**

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This effort was initiated to find new ways to improve Air Force base level residential solid waste collection. This study investigated two collection modifications which were intended to improve system efficiency and, thus, conserve resources. The two modifications were: (1) optimum routing of the refuse collection vehicles; and (2) curbside, paper bag collection. The study results showed that large economies (exclusive of paper bag costs) could be realized if the two-system modifications were implemented together. In fact,		

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estimated savings amount to about one-half of the solid waste collection budget. It was concluded that both optimum routing and curbside collection were potential money savers and could offer the Air Force significant cost benefits. Moreover, these cost benefits could be realized without large expenditures of capital since they involved only differences in how, where, and when residential refuse was collected.

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SECTION I

INTRODUCTION

In an effort to evaluate new techniques for Air Force residential refuse collection, the Environics Directorate of the Air Force Civil Engineering Center conducted a study to determine the effect of two modifications on the collection system efficiency. The modifications investigated were computer optimum routing of the refuse vehicles and curbside, paper bag residential refuse collection. The routing improvement was implemented throughout the residential areas on Kirtland AFB East (KAFB) while the curbside, paper bag pickup study was examined on two streets within these residential areas. The routing portion was intended to be permanent while the new collection technique was investigated for a 30-day period. The results showed that both aspects of the study were functionally feasible and that economic benefits could be derived from the improved system efficiency.

SECTION II

PROBLEM DEFINITION AND STUDY DESCRIPTION

1. GENERAL STATEMENT OF THE PROBLEM

Solid waste collection and disposal has in recent years become an increasing concern for managers responsible for its operation. As concern and problems have mounted, solid waste collection and disposal technology development has commanded more resources than at any other time. However, while the private sector has largely accepted as fact the seriousness of the problem and is actively engaged in technology improvement, Air Force solid waste engineers have been acutely unaware of the problem, or unable or unwilling to do something about it. While much progress has been made in solid waste management technology, the military establishment has been slow to accept and adapt to new methods, and is still operating with the technology of the early part of the century.

Military engineers have made minor attempts to remedy the chronic ills that afflict solid waste management efficiency at Air Force installations, but these have had, thus far, little effect on the system. One of the most promising signs to date has been a letter from Headquarters AFSC requesting that many of its bases write or renegotiate their FY 76 contracts to require curbside collection (Reference 1). Moreover, further direction in the letter states that Military Family Housing (MFH) occupants will place their dry paper in a separate container for curbside collection. While the request for curbside refuse collection is generally applicable and economically advantageous at all bases, the paper segregation and pickup may not always be economically justified.

Although the entire gamut of solid waste management must be given proper consideration sooner or later, this study is one step toward achieving that goal. Two modifications were made to the KAFB system in an attempt to improve its overall efficiency. The modifications investigated were improved routing of the refuse vehicles through the collection areas, and a change in the collection process between each residential unit and the refuse collection truck. More explicitly, the following aspects of the system were investigated. First, improved routes reduced the inefficient ones used by the contractor. Second, the metal containers at each residence were replaced by a metal rack and paper bag containers. Third, the collection point was changed from the backyard or carport area to the curb.

Reference

1. Letter, Villone, V. J., Col., Headquarters AFSC, to 4900 ABG, Kirtland AFB, NM, Refuse Collection in Military Family Housing (MFH) Areas, 14 Feb 75.

2. OPTIMIZED ROUTING

Enviro-nics efforts in refuse vehicle routing have shown that analytic techniques can improve the routing of collection vehicles for refuse pickup. Two techniques have been investigated, (1) a manual methodology, and (2) a computer technique. Both methods have been applied to the residential areas of Kirtland AFB East and showed routing mileage reductions of approximately 20 percent. The routing scheme implemented in this study was the computer technique with the output manually modified. The contractor's routing mileage through the residential areas was 30.4 miles while the modified, computer route mileage was 24.6. The mileage savings per cycle was 5.8 which translates to an annual savings of 562 miles. The percentage savings was approximately 20.

3. PAPER BAG, CURBSIDE REFUSE COLLECTION

The contractor presently collects refuse from either the occupants' backyard or carport. The metal containers are shown in the backyard and carport areas in Figures 1 and 2 respectively. The collectors accomplish this removal by transferring the contents of the metal containers from one or more residences to a 55-gallon "swamper." When the swamper is full the collector returns to the refuse truck and empties it. As the collection process requires frequent, time-consuming trips between the truck and the containers, this system of collection could be accomplished much more efficiently.

The following system was implemented during this study:

(a) A metal rack and paper bag system, as shown in Figure 3, replaced the metal containers.

(b) The location of the metal rack and paper bag system was left to the resident.

(c) The filled paper bags were stored wherever the resident desired until the day of collection.

(d) The occupant placed the filled paper bags at the curb on the specified collection day.

Figure 4 shows the bags at the curb awaiting pickup by the collectors, thereby eliminating the trips to the backyard and waste transfer to the 55-gallon swampers.



Figure 1. Metal Containers in Backyard



Figure 2. Metal Containers in Carport



Figure 3. Metal Rack and Paper Bag



Figure 4. Paper Bags at Curb Awaiting Pickup

4. CONTRACTOR, BASE CIVIL ENGINEERING ACCEPTANCE OF STUDY

Environics originally envisioned this study to evaluate only the implementation of the optimal routing. The intention was to study the effects of an improvement to the system with minimum disruption of service to the occupants involved. The routing implementation met this requirement with the only disruption being a change in collection day for a small number of the residents. However, since the curbside, paper bag investigation was independent of the routing portion, it too, could be implemented simultaneously without undue disruption of the collection operation.

