LOWER RIO GRANDE VALLEY REGIONAL PLAN FOR SOLID WASTE DISPOSAL UTILIZING RAIL HAUL

A solid waste management open-file report (SW-5tg)

U.S. ENVIRONMENTAL PROTECTION AGENCY

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FOREWORD

This Nation is facing the ever-growing problem of how best to manage its solid wastes. Not only are present practices of solid waste storage, collection, processing, and disposal becoming inadequate, but the United States also faces a shortage of trained professional workers in the field who are equipped to deal with the problem.

To help alleviate this shortage, the U.S. Environmental Protection Agency, under authority of the Solid Waste Disposal Act (Public Law 89-272), administers a program of grants-in-aid which supports graduate-level training programs at 13 universities for approximately 65 masters' degree candidates each year. These students receive specific training in the many aspects of modern-day solid waste technology and management. Some of these training programs are located at large urban universities and center their instruction on solid wastes in the urban environment, while other programs are at schools in agricultural regions and may place their emphasis on food-processing and farm waste problems. To date, over 100 engineers have been trained at the graduate level in universities receiving support from the Federal solid waste management training grant program.

One phase of the graduate students' training is to conduct a research project dealing with a specific aspect of solid waste management. This document reports on the results of one such research project and provides information which should be useful to others concerned with better solid waste management practices.

ACKNOWLEDGMENT

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ABSTRACT

Solid wastes collection and disposal is one of the major urban problems facing the public officials of the United States today. An accurate appraisal of the solid wastes production in the community is an important but often overlooked factor. A thorough evaluation of the alternative methods of solid wastes collection and disposal must be completed, and the local factors which influence the disposal system must be considered.

The objective of this study was to develop a regional approach to solid wastes management for the Lower Rio Grande Valley (Cameron and Hidalgo Counties) in the State of Texas. The measurement of the solid waste production was the first step. The solid waste production was determined by weighing the municipal refuse and brush collected by trucks in several communities in the Valley. The average net load by each size of truck was determined. The weekly average number of loads for each community was obtained from municipal records and Department of Public Works personnel. This approach gave an average 4.8 pounds of municipally collected refuse per capita per day. The total solid waste production estimate of 8.0 pounds per capita per day was based on the municipal sanitary landfill operations and the estimated industrial and feed processing waste disposal by private organizations.

A secondary objective was the investigation of the feasibility of utilizing the existing railroad system as an integral part of the regional refuse disposal operation. The present refuse transport and disposal practices in the Lower Rio Grande Valley were studied for quality and cost of operation. The average truck operates far below rated net load capacity, thus the transportation cost per ton to the sanitary landfills is very high. The central location of the railroad system and the availability of sanitary landfill sites adjacent to the system make refuse rail-haul applicable to the Valley region. Economic factors indicate that rail-haul may be the best method for removing refuse from the nation's urban centers.

Solid waste disposal in the Valley was excessively costly and often of poor quality. In most cases, the sanitary landfill equipment was undersized for the task of compacting and covering. The lack of standby equipment and the frequent breakdowns caused periodic excessive build-up of uncovered refuse. The high cost of rental equipment during these emergencies increased the overall cost of operation. The unusually large volumes of brush, demolition wastes, food processing wastes, and dead animals caused many problems for the small community sanitary landfills. A large-scale operation, such as a regional solid waste management approach, could solve many of the solid waste problems in the Lower Rio Grande Valley.

CONCLUSIONS AND RECOMMENDATIONS

1. The data collected during this investigation indicated that for the cities studied, the average solid waste production is 8 pounds per capita per day. Yard trimmings and brush constitute 50 percent of the volume, and refuse production is 4. 8 pounds per capita per day.

2. Records on solid waste production and disposal are at best only fair and are not always comparable from town to town. More extensive weighing of the solid wastes collected by private and commercial haulers as well as by city crews is required in order to plan a sound solid waste management program.

3. The development of a regional solid waste management agency (SWMA) for the two-county area would give better reliable service to the people. The SWMA would give better protection to the communities' health and minimize the cost of operation by economy of scale and long-term planning. A large central disposal facility would improve the economy for reclamation and salvage of material from the refuse.

4. Rail-haul as an integral part of the regional refuse collection and disposal system appears feasible. The location of the rail system in the centers of the population, the availability of existing rail siding for transfer stations, and the availability of landfill sites

adjacent to and paralleling the railroad rights-of-way are factors which make the railroad a feasible transportation system for the Lower Rio Grande Valley regional solid waste management agency.

5. Sanitary landfill is the most economical disposal method for the Lower Rio Grande Valley. However, the high elevation of the ground water table increases the possibility of ground water pollution in this irrigated farm land area, so these operations should be moved to the perimeter of the Valley with the use of the rail-haul system.

6. Long-term plans should be developed with emphasis toward salvage and recycle of material. The extensive agriculture development of the Lower Rio Grande Valley indicates a possible market for compost which is a potential method of recycling our refuse.

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I. INTRODUCTION

In recent years there has been a public awakening to the magnitude of the growing problem of solid waste disposal in communities throughout the United States. The development and operation of a refuse collection and disposal system is one of the major financial obligations of a community or area. This public investment must be preceded by a thorough investigation of the local solid waste production, evaluation of the alternative methods of disposal and collection, and the unusual local factors which might influence or dictate the system of collection and disposal. The rising standards of living are causing an ever-increasing quantity of refuse produced per person. The trend toward urbanization and industrialization has magnified the problem through concentrating the population.

The primary objective of this study was to investigate the various facets of a regional program of solid waste production and disposal within the Lower Rio Grande Valley in the State of Texas. A secondary objective was to investigate the feasibility of using the existing railroad system as an integral part of the regional refuse disposal system. Alternate methods of disposal are also discussed to a lesser extent.

The Lower Rio Grande Valley includes Cameron, Hidalgo, Willacy, and sometimes Starr Counties. Cameron and Hidalgo

Counties were selected to form the solid waste management region because of several common factors; namely, high population growth rate, similarity of refuse disposal problems, and existing railroad system. Investigation of the solid waste problems of all four counties were included in the field study, but a regional plan was developed for Hidalgo and Cameron. These two counties had a 1960 population of 332, 000 (10). The area is primarily agriculturally supported with 749, 271 acres ofirrigated farm land. The dollar value of crops sold by the farmers in these two counties in 1969 was $81.2 million (10).

All the communities in the Lower Rio Grande Valley with a population greater than 5, 000 were visited to obtain refuse production data and present disposal methods. The quantities of solid wastes generated were obtained from the records of the various municipal agencies, and actual weights were taken in Pharr, McAllen, Edinburg, Harlingen, Brownsville, and Mission, Texas. The mayors, city managers, and Department of Public Works personnel of the communities in Cameron and Hidalgo Counties were contacted to get their opinions of a regional refuse disposal organization for their area. Visits to the local Missouri Pacific Railroad Office in Harlingen and field investigations of the rail network in the Valley were conducted to analyze the feasibility and accessibility of the rail system for solid waste transport.

The Valley area was selected for this study because of the high brush production and the extreme pressure on the public officials to find a solution to the present refuse disposal problem. The two-county area is presently spending $1.3 million on refuse collection and disposal (30). The enactment of the Texas Air Pollution Law (Clear Air Act of Texas, 1967), which prohibits open dump burning, has caused a temporary crisis for the communities in the Lower Rio Grande Valley. Brush, trees, and yard trimmings, plus some over-sized furniture and appliances, account for approximately one-half the volume of the municipally collected refuse in the Valley. Until July 1, 1969, the major part of this material was burned along with varying percentages of the garbage. Landfill areas that were predicted to last another five to ten years will be filled in half that time as a result of the increased volume that must be buried. The layout of the rail system was such that over 90 percent of the solid wastes is produced within five miles of the tracks. Therefore, the rail-haul system was selected as the primary method of investigation for hauling the refuse to a disposal site. The relative high cost of land in the Valley and the availability of cheaper land which includes salt flats to the east and arid land to the north, within 50 to 100 miles, support the selection of a disposal system with rail-haul transportation.

