

RURAL SOLID WASTE COLLECTION AND TRANSFER ALTERNATIVES

by

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Rural Solid Waste Collection and Transport Alternatives

The concern for protecting our environment caused federal legislators to adopt six federal acts which have governed solid and toxic waste disposal since 1965¹. Rural government officials are operating with limited resources; consequently, as rural leaders evaluate and analyze solid waste systems, they will benefit from a knowledge of all alternatives.

It is estimated that Americans toss out 160 million tons of waste a year, ranging from 3.5 to 5 pounds per person per day. Clearly, collection and transportation is a major component of solid waste system. This is especially true in sparsely populated rural areas where house to house pickup may not be feasible. The objective of this paper is to provide an overview of alternative rural collection and transport systems. More specifically, the paper will review:

1. Alternative collection systems
 - a. greenbox
 - b. convenience centers
 - c. transfer stations
 - d. door-to-door pickup; and
2. Provide an example study to illustrate the application of data and alternatives to an actual community

ALTERNATIVE COLLECTION SYSTEMS

As rural leaders study and evaluate systems which they might desire to adopt, it is important to specify alternatives in modular form because alternatives can and probably will consist of combinations. This will be illustrated in the example section. The alternatives discussed include greenboxes, convenience centers, transfer stations, and door-to-door or mailbox-to-mailbox collection systems. It must be emphasized that there are many possible collection systems for rural areas, and since no two rural areas are alike, there may not be two identical collection systems.

¹ See literature relating to: (1) The Resource Conservation and Recovery Act; (2) Clean Air Act; (3) Clean Water Act; (4) Safe Drinking Water Act; (5) Public Utilities Regulatory and Policy Act; (6) Comprehensive Environmental Response Compensation and Liability Act.

Greenbox Collection System

A greenbox collection system entails placing greenbox containers (generally 8 cubic yard dumpsters) at strategic rural locations. Rural residents deposit waste in the dumpsters as they conduct normal rural travel patterns. Thus, locations should be on frequently traveled roads. The waste is collected once or twice a week with a packer-body truck and hauled either to a landfill or transfer station. The number of greenboxes at each location is a function of the number of households they serve.

Capital items for a greenbox system are specified in Table 1. The most expensive item is the packer truck. A 35 cubic yard packer-body costs about \$45,113, and a 64,000 pound GVW chassis diesel truck is estimated to cost about \$75,188. So total cost for a packer-body truck is about \$120,301. Each greenbox site should be constructed on a cement slab with a chain-link fence barrier to facilitate control and clean up of the site.

Table 1: Capital Items Associated with a Greenbox Collection System.

<u>Item</u>	<u>Price per Unit</u>
Greenbox (eight cubic-yard dumpsters)	\$450
Packer truck	\$120,301
Site preparation and fencing	\$2,775

Convenience Centers

Convenience centers are strategically placed garbage collection facilities composed of at least 150 cubic yards of greenboxes custom designed to be appealing to users and attract rural solid waste disposal. The centers are constructed in heavier populated areas along well traveled routes, landscaped and manned by an attendant during specified hours. Residents living nearby are required to transfer their solid waste to these centers for disposal. Many of the inefficiencies of collecting waste from partially filled greenboxes along routes are eliminated because a packer

truck is dispatched to a convenience center only after the attendant calls for a full load to be removed. Waste separation and compaction are often performed at convenience centers.

Patrick O'Connor (TVA) identifies six basic advantages of convenience centers. These are:

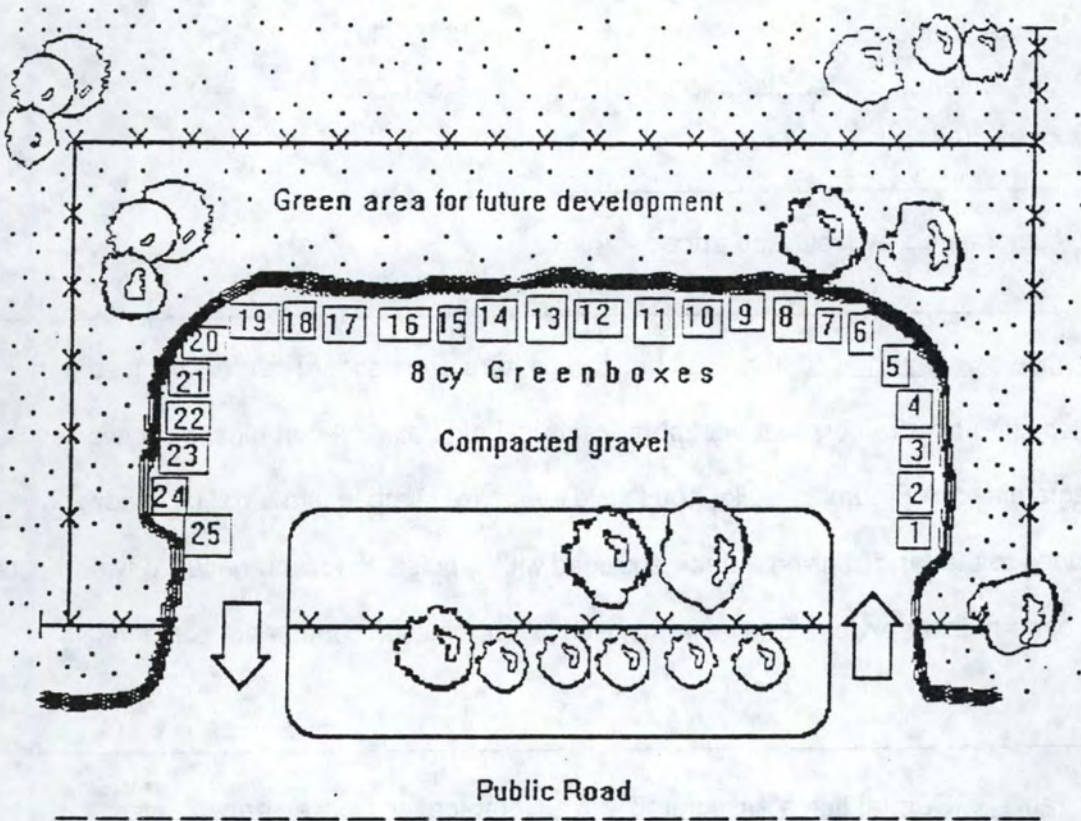
1. Cleanliness - Attendants keep the area clean and help residents unload trash.
2. Efficiency - Attendants call for trucks only when full loads are available. There tend to be fewer management problems and public complaints with convenience centers than with standard greenbox collection systems.
3. Cost - After initial start-up costs, convenience centers are less expensive to operate than are standard greenbox collection systems, due to transportation, routing, site cleaning, and labor savings.
4. Convenience - Operating hours can be adjustable to user schedules, and centers can be located near populated areas along major roads. Convenience center attendants can help the elderly, and the handicapped in unloading.
5. Security - Convenience center attendants maintain security and help eliminate scavenging, vandalism, stray dogs, and illegal dumping by residential and commercial waste generators.
6. Public Health - Controlling illegal dumping helps eliminate pollution problems and rodents.

Three types of convenience centers are presented. These include:

1. a standard greenbox convenience center;
2. a combination convenience center; and
3. a compactor convenience center.

Standard greenbox convenience center. A standard convenience center consisting of a number of greenboxes located on a one-acre site is depicted in Figure 1. The greenboxes are conveniently located such that a packer truck can easily access them. As households deliver waste, a certain amount of source separation can be carried out. This is done by placing items such as plastics in a certain container, and other items, such as paper, in other containers. It is usually important for an attendant to be on duty at a convenience center to help users. The attendant may also collect tipping fees. Capital items used in a greenbox convenience center are

Figure 1. Greenbox Convenience Center.



Source: O'Connor, Patrick B. Convenience Centers. Waste Management Program, T. V. A., Knoxville, TN. 1987.

greenboxes, packer truck and site (Table 2). The Tennessee Valley Authority (TVA) has indicated that the costs of developing a one-acre site as pictured in Figure 1 is about \$10,000. Naturally, land costs vary with location.

Table 2: Capital Items Associated with a Standard Greenbox Convenience Center.

<u>Item</u>	<u>Price per Unit</u>
Greenbox (eight cubic-yard dumpsters)	\$450
Packer truck	\$120,301
Convenience center site preparation	\$10,000
One acre land	-?????-*