The study was proposed to the contractor and his response was enthusiastically affirmative. Environics anticipated some resistance from Base Civil Engineering (BCE) personnel due to the proposed changes to the contractor operation, but they were, on the contrary, quite helpful. The cooperation of BCE personnel paved the way for implementation of this study. Apparently, as BCE is operating with fewer resources each year, they are constantly looking for new ways to conserve these resources. The BCE office was very receptive to our program as a potential way to cut costs.

Both portions of the study were implemented during the same week. The routing portion was publicized by use of the base bulletin and newspaper. The paper bag, curbside phase was publicized by the base newspaper and by letter to those occupants involved. The rack and paper bag system was also demonstrated to each occupant by Environics personnel. It should be noted that the metal containers in the areas affected by curbside pick-up were removed so that all occupants would use the new system. The articles and letters pertaining to the implementation of the study and the subsequent base curbside policy change are shown in Appendix A.

SECTION III

STUDY RESULTS

1. OPTIMUM ROUTING

Personnel from DEE traveled both the contractor routes and the computer generated routes to ascertain the mileage differential. The contractor's previous routes measured 30.4 miles, while the computer routes measured 24.6 miles. The computer route gives about 20 percent savings. Table 1 is a tabulation of the savings between the old and the new routing. The mileage savings was the immediate desired result but another effect of the new route implementation was also felt immediately. The contractor was able to eliminate one collection day from his weekly cycle while providing the equivalent level of service. The collectors can pick up refuse twice weekly from all areas in 4 days instead of 5. The contractor estimates that while approximately the same number of hours are required as before, the 4-day service is preferred. This is primarily due to increased crew motivation, and less wear and tear on the trucks from the reduced mileage.

2. ECONOMIC BENEFITS OF CURBSIDE REFUSE COLLECTION

An investigation was made to determine the expected economic benefits by changing from backyard to curbside service. These benefits are expected to be substantial because of the potential labor savings. This investigation examined the change from twice-a-week backyard collection, to once-a-week curbside collection. The analysis examined labor and equipment savings only. No additional cost for disposal containers for curbside collection was included since this cost, if any, is to be borne by the occupant. This particular change was selected for examination because it was the refuse collection policy change instituted at Kirtland AFB 1 July 1975. Potential economic benefits are estimated using information obtained from the Kirtland AFB solid waste collection contractor and from research performed for the USAF (Reference 2).

Using the information provided, the policy change would effect a cost savings of approximately \$60,000. The estimated cost breakdown is given in Table 2 which shows that savings in system costs are due to vehicular and personnel reductions. The estimated vehicular savings are about \$18,000 and the labor savings over \$41,000.

Reference

2. Kahle, Richard, et. al., Optimization of Air Force Solid Waste Management, unpublished report under Contract F29601-74-C-0084, Air Force Weapons Laboratory, KAFB, NM, pp 800-801, October 1974.

TABLE 1. OPTIMUM ROUTING MILEAGE SAVINGS

Route	<u>Previous Collection Routing</u>			<u>Proposed Collection Routing</u>			
	Start	Stop	Mileage	Route	Start	Stop	Mileage
1	40789.2	40798.7	9.5	1	52006.5	52013.6	7.1
2	40798.9	40801.3	2.4	2	35953.0	35963.7	10.7
3	40801.5	40804.3	2.8	3	35979.6	35982.8	3.2
4	40805.9	40811.0	5.1	4	40782.7	40786.3	3.6
5	40811.0	40812.0	1.0				
6	40813.1	40814.5	1.4				
7	40814.5	40815.8	1.3				
8	40816.8	40820.1	3.3				
9	40821.2	40824.8	<u>3.6</u>				
Total			30.4	Total			24.6

Percentage Savings Proposed Routing 19.1

TABLE 2. ESTIMATED COST SAVINGS WITH SYSTEM CHANGES

<u>Present Estimated Costs</u>		<u>Estimated Costs Using Old System</u>	
1 truck	\$18,760.00	2 trucks	\$37,520.00
3 men	29,078.40	7 men	67,849.60
	<u>2,282.65</u>		<u>5,326.19</u>
	\$50,121.05		\$110,695.79
			\$73,175.79

Vehicle Savings	\$37,520.00 - \$18,760.00 = \$18,760.00
Labor Savings	\$73,175.79 - \$31,361.05 = <u>\$41,814.74</u>
Total Estimated Savings	\$60,574.74

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<u>Annual Cost Per Truck</u>	<u>Manpower Costs</u>
Lease \$850.00/mo x 12 mo = \$10,200.00	\$4.66/hr x 52 weeks x 40 hrs = \$ 9,692.80
Ins. \$1000.00/yr x 1 yr = 1,000.00	Benefits \$7.85/\$100 wages = <u>760.88</u>
Maint. \$300.00/mo x 12 mo = 3,600.00	
Fuel 600 gal/mo x \$0.55/gal x 12 mo = <u>3,960.00</u>	
	\$10,453.68
	<u>\$18,760.00</u>

Figures given by Kirtland AFB Refuse Collector

For comparison with the contractor's estimate, information from a research effort was used to estimate cost savings due to the hypothetical operation changes. The analysis was to determine the potential economies by instituting once-a-week curbside service in place of the standard twice-a-week backyard pickup. Using the research data, time requirement estimates to perform backyard and curbside collection were made using research data. Environics interpolated those figures to determine the time necessary per residential unit to perform twice-a-week backyard versus once-a-week curbside collection.