II. SOLID WASTE MANAGEMENT

A review of published information on solid waste production and disposal was necessary prior to investigating the local solid waste conditions in order to establish study guidelines and bases of comparison with other areas. Therefore, the evaluation included (1) regional approaches to solid waste disposal; (2) trends in solid waste production; (3) present methods of solid waste disposal; (4) refuse rail-haul systems; and (5) transfer stations.

The approach taken in this study was the development of the type of information that the communities in the Lower Rio Grande Valley would need to form a regional solid waste management organization. Such evaluations are usually required by any community or region in planning and executing a solid waste management program.

Regional Approach to Solid Waste Management

There is a trend in the United States today toward regional planning and development. This trend is partially due to the influence of the federal programs that give preference to regional plans over individual community plans. However, the major causes for this regional planning trend has been the recognition by public officials that the surrounding area has a profound effect on the town and that the municipality affects the immediate environments. The economies and comprehensive nature of large-scale operations are obvious to urban planners. The union of several towns into a single unit to solve a common problem has been widely practiced in recent years and appears to be the pattern for the foreseeable future.

The advantage to both large and small communities of having access to specialized personnel and equipment made possible by a large operation should not be underestimated. Towns of a population of less than 20,000 normally cannot economically operate the size and specialized equipment required for an adequate sanitary landfill.

In the past, rural families and the commercial and industrial establishments outside of the jurisdiction of the city were not included in the refuse collection and disposal plans of the community. The realization by the municipal public officials that the surrounding rural area has a great deal of effect on the environment of the city has caused the change in approach. Any inadequate disposal methods in the outlying rural area may completely void the sanitation and public health projects conducted by the city. The recognition by public officials of the interplay of solid waste disposal methods on the urban and rural environment has caused many cities and counties to form regional agencies to solve their common refuse problems. These regional agencies have been able to serve the people better for less cost.

A recent study of the Des Moines, Iowa, Metropolitan Area for the development of regional refuse collection and disposal plan showed that a regional agency could collect the refuse from both urban and rural population with greater reliability and at less cost to all taxpayers (1). Added advantages such as better sanitary disposal operations, more flexibility to handle emergency situations, and more reliability are made possible by a regional solid waste agency.

There are many other successful solid waste disposal regional programs such as Butler County, Ohio; Flint, Michigan; and St. Joseph, Michigan (2, 3, 4, 5, 6). These regional programs have shown the way for regional comprehensive solid waste disposal plans. Another program, the "Centre Regional Sanitary Landfill" program of State College, Pennsylvania, with six communities cooperatively running a landfill is applicable to the Lower Rio Grande Valley solid waste problems (7).

One of the normally forgotten but important benefits made possible by a regional approach to solid waste management is future reuse. The technology to reclaim and reuse some of our waste products is rapidly developing. The economics of refuse reuse is tied very closely to the size or volume of material handled. Presently, the separation of tin cans from refuse for sale to industrial and manufacturing organizations is only economical for populations larger than approximately 200,000. The economics of this ferrous metal reclaiming operation improves rapidly with increasing volume. The regional approach gives the disposal operation a better chance of taking advantage of these reclaiming operations resulting from the large volume as compared to the production of the individual towns and cities. An interpretation of the 1965 Solid Waste Act by Mr. Richard D. Vaughan was stated as the development of technology for refuse recycle, reuse, and management to protect our nation's health, natural resources, and environment (2).

Even when the present technology does not permit the salvage of valuable material from the refuse, the regional management approach can operate a resource storage facility, sanitary landfill, for future reclamation. The ultimate need for the recycle of our natural resource is obvious to the writer because this method guarantees a supply of these resources for future generations and the protection of our environment.

Trends in Solid Waste Production

The United States is expected to double its population within the next thirty years. This estimate is based on an expected annual growth rate of 1.75 percent per year. Therefore, an area whose growth can be expected to approximate the national average will have an estimated solid waste production increase of almost 10 percent within five years even without considering per capita increases of even greater magnitude. A recent National Academy of Science report states that the United States daily per capita production of routinely collected refuse grew from 2.75 pounds in 1920 to 4.5 pounds in 1965 (8). Recently the per capita solid waste production has been increased at the rate of 4 percent per year. An investigation of refuse production in seven major cities in Texas during 1965-66 indicated total refuse collected by municipal and private collectors at the rate of 5.0 pounds per capita per day (9). The national trend of urbanization shows an annual increase in the percentage of our population in the metropolitan areas. This trend has however slowed somewhat in recent years. The concentration of the population in our urban areas complicates and magnifies the solid waste problems.

The population of the study area has more than doubled between 1940 and 1960. The Valley area continues to show great population increases in the urban areas, but little if any increase in population is reported in the rural sections (10). This rapid growth continues as indicated by the 1968-1969 predictions indicated in Figure 1. The two-county study area including Cameron and Hidalgo Counties is one of the fastest growing areas in Texas. The estimated future refuse production for the Valley is shown by Figure 2. This graph indicates the magnitude of the solid waste problem facing the population of the Lower Rio Grande Valley.