*Determined by local land prices

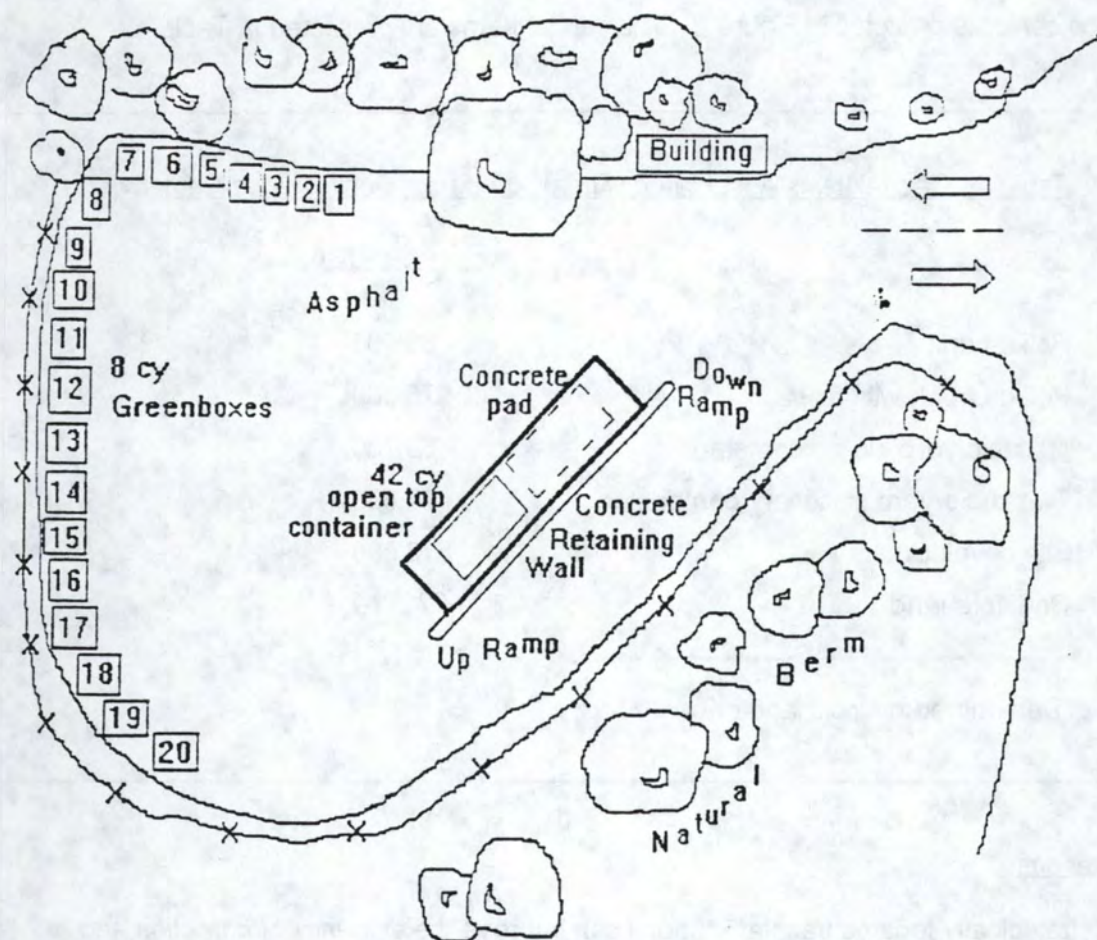
Combination convenience center. Combination centers are standard centers outfitted with large open-top roll-off containers that accept bulky household items. A combination convenience center is diagrammed in Figure 2. Bulky household items are dumped into a roll-off unit which is then transported to the landfill using a truck equipped with a hoist. If advantageous, private waste haulers can perform this service. Capital items used in combination centers are presented in Table 3.

Table 3: Capital Items Associated with a Combination Convenience Center.

<u>Item</u>	<u>Price per Unit</u>
Greenbox (eight cubic-yard dumpsters)	\$450
Packer truck	\$120,301
Convenience center site preparation	\$12,000
One acre land	-?????-*
Roll-off unit	\$3,700
Roll-off truck with hoist	\$75,000

*Determined by local land prices

Figure 2. Combination Convenience Center.



Source: O'Connor, Patrick B. Convenience Centers. Waste Management Program, T. V. A., Knoxville, TN. 1987.

Compactor convenience center. A compactor convenience center utilizes a 2 cubic yard stationary compactor together with a 42 cubic yard closed container. Waste is deposited into the container by users and then compacted by a center attendant. Compactor convenience centers do not use greenboxes. However, two open-top roll-off units are utilized. A compactor convenience center is depicted in Figure 3. The capital items are presented in Table 4.

Table 4: Capital Items Associated with a Compactor Convenience Center.