The research data indicate that the time required for twice-a-week backyard service per residential unit is 2.174 minutes, while once-a-week curbside pickup requires approximately 0.926 minute per residential unit. The following analysis shows the estimated hours savings due to the policy change. First, calculate the annual number of hours necessary to complete twice-a-week backyard collection at Kirtland AFB.

$$\frac{2.174 \text{ min}}{\text{unit-week}} \times 2200 \text{ units} \times \frac{52 \text{ weeks}}{\text{year}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 4145 \frac{\text{hours}}{\text{year}}$$

Using the contractor-supplied collection costs (exclusive of disposal), the hourly cost of collection is calculated.

$$\text{Hourly collection cost at Kirtland AFB} = \frac{\$110,695.79}{4145 \text{ hrs}} = \$26.71/\text{hr}$$

Next, calculate the number of hours once-a-week curbside pickup at Kirtland AFB would require.

$$\frac{0.926 \text{ min}}{\text{unit-week}} \times 2200 \text{ units} \times \frac{52 \text{ weeks}}{\text{year}} \times \frac{1 \text{ hour}}{60 \text{ min}} = 1766 \frac{\text{hours}}{\text{year}}$$

Using \$26.71/hr as the operating cost at Kirtland AFB, an estimated annual cost for once-a-week curbside pickup can be made.

$$\text{Annual Kirtland AFB cost for curbside pickup} = 1766 \frac{\text{hours}}{\text{year}} \times \$26.71/\text{hr} = \$47,150.09$$

To determine the annual savings, the difference between the total estimated annual costs is calculated.

$$\text{Estimated Annual Savings} = \$110,695.79 - \$47,150.09 = \$63,545.70$$

The following data give the comparative savings of the two estimates, the percentage savings, and the percentage difference.

<u>Data Input</u>	<u>Backyard Twice Per Week Costs</u>	<u>Curbside Once Per Week Costs</u>
Kirtland AFB Refuse Collector	\$110,695.79	\$50,121.05
Research Data	110,695.79	47,150.09
<u>Annual Savings</u>	<u>Percentage Savings</u>	<u>Percentage Difference Estimated Savings</u>
\$60,574.74	54.7	4.6
63,545.70	57.4	

The above data show good agreement between the respective estimated savings. It is assumed that the contractor-derived estimate is generally valid. The analysis using the research information was made for comparison purposes and the results do not validate the methodology. However, it may well be that the latter method of estimation can be used effectively to determine potential economies at other Air Force installations. It will require additional research and analysis to validate that assumption. However, it is probable that vehicular and labor savings of about 50 percent should be realized if a base changes its refuse collection policy from twice-a-week backyard to once-a-week curbside.

In a period of scarce resources, increases in efficiency and productivity are being sought in all aspects of the military budget. With relative ease, budgetary savings in the Base Civil Engineering account should be realized with improved efficiency in solid waste management operations. Therefore, as curbside service is a proven money saver, the Air Force should adopt this policy now at all installations.

3. QUESTIONNAIRE RESULTS

A questionnaire evaluation of the paper bag, curbside service portion of the study was undertaken to determine occupant reactions. The questionnaire is shown in Appendix B. A tabulation of the occupants' reactions is given in Table 3. With 86 percent of those involved in the study responding, a good idea of occupant reaction can be ascertained. As shown in Table 3, most residents preferred paper bags when asked which container they would use if curbside service was implemented. Fifty-four percent of those responding said they were willing to pay for the bags if necessary. The residents felt the study system to be quieter and more convenient than the previous collection method, but did not feel the new system gave them increased privacy. The occupant attitude toward the study was generally good with little attitude change occurring during the course of the study. Some of the more favorable comments from the questionnaires were:

"This collection method appears to be cleaner and quieter. I grew to like the "Orbie" system very much. I hope you will give us back our "Orbie." I would rather be without my Clorox® than my "Orbie."

"We would like to see this type of refuse collection all the time."

"There were less small pieces of trash blowing around after pickup. If it will cost less, I highly recommend this method."

"If we must have curb service, I'd much prefer carrying bags to the street."

"This system was extremely good. At the end of the study we did not want to give up our bag and paperbags and go back to the metal trash cans. Give us back our "Orbie."

"Found the bag system very convenient. Much prefer over cans. Present cans are so heavy that when full it takes a gorilla to take the trash out."

Some of the unfavorable comments were:

"It's a pain for me to remember which days to take the trash out. Also, I couldn't put the bags on the rack myself. My husband had to close the hinge (on the rack). That will never do."

"The curbside pickup saves the time of the pickup crew only, not the occupants. The paper bags do not close. There is no good way, save stapling, to close the bag."

"I'm sure that with a paper bag of trash at each house, when the temperature reaches 100+ for about three days, the odor would equal that of the city dump."

TABLE 3. CURBSIDE PICKUP QUESTIONNAIRE

<u>Occupants</u>	<u>Percentages</u>	
Responding	86	
Officers	92	
Enlisted	80	
<u>Favorable Towards Paying for Bags</u>	54	
Officers	55	
Enlisted	53	
<u>Curbside Preference</u>		
Paper	49	
Plastic	8	
Cans	28	
Paper or Plastic	11	
Other	4	
<u>Attitudes</u>	<u>Yes (Percent)</u>	<u>No (Percent)</u>
System More Quiet	73	27
System More Convenient	56	44
System More Privacy	29	71
<u>Occupants' Feelings</u>	<u>Numerical Rating *</u>	
Toward Entire Study Initially	2.1	
Toward Entire Study Finally	2.3	

TABLE 3. CURBSIDE PICKUP QUESTIONNAIRE (CONCLUDED)

Paper Bag Usage

Minimum No. of bags/capita-week	0.63
Minimum No. of bags/capita-year	32.8
Average No. of bags used/capita-week	0.72
Average No. of bags used/capita-year	37.4

<u>Problems with Paper Bags</u>	<u>Yes (Percent)</u>	<u>No (Percent)</u>
Animals	51	49
Flies	4	96
Odors	17	83
Wind	28	72

* Scale

- 4.0 Extremely Favorable
- 3.0 Moderately Favorable
- 2.0 Favorable
- 1.0 Moderately Unfavorable
- 0.0 Extremely Unfavorable

"Full bags were blown over, and wind scattered the refuse."