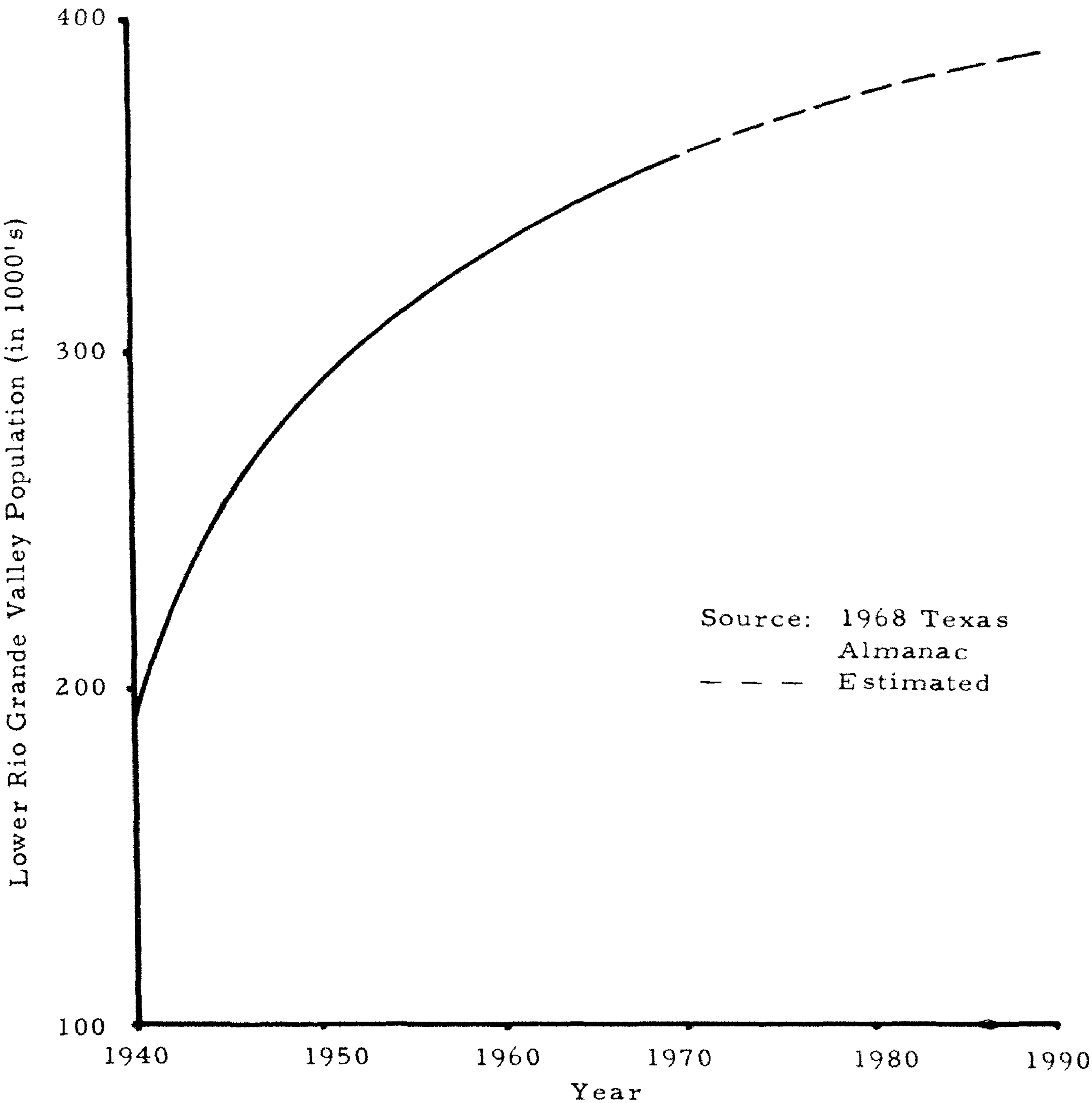


Figure 1. Population Growth in Study Area

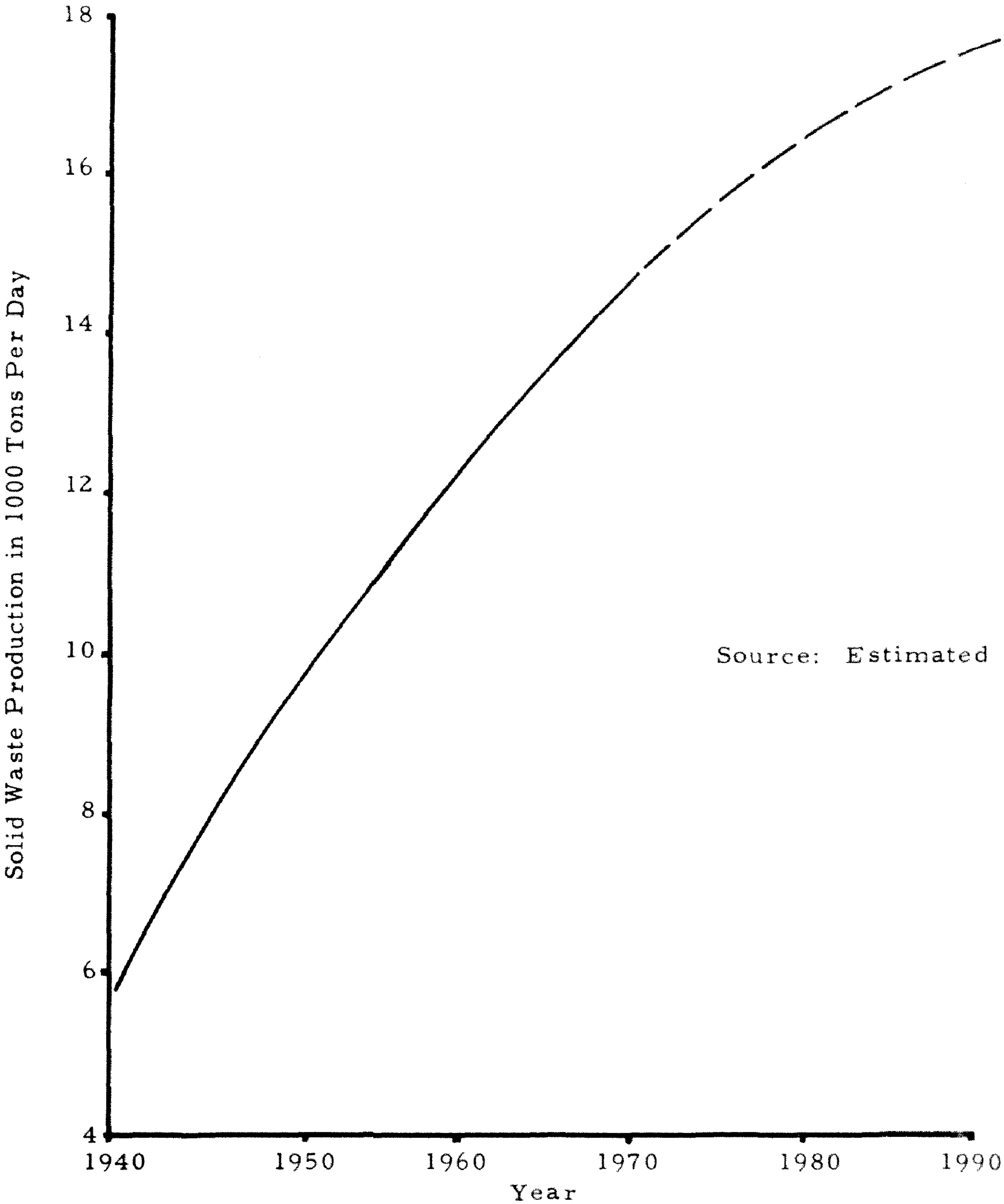


Figure 2. Lower Rio Grande Valley Total Solid Waste Production Per Day

Present Methods of Solid Waste Disposal

The excellently prepared report by M. L. Smith summarizes the present methods of solid waste disposal (9). Therefore, only a short review of solid waste disposal methods will be included in this report.

Sanitary landfill is recommended as the most economical method of solid waste disposal for the State of Texas according to a 1969 report by L. P. Gazda (11). A well-operated sanitary landfill provides at least six inches of compacted cover at the close of each day's operation and a minimum of two feet of compacted cover over the fill after it is completed (35). The relatively low cost of land and the availability of this land near the population centers of the Valley for the next few years confirms this recommendation. As the population increases in the Valley, the cost of land will increase and the distances to available landfill sites will be greater, resulting in a higher cost for the landfill disposal system. However, the landfill operation seems the most economical for the Valley for the foreseeable future.

Composting has some promise for agriculturally oriented areas but only as one part of the solid waste management operation. The compostable fraction of municipal refuse seems to be decreasing in the United States (12). The operation of a compost plant at a large landfill site where only the best compostable material is used has some potential. One of the major factors limiting present composting operations is the limited market for the product (13). The Lower Rio Grande Valley has 749,271 acres of land in irrigated agriculture production (10). These conditions are favorable for the development of a local market for the compost. The large production of organic waste from local food processing, vegetable farms, and citrus groves are additional factors that could make composting feasible for this region.

The development of a compost market in the Valley could greatly reduce the overall cost of the composting operation. As the cost of land increases and the haul distance to landfill sites increases, the compost operation will become more competitive. The combination of composting, landfill, and salvage has great promise as a part of the solution to the solid waste problem of the Valley. The present costs of operation of compost plants average $3.38 per ton. This is still above those of a sanitary landfill for this area (14, 15, 16, 17).

Incineration seems to be too expensive, both in capital investment and operational cost, as compared to sanitary landfill. The recent enforcement of the Texas Air Pollution Control Law (18) has increased the cost of incineration even further through the increased air pollution control equipment. Present cost estimates for incineration range from $3.50 to more than $5.00 per ton (19).

The recovery of heat and power from refuse has good possibility, but U. S. utility companies have been very reluctant to invest in this area. The difficulties of refuse incineration operation, the increased capital investment to handle refuse, and the variable heat value (BTU) per pound of refuse are only some of the problems facing the utility companies in using refuse. The existence of oil and gas reservoirs in the Valley makes refuse as a fuel even less competitive.

The use of an above-ground sanitary landfill to develop hills in an otherwise flat terrain is an interesting possibility in this area. A plan submitted to Norfolk, Virginia, proposes building a hill out of refuse to form a 35-acre park on a flat area near Virginia Beach (20). Surrounding the refuse hill are burrow pits resulting from the removal of soil to cover the refuse; these holes are filled with water to become a recreation lake. The hill was developed as a tourist lookout. Parking, trails for hiking, slopes for soap box derby coasting, and improvement of the general scenic beauty of the area are also included. The added effect of a wind breaker for a Valley town may have some value in protection from the frequent hurricanes of the Valley. The addition of a recreational area and scenic landmark would definitely be an advantage to this flat land.