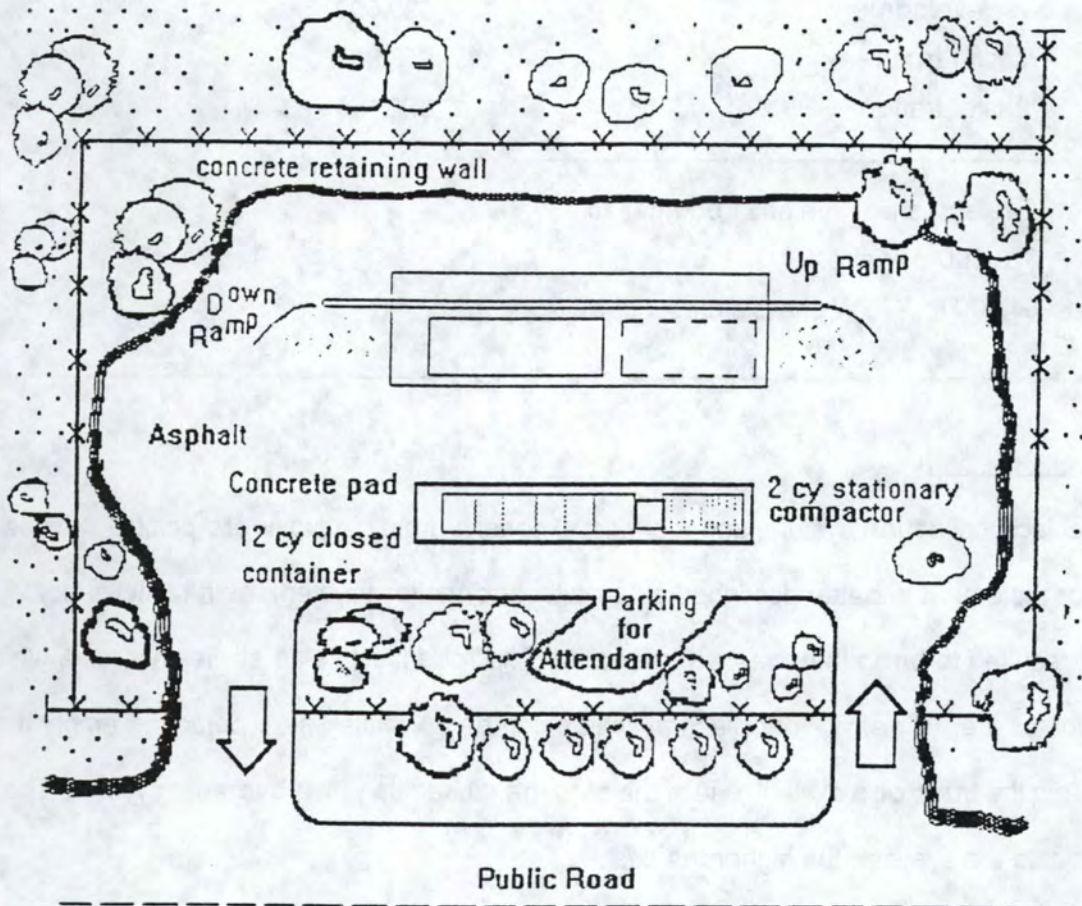
<u>Item</u>	<u>Price per Unit</u>
Roll-off unit	\$3,700
Roll-off truck with hoist	\$75,000
42 cubic-yard closed container	\$3,700
Two cubic-yard stationary compactor	\$7,500
Site development	\$13,000
One acre land	-?????-*

*Determined by local land prices.

Transfer Stations

Often, strategically located transfer stations can improve the efficiency of collection and transportation by saving time and operating costs associated with distant disposal sites. Waste brought in by collection vehicles is placed in high capacity transfer trailers or roll-off boxes and hauled to distant landfill sites. Transfer stations are often used as a base for waste separation and compaction; that is, they can be easily integrated with recycling programs. The cost of basic transfer items is depicted in Table 5. There are significant capital costs associated with transfer stations. Accordingly, decision-makers must determine whether or not a transfer station is justifiable for their region.

Figure 3. Compactor Convenience Center.



Source: O'Connor, Patrick B. Convenience Centers. Waste Management Program, T. V. A., Knoxville, TN. 1987.

Table 5: Capital Costs of Items at a Transfer Stations System.

<u>Item</u>	<u>Price per Unit</u>
Land ¹	\$5,000
Site development ²	\$20,000
Transfer truck ³	\$75,000
Transfer trailer	\$73,150

¹Five acres per site at \$1,000 per acre.

²\$20,000 per site.

³64,000 lb. GVW chassis diesel truck.

Door-to-Door-Collection

Another local collection system, and the most expensive from the providers' point of view, is a door-to-door system. It is better described as a mailbox-to-mailbox system, as rural households are usually required to bring their waste to the road. (The road must be an all weather road, which most mail routes are.) The type of collection vehicle can be a vehicle where personnel empty the trash cans into the truck or a system where the cans are picked up with a hydraulic system. The more automated the system, the higher the cost.

Door-to-door systems cost more to provide than greenbox or convenience center systems. Some experts argue that this system is less expensive if both consumer and provider costs are included. If consumers make special trips to the greenbox or convenience centers to deposit their waste, the door-to-door system is indeed the least expensive. But, if consumers drop off waste on their way to work, school, meetings, etc., and no special trips are made, the other systems are less expensive.