"Crushing garbage, changing bags, storing full bags, carrying bags to curb, picking up strewn garbage all make it great for refuse collectors. But it has made the recipient of the service do all the work."

"I don't think you should attempt to turn the housewife into a trash crusher. She could spend most of her day hammering cans and jumping up and down on milk cartons. If you want to do something get us trash compactors installed in our quarters."

"Bags torn by animals when left outside."

Some other comments on the questionnaires were:

"Construct a bin to hold the bags."

"Believe you should let people know how much savings will be realized from whatever method is chosen."

"At other stations we've used plastic bags and I've found them to be very vulnerable to dogs tearing them open."

"Suggest some sort of stapling device or adhesive to fasten top when the bag is full."

As is evident from the foregoing comments, the attitudes toward the study ranged from extremely good to extremely bad. The favorable comments centered around the new system being quieter, more convenient, and much easier than carrying the metal containers to the curb. The unfavorable comments centered around the issue of additional work for the occupants to compact the refuse and the idea of carrying the refuse to the curb. The occupants need to realize that they should no longer expect services that expend large quantities of Air Force resources unnecessarily. With a little extra effort curbside service can be implemented, resulting in substantial savings of Air Force funds.

Another primary criticism of the bags was the inadequate way in which they were closed. There is merit in this criticism and some thought must be given toward improvement of the system in that regard.

According to the questionnaire results, the average number of paper bags used per occupant per week was 0.72. Using this figure the yearly per capita bag usage would be 37. For a family of 4, on the average, 148 paper bags would be used annually. At a cost of \$0.14 per bag the annual cost would be about \$21.00. Using the questionnaires' minimum per capita bag usage of 0.63 yields an annual per capita rate of 33. At the cost of \$0.14 per bag the yearly cost for a family of 4 would be approximately \$18.00.

A comparison cost of plastic bags is as follows. One paper bag holds approximately two 30 gallon plastic bags. Therefore, yearly usage by a family of four would be about 256. At a cost of \$0.07 per bag the annual cost using plastic bags would be about \$18.00. Therefore, the annual cost for both types of bags is essentially equivalent.

Since costs are nearly the same, Envirionics considers paper bags superior for the following reasons:

- (a) Paper bags are stronger than their plastic counterparts.
- (b) Since paper bags hold approximately twice the amount of refuse as the plastic bags, fewer trips need to be made to the curb on pickup days.
- (c) According to the questionnaire results, if curbside service was implemented, paper bags are the preferred container.
- (d) Paper bags are biodegradable in the landfill whereas plastic bags are not. Additionally, paper bags are incinerated much easier and with less environmental pollution than plastic bags.
- (e) A subjective evaluation of both types of bags show that they both are susceptible to animal attack.
- (f) With reference to metal containers, a California study showed that paper bags were 90 percent more effective against fly population than conventional metal containers.

The Envirionics study showed that paper bag, curbside pickup could operate feasibly and was not an undue hardship on base residents. In fact, as some residents commented in the questionnaires, they were quite upset in having to give up the study system.

Probably the primary concern of the residents regarding use of the paper containers was susceptibility to animal attack, and would also be a problem with plastic containers. However, this problem can be minimized by placement of the bags at the curb on the day of collection.

Finally, paper refuse sacks are cleaner with less of a fly problem than with the metal containers. Also, use of paper bags would eliminate the necessity of metal container cleaning, a dirty job at best.

SECTION IV

CONCLUSIONS

Optimal routing techniques can save on the mileage a refuse vehicle must travel, and thus give savings in gas, oil, truck maintenance and labor.

Curbside pickup is a viable, feasible alternative to backyard collection and can cut costs. Studies have shown up to 100 percent increase in daily collection pickups.

Paper bags are cleaner, safer, more convenient, and quieter than metal containers.

Kirtland should continue with the optimal routing and initiate curbside pickup using paper bags.

This study showed that solid waste collection can be improved with little or no capital investment which can result in reduced costs.

SECTION V

RECOMMENDATIONS

Increased effort must be made toward optimizing all aspects of Air Force solid waste collection practices.

Solid waste management research findings which can effect significant efficiency and economic improvement must be implemented by all bases as soon as possible. No longer can the Air Force afford to file away new potentially important cost reducing methods.

Computer optimized routing of refuse collection vehicles should be implemented throughout the Air Force.

Kirtland Air Force Base should institute curbside pickup to reduce costs and give the homeowner the option of purchasing paper or plastic bags. All bases should adopt the policy of curbside refuse collection to effect large monetary savings in their solid waste management budgets.