Refuse Rail-Haul

In recent years a great deal of interest has been developing around the use of railroad transport of refuse from the high population centers to suitable disposal sites. The railroad has a low ton-mile haul rate for bulk and containerized freight. The average rate of rail-haul during 1965 was $0.0118 per ton-mile. The existence of the rail system in nearly all metropolitan areas makes this type of transportation readily accessible.

A rail-haul landfill disposal system proposed by the Rio Grande Railroad to the City of Denver, Colorado, and the recently operating Reading Railroad and Philadelphia, Pennsylvania Refuse Rail-Haul and land reclamation projects are proving the feasibility of this approach (21, 22, 23). One of the disadvantages of this system is the one-direction haul. The freight rate must be high enough to cover the cost of returning the empty cars.

The rail-haul cost estimates vary over a wide range from under $2.00 to over $4.00 per ton for a round trip of less than 200 miles, including cost of the transfer stations. However, landfill operations in conjunction with rail-haul may be operated as low as $.50 per ton. It appears that a sanitary landfill can be operated cheaper in conjunction with the rail-haul system. The U. S. Public Health Service and American Public Works Association are presently investigating this combination.

The rail-haul system has the potential of collecting the refuse from a large geographical area for central processing, salvage, and

and disposal. The area economically covered by the rail-haul system serving the Valley could be as great as 200 miles in radius (120,000 square miles) or larger as illustrated in Figure 3. The potential dollar value of salvageable material produced in an area of this size makes a thorough investigation fully justified. The American Public Works Association and Public Health Service demonstration and research programs that are presently going on should help determine the feasibility of this type of operation (24).

The rail-haul transportation system has many good features. Work stoppage and strikes have not seriously affected the daily operation of the railroad. Weather conditions have little effect on railroad transportation. Railroad bulk ton-mile freight rates are usually very low. The flexibility of the rail-haul system to handle large shock loads is a definite advantage in an area like the Valley with periodic storms and freezes that generate large volumes of solid wastes. The railroads are developing cars specifically designed to carry refuse. It was reported that these cars can be delivered in less than a year from order date (25); therefore, a refuse rail-haul system could be put into operation quickly. Municipal or public ownership of equipment and hardware should reduce these reported rail-haul costs through tax advantages. The non-profit operation by a public agency will give another reduction in the cost of rail-haul operation as compared to the

Missouri Pacific and Southern Pacific Railroad Lines
Servicing Lower Rio Grande Valley
State of Texas

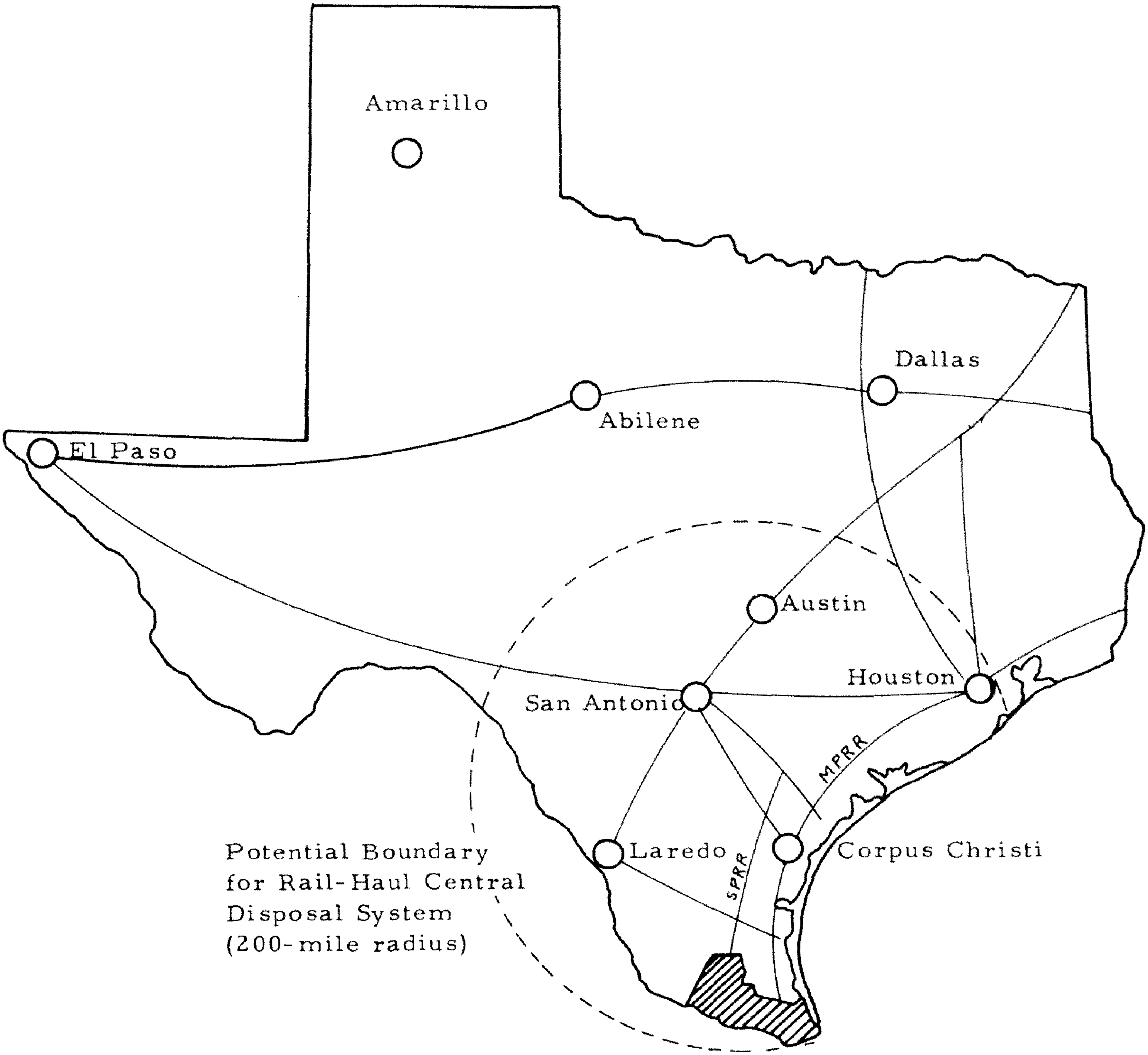


Figure 3. Location of Study Area

cost proposed by some of the railroad companies. However, the tax savings are not true savings because the area does lose the tax revenue the railroad companies would have paid.

A regional solid waste collection and disposal agency with rail-haul as an integral part of the system definitely seems economically feasible for the Lower Rio Grande Valley and particularly for the two-county study area.

Transfer Stations

A regional refuse disposal plan to serve the Valley area will eventually involve one or more transfer stations. The reported cost of operating a transfer station has varied considerably from less than $1.00 per ton to over $4.00 per ton. Some processing such as baling, size reduction, containerizing, separation, and salvage has been included in most of the stations which report higher operating costs. The cost of baling or size reduction appears to be between $0.80 and $1.50 per ton (26). Adequate data on the cost of the separating or the containerization of refuse at the transfer station is not available.

Lancaster, Pennsylvania, and six nearby townships are operating a transfer station to transport refuse 17 miles to a sanitary landfill (27). The construction and operation was started with an advancement of $31,000 from each township instead of a bond issue. This amount was repaid in a few years as the regional transfer and disposal agency became self-supporting since a monthly service charge was levied on each family served. This system is a good example of how a regional refuse collection and disposal plan can go into operation with little difficulty or time-consuming delays. A transfer station will be a definite part of any rail-haul system or any disposal system with transportation distance from point of refuse generation to disposal site of more than ten to fifteen miles (28). The size of the collection trucks will help determine when the cost of the haul warrants a transfer to a larger unit.