APPLICATION OF DATA AND ALTERNATIVES TO AN EXAMPLE COUNTY²

Citizens of Sequoyah County, Oklahoma are considering the feasibility of alternatives to provide solid waste collection and disposal services to rural residents. They requested the assistance of the Cooperative Extension Service, and the resulting study is summarized in this report. Three options were identified as possibilities, and cost estimates were prepared. These included:

1. a collection system using two packer trucks and greenboxes in rural areas, and disposal in the nearest landfill;
2. a collection system using packer trucks and greenboxes in rural areas, with two transfer stations and disposal in the nearest landfill; and
3. a collection system using packer trucks, greenboxes, three standard convenience centers, and two transfer stations with disposal in the nearest landfill.

Other combinations are possible. However, the above options were favored by decision-makers given local conditions.

Greenbox and Disposal at Landfill

The first step in the analysis is to estimate the amount of solid waste generated weekly. Local officials identified 27 possible greenbox sites. It is important that these are on frequently traveled roads to facilitate convenience for residents. From the first step, an estimate of users, amount of solid waste, and greenbox needs can be estimated. The location of the greenboxes is depicted in Figure 4 and the estimate of the solid waste generated is specified in Table 6.

A collection system would require 131 greenboxes. In addition, two 35 cubic yard packer body trucks are needed to collect the solid waste once a week and deliver it to the landfill. Annual capital and operating costs for this system are presented in Table 7. If the greenboxes and packer trucks are paid for over five year lives at ten percent annual percentage rate (APR), their annual capital costs are \$15,534 and \$63,470, respectively. Fencing for the sites paid for over ten years

² For complete details of the study see Allen, et. al. "An Economic Analysis of Solid Waste Management Alternatives for Rural Sequoyah County." Department of Agricultural Economics Paper 9100, Oklahoma State University. January 1991.

Figure 4. Sequoyah County Solid Waste Management System.