APPENDIX A

STUDY IMPLEMENTATION INFORMATION AND PUBLICITY

Major

DN 4 Feb 75

DEPARTMENT OF THE AIR FORCE
AIR FORCE WEAPONS LABORATORY (AFWL)
KIRTLAND AIR FORCE BASE, NEW MEXICO 87117



REPLY TO
ATTN OF **DEE**

27 JAN 1975

SUBJECT: **Solid Waste Collection Study**

TO: **4900th ABGp/CC/Col James B. Myers**

CC	
CD	
CCX-1	
CMS-1	
SEC-1	

1. The Civil Engineering Research Division of the Air Force Weapons Laboratory is researching improved methods of solid waste collection for Air Force application. The rising operations and maintenance costs and inefficient practices used at many Air Force bases have made this a subject of concern to Hq USAF. To assist us in evaluating two of our research efforts towards reducing collection costs while suffering no loss of service, we would like to initiate a 30 day study in the east family housing areas. A brief description of the research efforts, objectives, and proposed study is attached.

2. Details and objectives of the study have been discussed with your Base Civil Engineering officials. Every attempt has been made to minimize disruption to base housing occupants. The present collection contractor is willing to undergo the test and to submit a letter to procurement specifying no additional cost to the existing contract is required. All material costs, approximately \$165, will be paid with our project funds.

3. The results obtained from the study will greatly assist us in completing our research efforts and to make subsequent recommendations to Hq USAF for reducing solid waste collection costs throughout the Air Force. I am hopeful the proposed study meets with your approval and that the findings may also be of value to your Base Civil Engineers. AFWL/DE project officers are Major Frank Sanpei and 1st Lt Dennis Lundquist, 61-2544/2771.

FOR THE COMMANDER

William B. Liddicoet

1 Atch
Proposed Study

WILLIAM B. LIDDICOET, Colonel, USAF
Chief, Civil Engineering Research Division

Cy to: **4900th ABGp/DE/Mr. Alex Griego**

1st Ind
Hq 4900 ABG/CC

TO: **AFWL/DEE**

30 JAN 1975

Approved.
J. B. Myers
J. B. MYERS, Col, USAF
Commander

1 Atch n/c

Kirtland AFB (East Family Housing)
Proposed Solid Waste Collection Study

1. OBJECTIVES

The proposed solid waste collection study is for 30 days and plans are to begin 17 February 1975. Objectives of the study are:

a. Optimum Refuse Collection Vehicle Routing

To determine whether the AFWL developed optimum routing actually results in vehicle mile savings. (Lab results indicate a savings of 22 percent over present route used.)

To determine optimum routing limitations.

b. Curbside Paper Bag Collection

To determine family housing occupant reaction to using paper bags and curbside pickup.

To evaluate performance of paper bags in inclement weather, and their resistance to animals, flies and odors.

To obtain cost information on curbside paper bag collection for comparison with present backyard collection costs.

The results of the study will be used to recommend improved solid waste collection techniques to Hq USAF for Air Force application. Kirtland AFB Base Civil Engineers can also use the results in future base efforts towards reducing collection costs.

2. DESCRIPTION OF AFWL RESEARCH EFFORTS

Optimum Refuse Collection Vehicle Routing - A computer program has been developed by the AFWL to determine the most efficient solid waste collection vehicle routing on Air Force bases. Work on the program is complete and data from four Air Force bases have been used to test the program. Results indicate that the optimum route for Kirtland east side family housing saves approximately 22 percent of vehicle mileage from the present route. The proposed study will assist in validating the computer program.

Curbside Paper Bag Collection - The majority of Air Force bases presently use twice-a-week backyard collection service. In this method the family housing occupant places refuse in 32-gallon containers located in his backyard. The collection contractor then has to enter the backyard, transfer the refuse into a carrying container, and carry the refuse to the waiting collection vehicle. Tests in the civilian community have shown

this to be an inefficient and costly collection method. Almost all civilian communities have gone to curbside collection. AFWL efforts have included researching several different curbside collection techniques. The method proposed for the study at Kirtland is a paper bag (made of heavy paper stock) which is attached to a metal rack. Each paper bag will hold approximately the same amount as a 32-gallon container. The rack and bag can be located in the kitchen, garage, carport, storage room, or any other convenient location. When filled, the bag is removed from the rack, closed, stored, (a maximum of 3 days at Kirtland with twice-a-week collection) and taken to the street curb on collection day. It is estimated that this method will considerably reduce labor man-hours, collection vehicle miles, and gas consumption. AFR 91-11, Solid Waste Management, encourages bases to evaluate the use of paper bag refuse container systems. However, before recommendations can be made, a cost determination should be made to determine economic feasibility.

3. IMPACT OF STUDY ON EAST FAMILY HOUSING

Every effort has been made to minimize the disruption to family housing occupants. The optimum collection vehicle routing portion of the test will affect Pershing Park and a portion of Zia Park. Collection days will change as follows:

<u>Location</u>	<u>Presently</u>	<u>Study</u>
Pershing Park (all)	Wednesday, Friday	Monday, Thursday
Zia Park (portion)	Wednesday, Friday	Tuesday, Friday
25919 - 25925 San Pablo		
25550 - 25613 Perimeter		
Bradshaw and Anthis		

The curbside paper bag collection portion of study will involve two streets:

<u>Street</u>	<u>No. of Units</u>	<u>Occupants</u>
24th Loop	26	Officer
Hill Drive	36	Enlisted

Occupants in these two loops will be required to use the paper bags and carry them to the curb for the duration of the study.

4. PROPOSED STUDY COSTS

The present solid waste collection contractor is willing to undergo this study with no additional cost to his present contract. AFWL will use project funds to cover the cost of the paper bags (\$165.00). No funds are required from the 4900th ABGp.