Orange County, California, uses the direct dump collection truck to truck transport transfer station (29). The collection trucks dump directly into a trailer. Compaction to get the maximum legal highway load is obtained with a modified back hoe, with clamshell. The hydraulic equipment exerts 8,000 pounds of down pressure on the pile. One transfer station in Orange County services 200,000 people and handles on the average of 94 trucks per day and 457 tons of refuse per day. As many as 170 loads and as much as 830 tons of refuse have been dumped at the transfer station in a single day. Total average cost of transfer, transportation, and sanitary landfill operation was $1.02 for three transfer stations and five landfills. This type of transfer station could be readily adapted to rail haul transportation system.

getting to the landfill. The maintenance of the collection trucks and the loss of time due to breakdowns are reduced. Orange County estimates that the elimination of the three transfer stations would increase the cost of the system about $5.00 per ton. The collection costs are estimated at $1.20 per month per family, and this cost would increase to $3.00 per month without transfer stations. The use of the simple hydraulic compaction equipment at the Orange County transfer stations to economically increase the density of the refuse is a good approach. This boom type equipment could be readily adopted to the railroad car transfer station at a lower operating cost than those reported or estimated for the shredding or baling processes.

The simplicity of, as well as the minimum amount of, equipment and manpower needed at the direct dump transfer stations makes it most economical to operate. The capacity of the open transport unit to handle all kinds of wastes is a big advantage over the shredding and baling operations. The economics of a transfer station with haul distance that will be involved in the Valley refuse disposal system make this operation applicable to this area.

III. DESCRIPTION OF STUDY AREA

The Lower Rio Grande Valley includes Cameron, Hidalgo, and Willacy Counties and is an area of rich alluvial soil with intensive irrigation. Starr County is sometimes included as part of the Lower Rio Grande Valley. Parameters such as economic growth, population growth, agriculture, and topography would indicate that Cameron and Hidalgo Counties have the most in common. The number of acres irrigated and the annual crop value according to the Texas Almanac (10) indicate that Cameron and Hidalgo Counties are chiefly agriculturally oriented. Cameron and Hidalgo Counties were selected to form the study area because of several common factors; namely, high population growth rate, similar refuse disposal problems, and existing railroad system. Although sections of Starr and Willacy Counties are very similar to Cameron and Hidalgo, a more effective solid waste disposal system could be developed for Cameron and Hidalgo Counties and then later expanded to include that portion of Starr and Willacy Counties that could be economically included in the system.

The population is distributed in a linear pattern along the highway and railroad system from Brownsville to Mission. Over 90 percent of the population is located within five miles of the new four-lane highway which parallels the railroad tracks. The population has been continually supplied with the flow of Mexican laborers into the area.

The high unemployment rate of 8.2 percent is partially attributed to the influx of the unskilled labor. The seasonal nature of the agriculture work also contributes to some of the high unemployment.

There is a great deal of competition among the towns in the Valley as evidenced by local high school sports, parades, political issues, and community projects of neighborhood appearance and flower planting. This healthy community rivalry, although useful as an incentive to be better than their neighbors, makes regional cooperative projects more difficult.

The study area is very flat with less than a 200-foot drop in the 80 miles across the two counties to the Gulf. The flat terrain causes severe runoff problems during the infrequent heavy rains caused by hurricanes and storms. The ground water table nearly parallels the slope of the land and fluctuates from a depth of ten to fourteen feet to within a few feet of the ground surface. Excavation in the area must be preceded by a good understanding of the soil type and ground water elevation. The annual average rainfall is 24 inches with a mean annual temperature of 74 degrees F. There is an occasional freeze in January or early February. The latest heavy damaging freezes occurred in 1951 and 1961; these freezes destroyed over 75 percent of the citrus trees in the Valley. The growing season is approximately 320 to 340 days out of the year or essentially year around.

The area is primarily agriculturally supported with a large number of food processing plants. Citrus and vegetable farms grow the following crops: oranges, grapefruit, broccoli, carrots, cabbage, onions, tomatoes, corn, cantaloupes, etc. Cotton and grain are also grown in this area.

The solid waste production of the area is extremely hard to quantify. The larger towns keep records of the municipally collected refuse by number of truck loads. The refuse collected by the municipalities includes residential with some commercial and is estimated at 4.8 pounds per capita per day. These data from both field survey and Texas State Health Department Solid Waste Survey are presented in Table 1. Brush accounts for 50 percent by weight of the total municipally collected refuse. The amount of solid waste produced by the food processing plants and other industrial operations was not available, but several food processing plants estimated 10 to 20 percent of the waste based on amount shipped was discarded. A certain amount of culling was reportedly done in the field, and culls and waste at that point are not considered in the solid waste production data. It is estimated that less than 35 percent of the basic industries and markets in the Valley that produce solid wastes are serviced by the municipalities. A total solid waste production of approximately 8 pounds per capita is generated in the Valley when these industrial and market solid wastes are added to the 4.8 pounds per capita

TABLE 1

REFUSE PRODUCTION BY SÈLECTED COMMUNITIES IN THE LOWER RIO GRANDE VALLEY

Community	Population*	Data From Field Study & Refuse Production Tons/Capita/Year	State Health Dept. Total Solid Waste Production Tons/Capita/Year
Alamo	4, 700	0. 405	1. 06
Brownsville	53, 600	0. 830	1. 01
Donna	7, 600	-	1. 58
Edinburg	20, 100	0. 548	1. 14
Harlingen	41, 400	0. 510	1. 35
McAllen	35, 000	0. 827	1. 13
Mercedes	12, 300	0. 470	1. 78
Mission	14, 800	0. 808	1. 11
Pharr	15, 300	0. 642	2. 22
San Benito	17, 000	0. 837	1. 47
San Juan	5, 000	-	1. 30
Weslaco	16, 500	0. 721	1. 37

*Population 1968-69 Texas Almanac.

already being collected. The high production rate and accumulation of solid wastes in the rural areas have complicated the problem in the Valley. However, the interest of the municipal officials, the existence of a Valley solid waste study committee, and the recent publicity at both the national and local levels have caused the present time to become the most appropriate time to attack the solid waste problem.

IV. PRESENT SOLID WASTE DISPOSAL PRACTICES

The towns in the Valley have worked independently for many years solving their individual solid waste problems. Most of the cities had established a fairly adequate disposal system or more properly stated a political balance between the demands of the citizenry in the way of services and the cost which the public was willing to pay. The resulting disposal systems at times were modified to meet the State Health Department requirements. Most of the public officials and sanitation personnel understood the need for better disposal methods, but at that time it was the best they could do under the financial and political atmosphere of the area.

The enactment of the Air Pollution Control Law prohibiting open burning at refuse dumps upset the established solid waste disposal methods; namely, burning the brush and combustibles and landfilling the household garbage. The volume of brush in nearly all cases equaled the volume of garbage; therefore, landfill operations will double after July 1, 1969. Most of the towns have neither the equipment nor the land for this increased sanitary landfill operation. The Air Pollution Law was not unexpected, and most of the towns had known about it for several years, but the lack of good solid waste data and lack of public interest caused a delay in planning for the change-over from the open dump type operation with burning to complete sanitary landfill.

Present Disposal Methods

All of the towns in the Valley dispose of their refuse on the land. Most of the towns are developing sanitary landfill methods although the quality of some lacks much that is desirable of a good sanitary landfill. This point is illustrated in Figure 4.