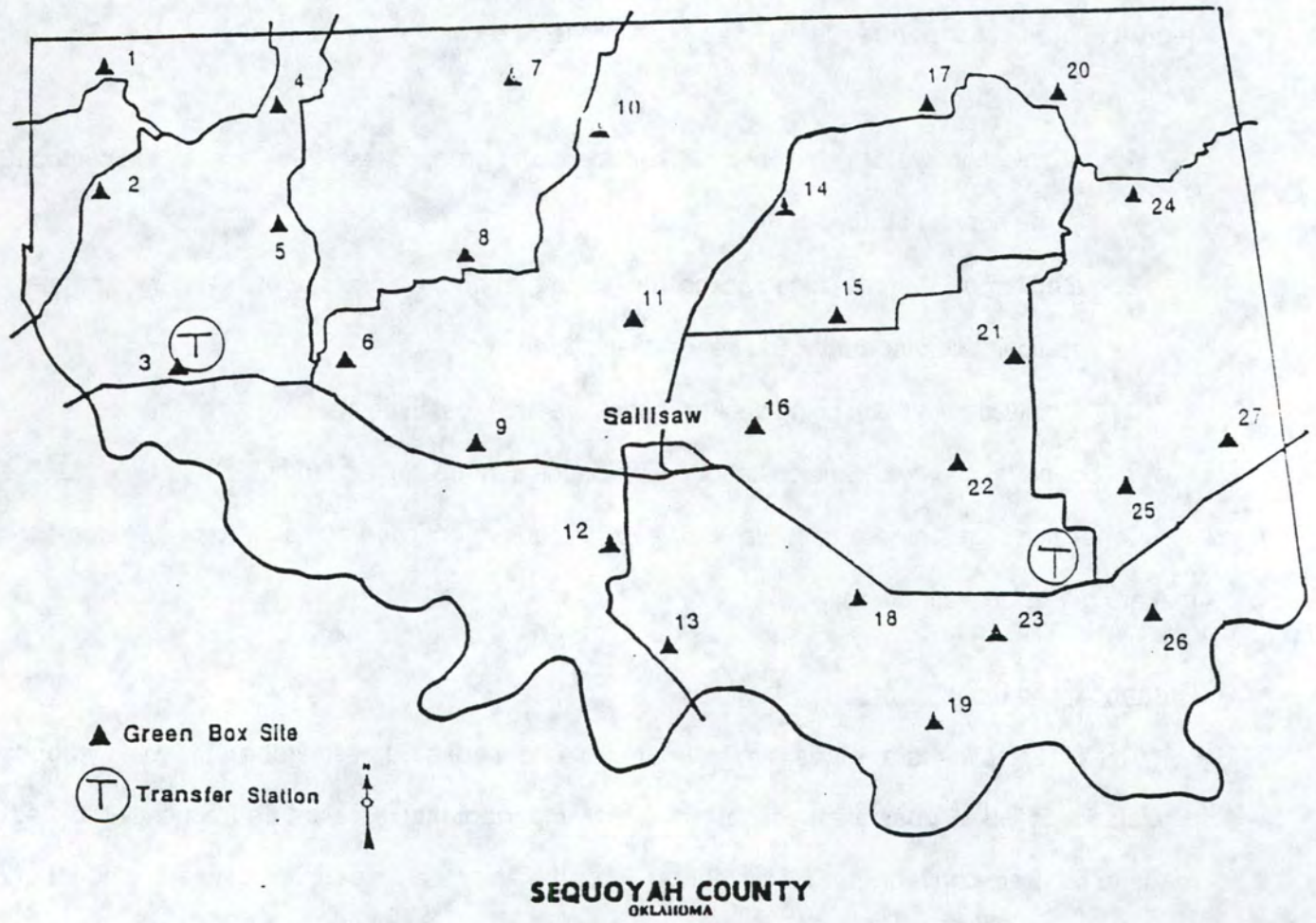


Table 6: Amount of Solid Waste Generated Per Week and the Number of Greenboxes Needed.

	<u>LOCATION</u>	<u>HOUSEHOLD</u> ¹	<u>USERS</u> ²	<u>LBS./WK</u> ³	<u>LOOSE CU. YDS</u> ⁴	<u>COMPACT CU. YDS</u> ⁵	<u>GREEN- BOXES</u> ⁶
1.	Paradise Hill	303	1,051	29,439	69.03	39.25	9
2.	Gore	174	604	16,906	39.64	22.54	5
3.	Siding	131	455	12,728	29.84	16.97	4
4.	Blackgum	252	874	24,484	57.41	32.65	7
5.	Vian-North	120	416	11,659	27.34	15.55	3
6.	Vian	135	468	13,117	30.75	17.49	4
7.	Marble-North	37	128	3,595	8.43	4.79	1
8.	Marble-South	89	309	8,647	20.27	11.53	3
9.	McKey	239	829	23,221	54.45	30.96	7
10.	Marble	131	455	12,728	29.84	16.97	4
11.	Sallisaw	230	798	22,347	52.40	29.80	7
12.	Sallisaw Airport	135	468	13,117	30.75	17.49	4
13.	R.S. Kerr Res.	152	527	14,768	34.63	19.69	4
14.	Brushy Lake	134	465	13,019	30.53	17.36	4
15.	Akin	152	527	14,768	34.63	19.69	4
16.	Seven Oaks	201	697	19,529	45.79	26.04	6
17.	Rocky Mountain	85	295	8,259	19.36	11.01	2
18.	Gans	217	753	21,084	49.43	28.11	6
19.	Foreman	60	208	5,830	13.67	7.77	2
20.	Nicut	74	257	7,190	16.86	9.59	2
21.	Long	213	739	20,695	48.52	27.59	6
22.	Flat Rock	255	885	24,776	58.09	33.03	7
23.	Muldrow	266	923	25,845	60.60	34.46	8
24.	Short	185	642	17,975	42.14	23.97	5
25.	Roland	271	940	26,330	61.74	35.11	8
26.	Shady Grove	238	826	23,124	54.22	30.83	7
27.	Packard	<u>77</u>	<u>267</u>	<u>7,481</u>	<u>17.54</u>	<u>9.97</u>	<u>2</u>
	TOTAL	<u>4,556</u>	<u>15,809</u>	<u>442,661</u>	<u>1037.89</u>	<u>590.21</u>	<u>131</u>

¹Estimated from housing counts from the Oklahoma Department of Transportation, Planning Division Maps.

²Estimated by multiplying households by persons per household (3.47)

³Estimated at 28 pounds per person per week.

⁴Estimated at 426.5 pounds per loose cubic yard.

⁵Compaction rate is 0.5687.

⁶Greenboxes hold eight loose cubic yards of waste.

Table 7. Annual Costs of a Greenbox System.

<u>CAPITAL COSTS</u>	<u>TWO TRUCKS</u>
Greenboxes ¹	\$15,534
Packer truck ¹	63,470
Fencing ²	<u>12,194</u>
TOTAL ANNUAL CAPITAL COSTS	\$91,198
<u>OPERATING COSTS</u>	
Fuel ³	\$6,702
Maintenance ⁴	18,394
Labor ⁵	24,960
Fringe benefits ⁶	3,744
Administration ⁷	77,488
Tipping fees ⁸	135,258
Maintenance on boxes ⁹	<u>699</u>
TOTAL ANNUAL OPERATING COSTS	\$197,245
TOTAL ANNUAL COST	<u>\$288,443</u>
Cost per user per month	\$1.52
Cost per household per month	\$5.28
Cost per cubic yard	\$9.60
Cost per ton	\$25.59

¹5 years at 10%.