5. SOLID WASTE STUDY SCHEDULE

The following time schedule for the study is proposed:

31 January 1975 - Study approved.

3 February 1975 - Contractor submits letter to procurement specifying that study will be accomplished with no increase to existing contract.

3 - 7 February 1975 - AFWL and BCE Industrial Engineering finalize specific data required from study.

3 - 7 February 1975 - Letters with Colonel Myer's signature sent to family housing occupants affected by study. Letters written by AFWL/BCE and sent by BCE Housing Office.

10 - 14 February 1975 - Paper bags and metal racks delivered to 24th Loop and Hill Drive. AFWL responsible.

10 - 14 February 1975 - Publicity on proposed study in Focus and Base Bulletin. AFWL/BCE responsible.

17 February - 17 March 1975 - Duration of study.

10 - 14 March 1975 - Questionnaires sent to Loops involved with curbside collection portion of study. Questionnaires developed by AFWL/BCE and sent by BCE Housing Office.

17 - 28 March 1975 - Data analysis by AFWL/BCE.

1 September 1975 - Economic analysis completed using data provided by base solid waste collection contractor and other AFWL research.

1 January 1976 - Final report completed.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 4900TH AIR BASE GROUP (AFSC)
KIRTLAND AIR FORCE BASE, NEW MEXICO 87115



REPLY TO
ATTN OF:

DEPDE (Mr. Griego, 4-6133)

FEB 4 1975

SUBJECT: Changes in Refuse Collection Days

TO: Housing Occupants

1. In an effort to reduce our operations and maintenance costs, we have been working with our refuse collection contractor to improve the routing of his trucks.
2. A shorter and more efficient route has been developed which will result in savings of gas, and labor manhours. To implement this new route will mean some changes to collection days in your area. The new collection routing schedule will be as follows:

Days & Times

Area

Mondays & Thursdays
0700-1530 hours

All of Zia Park housing and West Side housing south of Gibson.

Tuesdays & Fridays
0700-1530 hours

All the Loop housing, Antolak Pl through Johnson Drive housing, General Pershing Park housing and West Side housing north of Gibson.

3. The contractor will begin this new route on 24 Feb 75. Any questions concerning this change may be addressed to Civil Engineering, Mr. Alex R. Griego, 264-6133.

FOR THE COMMANDER

OREN G. STROM, Colonel, USAF
Chief, Civil Engineering Division

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 4900TH AIR BASE GROUP (AFSG)
KIRTLAND AIR FORCE BASE, NEW MEXICO 87115




REPLY TO
ATTN OF: DEPDE (Mr. Griego, 4-6183)

6 FEB 1975

SUBJECT: New Method in Refuse Collection

TO: Housing Occupants

1. Kirtland AFB has been selected to evaluate a new method in refuse collection. In the new method, housing occupants will use a disposable paper bag attached to a metal rack in lieu of the galvanized iron trash cans. The rack and bag can be located in the kitchen, garage, carport, storage room, or any other convenient location. When filled, the bag is removed from the rack, closed, stored, and taken to the street curb on collection day by the housing occupant. Collection days will not change.
2. This new method has several advantages over the present method:
 - a. Collection costs will be reduced.
 - b. Disposable paper bags are biodegradable.
 - c. Collectors will not enter backyards or drive heavy trucks on mesas.
3. The evaluation period begins 24 Feb 75 and terminates 28 Mar 75. Upon completion of the study, housing occupants will revert to the present collection method and a questionnaire will be sent to each housing occupant. We hope to determine the following:
 - a. Family housing occupant reaction to using paper bags and curb-side pick-up.
 - b. Performance of paper bags in inclement weather and their resistance to animals, flies and odors.
 - c. Cost information.
4. Representatives from the Civil Engineer's Office will deliver the paper bags and a metal rack to you the week of 18 Feb 75. They will provide instructions on its use and answer any questions you may have.
5. The results of this study will be used to make recommendations for possible application throughout the Air Force. The success of this study will be dependent upon your cooperation and I am hopeful for your support.


J. B. MYERS, Colonel, USAF
Commander

AFWL project studies problem

AF concerned about trash pickup

WHERE TO DUMP the garbage has long been a nationwide problem arising from urban sprawl and population growth. But now, with the energy crisis and sagging economy plaguing everyone, finding how best to collect refuse has become at least as important as locating a decent dump.

Air Force-wide, the inefficiency and costs of collection methods have increased to the point where Headquarters USAF has expressed concern.

Attempting to remedy the situation, a team from Air Force Weapons Laboratory's Civil Engineering Research Division's Environmental Branch embarked recently on a study of new routing and collecting approaches. The experiment will hopefully result in a cheaper means of picking up the

trash involving less wear-and-tear and fewer manhours.

Kirtlanders living in east housing will play a direct role in a 30-day portion of the study beginning Feb. 24. During that period, they'll be placed on a new routing system or participate in curbside collection, depending on their location. Service days will also change. West housing will not be affected.

Here's how the revised program looks: For those residing in Pershing Park, Loop Housing, and Antolak through Johnson, garbage will be collected on Tuesdays and Fridays. Zia Park residents will have their trash picked up on Mondays and Thursdays. Families on 24th Loop and Hill Drive will be provided paper bags, and place their refuse on the curb for collection.

HOW THE MONTH-LONG trial, which ends March 28, works out could affect future Air Force garbage collecting approaches in a big way. For one thing, computers have never been standard equipment in working out faster collection routes, but they're likely to be if the routes and scheduling used for the trial prove to be time and energy savers. For another, the use of large paper bags and curbside service in two areas on the east side should cut the time per stop.