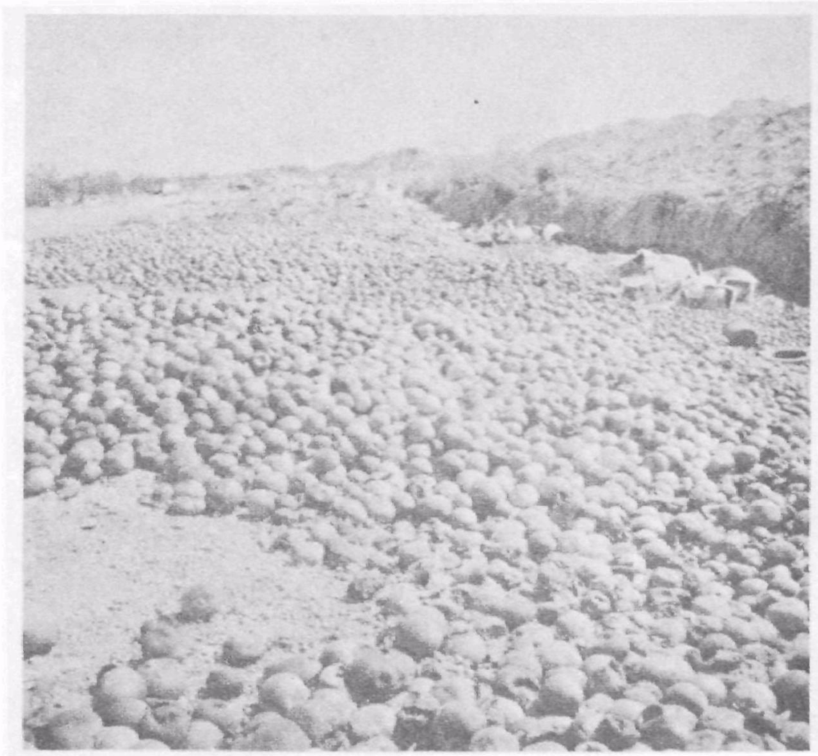
One big problem that all of the communities will have to face is the potential ground water pollution and further action by the Water Quality Board similar to the Air Pollution enforcement. The shallow ground water table and the seasonal fluctuation of the ground water elevation to within a couple of feet of the surface are conditions that will require good engineering design and operation to eliminate ground water pollution by the leachate of a sanitary landfill.

The periodic intensive rain storms in the Valley at times cause severe flooding; therefore, landfill site location and operation must take this into account. The present methods of leaving large holes and open pits partially filled with refuse for long periods of time must be discontinued. The open pit dumping of large volumes of citrus fruit culls and vegetable waste from the food processing plants must be handled in a way other than that presented in Figure 5a. The high temperature of the area, rains, and exposure of ground water cause a rodent, insect, and vermin breeding environment that has great potential of endangering the health of the communities.

Open Dump Burning

Blowing Paper and Plastic

Figure 4. Present Sanitary Landfill Problems



(a) Food Processing Waste--Oranges

(b) Demolition Waste

Figure 5. Complex Solid Waste Disposal Problem

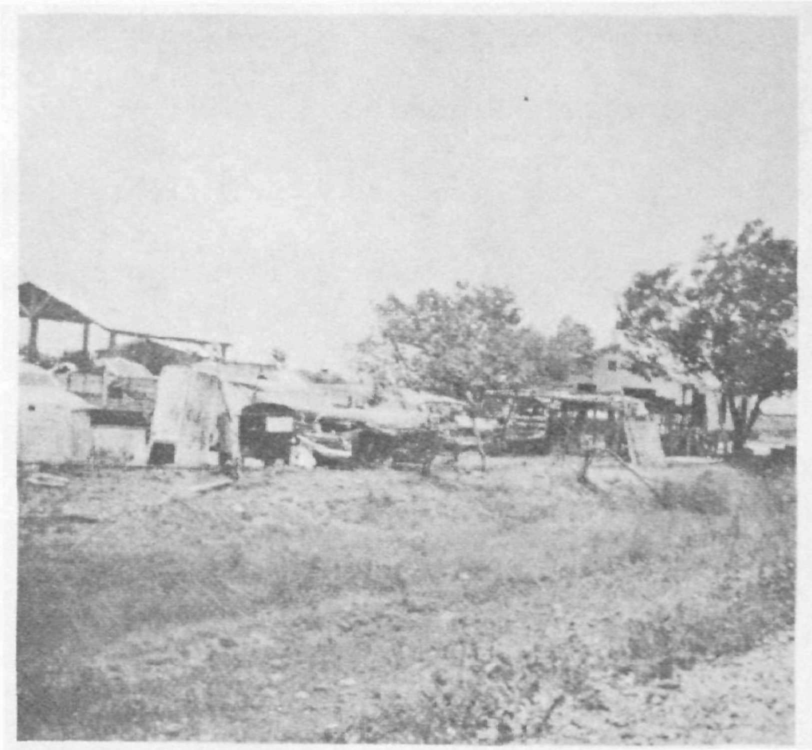
Approximately half of the municipalities make pit space available for the waste from the food processing plants within their community. Several of the towns charged the companies a small fee, but most were allowed free dumping. Very little attention or effort was given to the disposal of these food wastes because this operation did not pay for itself. Demolition waste (see Figure 5b), highway department roadway waste, industrial waste, and some wastes from individual rural residents are allowed to dump at the municipally operated landfills. Table 2 is a two-week survey of landfill users at the Edinburg sanitary landfill. The landfill operator does not usually have control of the private haulers, and attempts by the operator to keep a narrow working face are wasted. Strict rules or high user charges caused some of the private haulers to dump along the roads in the rural areas or outside of the sanitary landfill fence. One official felt that the ban on open burning would greatly increase the litter problem along the roadways and vacant lots.

The rural areas show a significant buildup of solid waste in and around the residences, equipment storage areas, and fence rows (Figure 6). This condition will continue to be a potential trouble spot for the communities and individual rural dwellers until an effective area-wide plan is in operation. None of the communities have developed a refuse collection and disposal program on area bases, although a Valley committee has been investigating these problems.

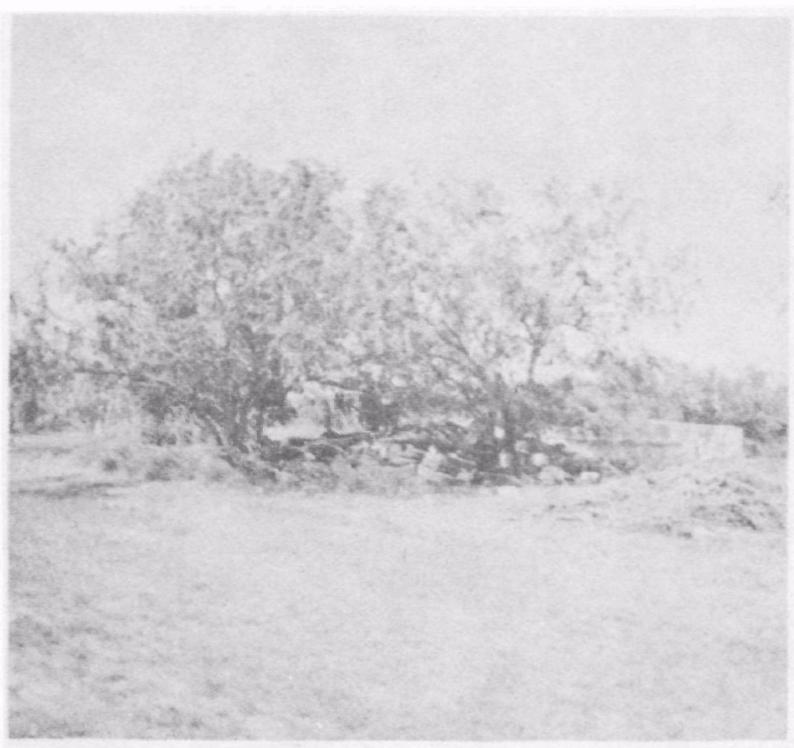
TABLE 2

TWO-WEEK RECORD OF VISITS TO CITY OF EDINBURG SANITARY LANDFILL

	Number of Loads Brought to Landfill											
Classification of User	3/10/69	11	12	13	14	15	17	18	19	20	21	22
City of Edinburg Refuse Compactor Trucks	7	10	10	10	8	5	9	9	10	10	8	6
City of Edinburg 2-Ton Brush Trucks	7	7	9	8	8	6	8	8	9	8	7	5
Public Agencies, Schools, County & State Highway Dept., etc.	7	11	18	7	5	8	10	6	11	14	6	5
Others--Commercial, Industrial, Food Processing, and Individuals	17	14	35	74	78	30	25	39	23	18	32	17
Total Visits for Date	38	42	72	99	99	49	52	62	53	50	53	33
Day of Week	Mon	Tue	Wed	Thur	Fri	Sat	Mon	Tue	Wed	Thur	Fri	Sat



Junk and Abandoned Cars Around Farm House



Discarded Truck and Tractor Tires

Figure 6. Rural Solid Waste Accumulation

Equipment

The operation of a sanitary landfill for the towns with populations less than 20,000 seems to be inherently inefficient. Normal equipment breakdowns cause excessively long interruptions in the collection and disposal operations.