²10 years at 10%.

³53,612 annual miles, 8 mph, \$1.00 per gallon.

⁴53,612 annual miles at 0.3431 per mile.

⁵Two drivers at \$6.00/hour, 40 hours per week.

⁶15% of labor.

⁷30% of labor.

⁸30,057 compact cubic yards (estimated actual annual amount hauled) at \$4.50 per cubic yard or 11,272 tons at \$12 per ton.

⁹131 boxes, 1/3 painted each year, 2 gallons required per box, \$8.00 per gallon.

at ten percent APR yields an annual cost of \$12,194. In all, the total annual capital costs are \$91,198.

Operating costs include fuel and maintenance for the packer trucks. These costs are estimated to be \$6,702 and \$18,394 a year based on the estimated annual miles traveled assuming the trucks averaged eight miles per gallon and fuel costs \$1.00 per gallon. The packer trucks would be operated by two drivers working forty hours per week at \$6.00 per hour; accordingly, labor cost is \$24,960 a year. Fringe benefits, such as Workmen's Compensation and Social Security, are about fifteen percent of the total annual labor cost or \$3,744 per year. Similarly, an administration cost is calculated as thirty percent of the labor cost or \$7,488 annually.

Based on current local tipping fees, the estimated annual tipping fee bill is \$135,258. Maintenance on the greenboxes is estimated to cost \$699 a year. The total annual operating costs are thus \$197,245.

The total annual cost of collecting solid waste using a greenbox system and transporting waste directly to the nearest landfill is \$288,443 (\$91,198 plus \$197,245) or \$1.52 per user per month (15,809 individuals), \$5.28 per household per month (4,556 households), \$9.60 per compacted cubic yard (\$288,443 divided by 30,057 cubic yards), or \$25.59 per ton (\$288,443 divided by 11,272 tons).

Greenbox System with Transfer Stations

Sequoyah County decision makers are considering placing two transfer stations within the county (Figure 4). Although transfer stations can improve the efficiency of collection and are often used as a base for waste separation and compaction, they have significant capital and operating costs that must be considered. If transfer stations are used, total collection costs decrease by \$12,462, since the trucks travel less miles (26,988 versus 53,612) and have lower labor costs. The total annual cost for collecting waste using a transfer station is \$275,981, not including the costs of the stations.

Collection costs are lower (\$257,981 versus \$288,443) but the capital and operating expenses of the transfer stations must be considered. A transfer station system in Sequoyah County includes land (five acres per site), site development (fencing, draining, grading, surfacing, and

structures), a truck, and eighty cubic yard trailers for hauling the waste from the stations to the landfill.

Total annual capital and operating costs are presented in Table 8. The total annual capital costs are \$128,512, and operating costs are \$218,816, for a total annual cost of \$347,328. This amounts to \$6.35 per household per month.

Greenboxes, Convenience Centers and Transfer Stations

For this alternative, two standard convenience centers, two transfer stations, and 14 greenbox locations are assumed. Exact locations are specified in Figure 5. The total annual cost of this system is shown in Table 9. The annual capital cost is \$125,377, and the annual operating cost is \$255,319. The total annual cost is \$380,696 or \$6.96 per household per month.

Summary

The purpose of this presentation was to provide an overview of rural collection and transfer alternatives. Alternative systems such as greenbox systems, convenience centers, transfer stations, and door-to-door services were discussed. Three different types of convenience centers were also discussed. In addition, an application of the alternatives for Sequoyah County, Oklahoma was presented. There are many possible collection and transfer alternatives that can apply in most situations. Each area is unique--what works for one county many not work for another. It is critical that comprehensive cost analyses be completed for all alternatives that local decision makers are considering. The pros and cons of each system must be clearly understood before a system can be successfully implemented.

Figure 5. Sequoyah County Solid Waste Management System.