Actually, the computerized routing portion of the study is intended to back up another one already completed by AFWL on four other Air Force bases. In it, researchers found that vehicle mileage was cut about 22 per cent. AFWL will use the Kirtland study to validate that result.

Kirtland AFB Bulletin Notification



BULLETIN

ALL ITEMS MUST BE RECEIVED BY 4900H ABGP/DAPE BEFORE 1200 TWO DAYS PRECEDING PUBLICATION.

OFFICIAL

20 FEBRUARY 1975

NO. 7

22. REFUSE COLLECTION PICK-UP DAY CHANGES. A new collection schedule for KAFB East will be implemented beginning 24 Feb 75. The new schedule will be as follows: Mon and Thur - Zia Park; Tues and Fri - Loop Housing, Pershing Park Housing and Antlak Place through Johnson Drive housing. West-side housing will not be affected. (AFML/DEE/61-2050).

DEPARTMENT OF THE AIR FORCE
AIR FORCE WEAPONS LABORATORY (AFSC)
KIRTLAND AIR FORCE BASE, NEW MEXICO 87117



9 1975

REPLY TO
ATTN OF: DEE (Lt Lundquist/2050)

SUBJECT: New Method in Refuse Collection

TO: Housing Occupants (Loop Drive & 24th Loop)

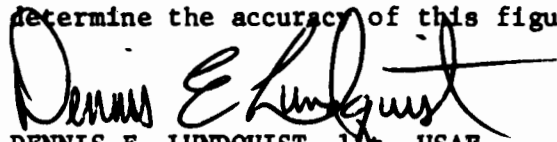
1. Our 30 day study on the use of paper bags for refuse collection is in full swing. To optimize this system, the most efficient use of the paper bags must be considered. One of the objectives of the study will be to determine the minimum number of bags required by a family per week. To assist in this determination, your cooperation is requested to:

a. Crush all milk cartons, boxes, etc., in order to maximize the amount of refuse that can be disposed of in each bag.

b. Compact contents in paper bag as much as possible.

c. Minimize the period of time at the curb by placing the bags there on the morning of the collection day.

2. Previous studies have indicated that an average family requires 2 paper bags per week. The results of our study should help us determine the accuracy of this figure.


DENNIS E. LUNDQUIST, Lt, USAF
Water and Solid Resources Research Section
Environics Branch

To start July 1

Base to begin once-a-week refuse collection

KIRTLAND FAMILY housing will go to once-per-week curbside refuse collection beginning July 1.

The new system, according to base Environmental Coordinator Alex Griego of the 4902nd Civil Engineering Squadron, will be less expensive and environmentally sounder than the current method of having workmen collect residential garbage in backyards twice a week. It was developed in accordance with a Systems Command directive released in mid-February.

As of July 1, family housing residents will have to bring their refuse to the curbside in sealable, disposable containers (usually plastic bags sealed with a tie-band, but cardboard boxes and heavy-gauge paper bags will be

acceptable) on the day their neighborhood is scheduled for service. A service schedule will appear soon.

Griego said that residents should not bring garbage cans to the curbside because workmen will pick up anything left out. He also urged occupants not to leave refuse out overnight, since roaming animals may get into the garbage and leave a mess on lawns.

RESIDENTS MUST supply their own disposable containers, he said, and arrangements have been made with the commissary to have an ample supply of plastic refuse bags on hand in time for the changeover.

While Griego said that he realized the new approach will result in some inconvenience and small expense to housing residents, he pointed to the economic and environmental benefits.

Once-a-week curbside service, he said, will result in roughly a 30 per cent savings in labor and fuel as compared to the current system.

Family housing occupants will be provided much the same service as Albuquerque receives, Griego said. The cost of disposable containers provided city people by sanitation workmen is figured into their bill. Base residents, too, will have to pay for the containers, but they'll have to go to the store to get them.

GRIEGO NOTED TWO environmental improvements over the old system that will result from the change. The frequency of noise will drop because garbage trucks will be servicing neighborhoods fewer times and for shorter periods, and the sound of metal cans

June 6, 1975

won't be heard anymore. The new schedule and method will also result in much-less impact on air quality from the refuse vehicles.

Capt. Dennis Lundquist, one of the men at the Air Force Weapons Laboratory's Civil Engineering Research Division who looked into the feasibility of curbside collection and computerized pickup routes, said that this is everyone's chance to pitch in.

"This is the way to go," he said. "With a little help from the occupants, the Air Force can see a lot of benefits. A little extra effort can save the Air Force a lot of money and give everyone a chance to do something for the economy and environment."

Griego asks that any questions about the how or why behind the new system be referred to him at 264-6183. Any complaints about the new service, though, should go to the civil engineering service desk, 264-7244.

APPENDIX B

OCCUPANT QUESTIONNAIRE

DEPARTMENT OF THE AIR FORCE
AIR FORCE CIVIL ENGINEERING CENTER (AFSC)
TYNDALL AIR FORCE BASE, FLORIDA 32401



REPLY TO: OL-AA, AFCEC/EVW (Lt Lundquist, 2050) 31 March 1975
ATTN OF: Kirtland AFB, NMex 87117
SUBJECT: Paper Bag Refuse Collection Questionnaire

TO: Housing Occupants (Hill Drive & 24th Loop)

1. Now that our 30 day study on the use of paper bags for refuse collection is completed, we would like to ascertain your reactions to it.
2. Please complete the attached questionnaire and return in the mail no later than 4 April 1975.
3. Thank you so much for your cooperation.

FOR THE COMMANDER

A handwritten signature in black ink, appearing to read "Dennis E. Lundquist".