In nearly all cases a single bulldozer and operator was responsible for the sanitary landfill. A few of the communities were in the process of purchasing a new bulldozer. No specialized compaction and refuse landfill equipment are in the plans of the individual communities because the equipment could not operate efficiently on such a small scale. The present undersized bulldozers are not doing an adequate job on compacting the refuse, back filling, and dressing up the finished area. A study conducted at Harlingen showed that a steel-tracked bulldozer improved compaction 23 percent over the rubber-tired payloader the city presently owns.

Land

Most of the towns are in the process of acquiring land for future use as sanitary landfill sites. Public opposition is rather strong against a landfill near any residences. This attitude is probably due to the long history of open dump burning practiced by the cities. Another public opinion factor is that most sanitary landfills once established continued at that site for ten to twenty years. Only a couple of the towns have enough available land at the present time to properly dispose of all their waste for more than five years. Some of the towns have the space, but because of the opposition of adjacent property owners future problems are predicted for the elected officials. Most of the operational cost estimates for the landfills did not include the value of the land. Most of the accounting procedures did not show the taxes lost because of municipal ownership of the land nor the cost of replacing the landfill area as it is used up. Very few plans are finalized regarding the use of the completed landfill areas.

Accurate mapping of the location of the sanitary landfill sites is almost completely lacking; therefore, future land development in and around these areas could be hampered. The lack of good maps may even decrease the sale price of the land because developers are uncertain of the compacted refuse depth and location.

Cost and Charges

The cost of operating the present refuse collection and disposal systems is passed on to the local citizens in several different ways. A few years ago one town eliminated the direct charge on individual dwellings for refuse collection and increased the property tax to cover these costs. However, most of the towns levy a fixed monthly charge on each dwelling or business to cover the major cost of collection; in all cases the income from the service rates was not sufficient to cover the total cost of collection and disposal. The solid waste survey conducted by the Texas State Department of Health estimated that the Lower Rio Grande Valley communities spend more than $1.28 million on refuse collection and disposal. This estimated cost of operation was for 343,000 tons and served a population of 254,600 (30). The average cost of collection and disposal based on these estimated values was $5.00 per capita per year or $1.67 per month for a family of four. The rates most common are $1.00 and $1.50 per month per family for twice a week collection and once or twice a month brush collection. Only a few of the towns have a good estimate of the actual cost of the administration, billing, equipment amortization, land replacement, labor, private property damage, special crew cost during storm cleanups, vehicle operators, insurance, personnel retirement, personnel training, and other expenses associated with refuse collection and disposal in sanitary landfills. Very limited information is available to the supervisors regarding the cost of operation of comparative methods and equipment, thus well-supported decisions are hard to make because of this lack of information. The cost of obtaining refuse production information and developing the costs for alternate collection methods have not been included in most city budgets.

V. EXISTING TRANSPORTATION SYSTEM

Highways

The Valley has good transportation facilities throughout the area. The network of roads are laid out in a grid pattern as shown in Figure 7. The present construction of a four-lane controlled access highway from Brownsville to Rio Grande City, which is also shown in Figure 7, will greatly improve the transportation facilities for both passenger cars and trucks. The new four-lane highway, which is nearly complete as of August, 1969, passes through or adjacent to the city limits of all the major towns in the study area. This system is readily accessible to trucks from any of the towns. This new highway will be an important factor to consider in selecting a refuse transport system. The shipment of a large portion of the citrus and vegetable crops by truck transport means that trucking equipment, supplies, personnel, and service facilities are available in the area.

Railroads

The second transportation system, by volume of traffic, is the railroad. During the last thirty-five years the number of miles of rail in operation has been decreasing in Texas. This decrease is particularly true for the Valley area, as illustrated by the amount of abandoned tracks shown in Figure 8. Many miles of track have

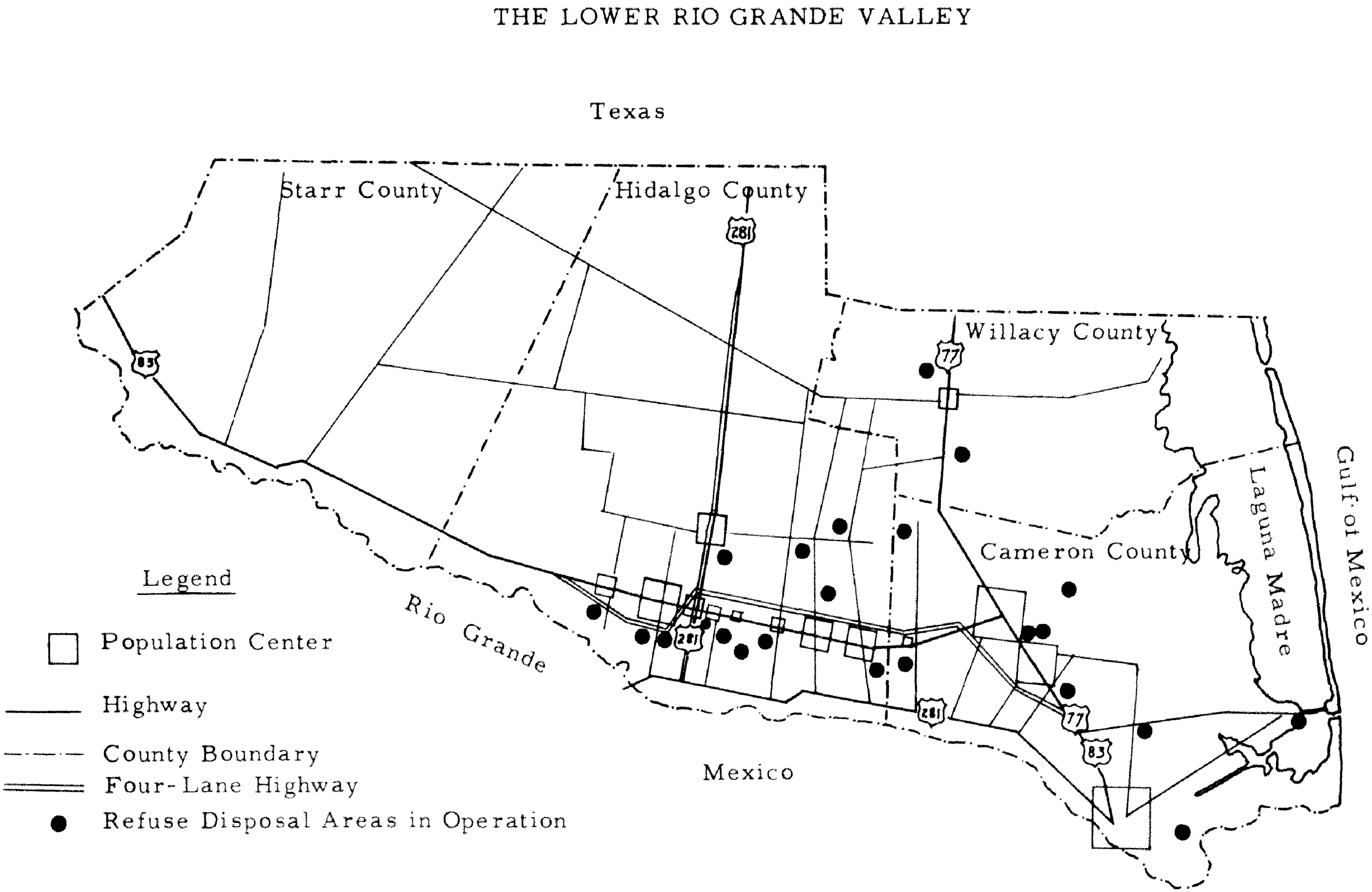


Figure 7. Study Area Highway System and Location of Present Refuse Disposal Sites