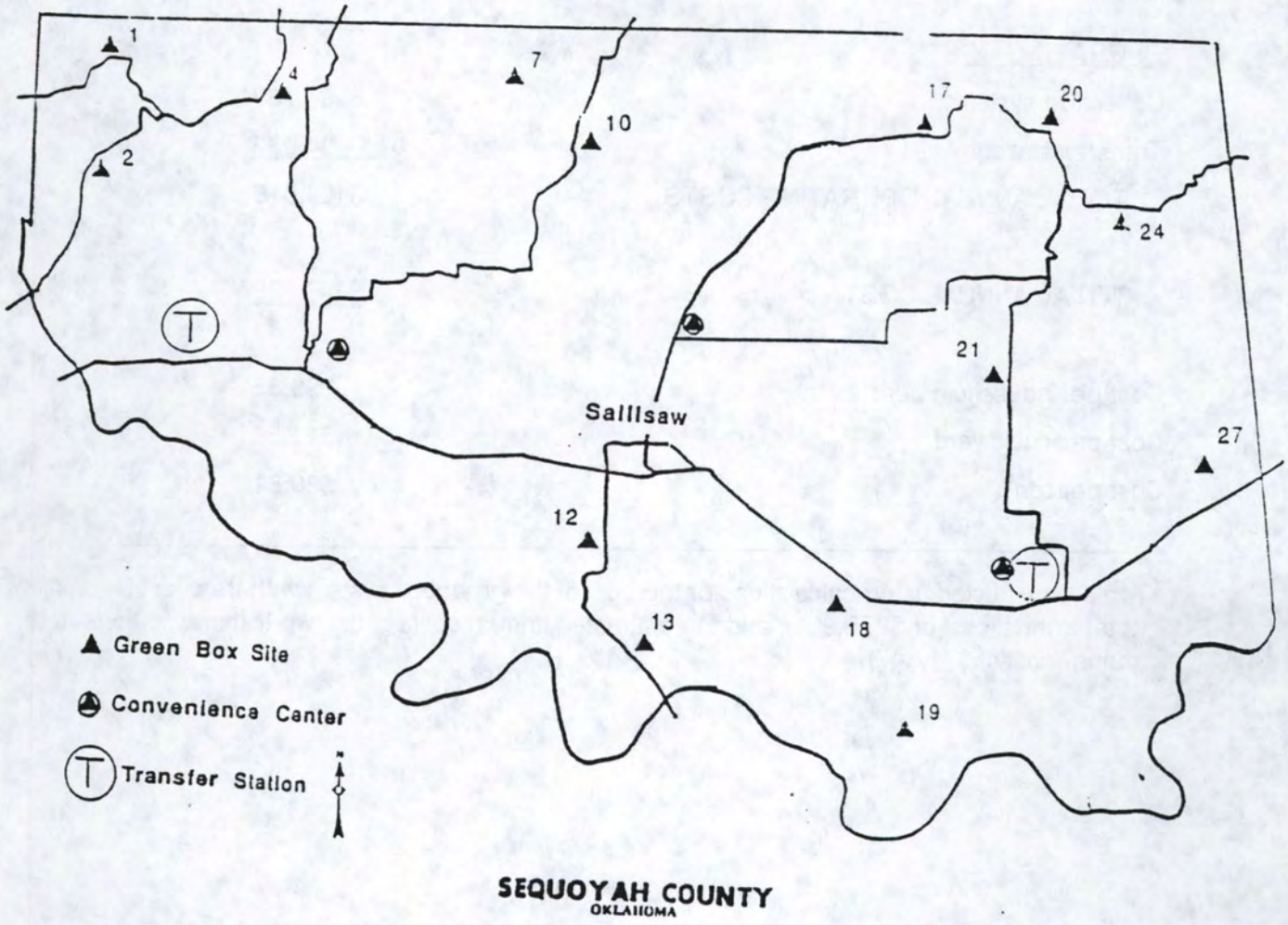


Table 8. Total Annual Cost of a Greenbox System Utilizing Transfer Stations¹.

CAPITAL COSTS

Collection system	\$91,198
Transfer stations	<u>37,314</u>
TOTAL ANNUAL CAPITAL COSTS	\$128,512

OPERATING COSTS

Collection system	\$184,783
Transfer stations	<u>34,033</u>
TOTAL ANNUAL OPERATING COSTS	\$128,816

TOTAL ANNUAL COST	<u>\$347,328</u>
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Cost per household per month	\$6.35
Cost per cubic yard	\$11.56
Cost per ton	\$30.81

¹Table constructed using calculations of the cost of the greenbox system with transfer stations (total annual cost of \$275,981), and the estimated annual costs of the two transfer stations (total annual cost of \$71,347).

Table 9. Total Annual Cost of a Greenbox Standard Convenience Center System and Transfer Station.

<u>CAPITAL COSTS</u>	
Collection system	\$88,063
Transfer station	<u>37,314</u>
TOTAL ANNUAL CAPITAL COSTS	\$125,377
 <u>OPERATING COSTS</u>	
Collection system	\$221,285
Transfer station	<u>34,033</u>
TOTAL ANNUAL OPERATING COSTS	\$255,319
TOTAL ANNUAL COST	<u>\$380,696</u>
Cost per user per month	\$2.01
Cost per household per month	\$6.96
Cost per cubic yard	\$12.67
Cost per ton	\$33.77

¹Table constructed using calculations of the costs of two standard greenbox convenience centers using transfer stations (total annual cost of \$309,348), and the estimated annual costs of the two transfer stations (total annual cost of \$71,347).

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