DENNIS E. LUNDQUIST, 1/Lt, USAF
Project Officer
Water Quality & Solid Resources Division

1 Atch
Questionnaire



Paper Bag Refuse Collection Questionnaire

A. Personal Information

Name (Optional) _____

Address _____

Number of persons
residing at this
address _____

B. Paper Bag, Rack, and Curbside Service

Where was your rack and
bag located? _____

Did your rack operate
satisfactorily? _____ Yes _____ No

How many bags did you use
per week? _____

a. Was everything
placed in the bags crushed? _____ Yes _____ No

b. Were some things
crushed? _____ Yes _____ No

c. Was nothing crushed? _____ Yes _____ No

What would be the minimum number of paper bags needed
if a conscientious effort was made to crush everything
_____ bags/wk.

The Air Force will be going to curbside refuse pickup
in the future. What type of system would you prefer?

Metal cans _____
Paper bags _____
Plastic bags _____
Other _____

If your preference was paper or plastic bags would you
be willing to pay a nominal monthly fee, say \$1.00

_____ Yes _____ No

Did you experience problems with:

	<u>Yes</u>	<u>No</u>
Animals	___	___
Flies	___	___
Odors	___	___
Wind	___	___

If so, what was the nature of these problems and how could they have been alleviated?

Did the paper bag system have any other worthwhile merits. For example: Was the operation quieter due to the absence of clanging metal cans ___ Yes ___ No

Did you consider the paper bag system more convenient than the metal cans ___ Yes ___ No

Did the absence of refuse collectors in the backyard give you more privacy? ___ Yes ___ No

C. Attitude Toward Study

Please indicate with the appropriate letter the response that most indicates your feelings about the study.

- A. Extremely Favorable
- B. Moderately Favorable
- C. Favorable
- D. Moderately Unfavorable
- E. Extremely Unfavorable

At the onset of the study what were your feelings on:

The entire effort _____

Paper bags _____

The rack _____

Curbside pickup _____

At the end of the study what were your feelings about:

The entire effort _____

Paper bags _____

The rack _____

Curbside pickup _____

D. Do you recycle any of your solid wastes?
____ Yes ____ No. If so, how are you doing it?

E. Additional Remarks
Please add any comments you feel are pertinent to this study. Do not hesitate to make constructive criticism.

INITIAL DISTRIBUTION

USAF/PREE	1	AFAL/TSR	1
USAF/PREV	1	AFFDL/TST	1
USAF/RDPS	2	AMRL/DAL	1
USAF/SAFOI	1	AFML/DO	1
USAF/SGPA	1	USAF Environ Health Lab, McClellan	?
USAF/PREV-P	1	USAF Environ Health Lab, Kelly	2
USAF/DEE	1	AFWL/SUL	1
ADC/DEECV	1	AFGL/XOP	1
ADC/DEV	1	USAFSAM/EDE	2
CINCAD/SGPAI	1	AFRPL/Lib	1
CINCAD/SGPAB	1	ASD/ENAMC	1
AFLC/SGB	1	RADC/DOT	1
AFLC/DEM	1	AEDC/DEE	1
AFLC/MMRF	1	SAMTEC/SEH	1
AFSC/DEE	1	SAMTEC/DEC	1
AFSC/SD	1	SAMSO/DEC	1
AFSC/DEV	1	SAMSO/SG	1
AFSC/SGB	1	AMD/RDU	1
AFSC/SGPE	1	ADTC/CSV	1
AFSC/DASR	1	AFATL/DLOSL	2
AFSC/DLCAM	2	AFFTC/DE	1
ATC/DEM	1	AFCEC/XR	1
ATC/ATSCPAC	1	AFCEC/EV	3
ATC/SGPAP	1	AFETR/DER	1
AAC/DEV	1	AFRES/DEEE	1
AAC/SGB	1	ESD/DE	1
MAC/SGPE	1	1035 USAF Tech Ops Gp/TDM	1
MAC/DEEE	1	USAF Rgn Civ Engrg, Atlanta	1
CINCPACAF/DEV	2	USAF Rgn Civ Engrg, San Francisco	1
CINCPACAF/SGPE	1	USAF Rgn Civ Engrg, Dallas	1
CINCSAC/DEPA	2	USAFSO/DEE	1
CINCSAC/DEPV	1	1 Med Serv Wg/SGB	1
CINCSAC/SGPA	1	USAF Hospital/SGPM	1
TAC/DE	1	DDC/TCA	12
TAC/DEEV	1	ARPA	1
TAC/SGPB	1	Def Research & Engrg/AU (E&LS)	1
USAFSS/DEMM	1	OASD/(I&L)ES	2
CINCUSAFE/Surgeon	1	USA Environ Hygn Agency	1
CINCUSAFE/DEPV	2	Ch of Engrg/ENGMCRD	1
AFISC/SGMS	1	Dir, USA WW Exp Sta	1
AFISC/SES	2	USA CERL	1
USAF/DEV	1	Dir, USA Eng R&D Lab/MERDC	1
3800 ABW/DEE	1	Dept of Army/DARD-ARE-E	1
4900 ABG/DEE	1	Nav Op Environ Protection Div/OP-45	1
AFIT/DEM	1	NCEL/Code 25111	1
AU/LDG	1	NADC/MAE	1
AUL	1	Nav Ship R&D Cntr/Code 3021	1
AU/Surgeon	1	Tech Transfer Staff/EPA	1
AFOSR	1	Ofc of R&D/EPA	1
AFAPL	1	Nat'l Science Foundation, Wash DC	1
USA Med Bioengrg R&D Lab	1		