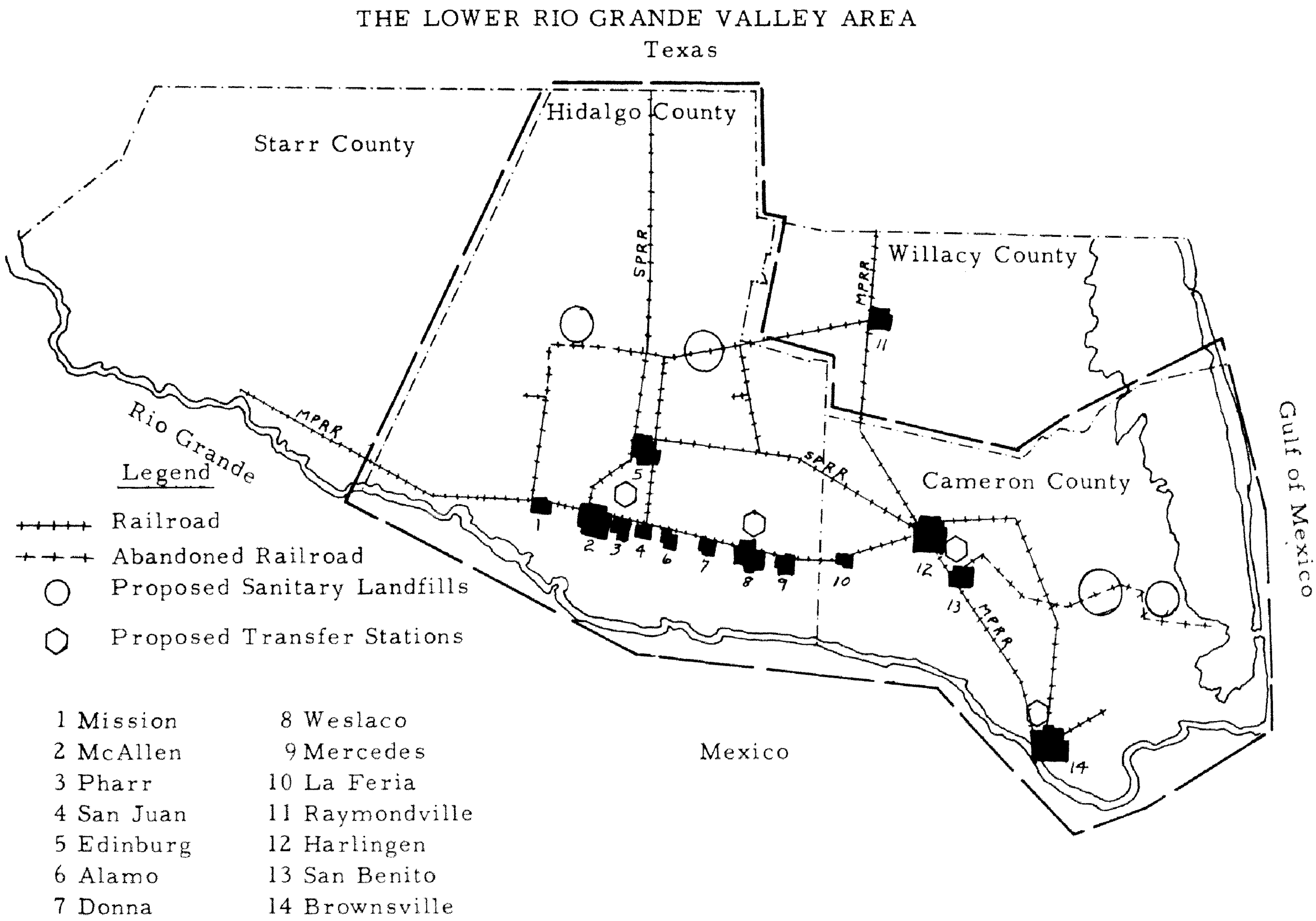


Figure 8. Location of Rail-Haul Transfer Stations and Sanitary Landfills

been abandoned in the last few years. It is assumed that the demand for the rail services for particular areas has not been sufficient to cover the cost of operation. Future plans of the railroad companies should be investigated before this means of transportation is actually incorporated into a refuse disposal system.

The location of the rails through the center of each town makes this system very accessible. Unused sidings, switching, and storage areas are available along the system in nearly every town. Miles and miles of the abandoned tracks are open and could be returned to use. Several stretches of the abandoned tracks are located in unproductive salt flats, which include some of the lowest priced land in the Valley. The economy of using the abandoned rail system for strip sanitary landfill operation has great potential and a relatively low cost operation. Although a sizeable volume of freight is shipped from this area by rail, the system is operating far below capacity. Therefore, a regional rail-haul system should be in a good position to bargain for good haul rates as well as an improvement in the efficiency of the railroad operation. The average rail-haul rate in Texas in 1965 was $0.0118 per ton-mile for all freight. The increased use of the railroad would help influence the railroads to maintain good rail service to the area and thus give the communities another benefit through increased appeal to industrial location.

The present switching times are too slow for effective movement of cars hauling refuse, primarily because of the bottleneck at the Harlingen railroad scales. This problem could be overcome by a billing system which is based on something other than weight or other adjustments with minimum effort or cost. The switch engines usually start at Rio Grande City and Brownsville and collect the loaded cars along the way and make up the train in Harlingen at night. The cars that are loaded by 5 p. m. are picked up that very night. This existing service is the same type that would be required by a refuse system, and if the delays at Harlingen could be overcome, this railroad system could be very reliable.

The location of the railroad in the center of the municipal refuse production areas and connecting all the major refuse-generating areas makes the railroad a good potential competitor for the Valley refuse transport business. The Missouri Pacific and Southern Pacific Railroads serve the area.

The recent development of specialized refuse rail-haul cars by Reading, Penn-Central, and Rio Grande Railroads makes it possible to put a rail-haul system into operation in a short period of time. A delivery time of approximately one year is estimated. The special refuse cars are estimated to cost between $25, 000 and $35, 000. The capital investment expense for the refuse rail cars would be around $1, 000 per year per car.

Other Types of Transportation

The accessibility to a waterways transportation system is limited to the Brownsville-Harlingen area. The use of a barge-haul refuse system would involve at least two transfer stations for the Edinburg, McAllen, and Mission area. Refuse from Hidalgo County would require transfer to either rail or truck transports for transportation to intercoastal canal systems in Brownsville. At the Brownsville dock a second transfer station would be needed to fill the barges. The double transfer stations would significantly raise the total cost of operation. In addition to the complex transfer operations, there is growing opposition to dumping any waste in or near the Gulf of Mexico.

The Valley area has a good network of gas and oil pipelines. The feasibility of pipeline transport of refuse has not been proven. Several studies are underway because the economy of pipeline transportation gives this method great promise if the problems can be solved (31).

VI. PROPOSED SOLID WASTE MANAGEMENT PLAN

Area To Be Served

The Lower Rio Grande Valley has long been recognized as an economically identifiable section of the State of Texas. The large irrigated citrus groves and vegetable farms has also established the boundaries of this region. The low productivity of the semiarid mesquite covered land to the north, the salt flats to the northwest and northeast, Gulf coast to the east, and the Rio Grande to the south and west have certainly helped establish the boundaries of the Lower Rio Grande Valley. It is suggested that the counties of Hidalgo and Cameron form a region solid waste management agency. Although Starr and Willacy Counties are frequently considered as a part of the Lower Rio Grande Valley, the population growth of recent years has been in Hidalgo and Cameron. The major agriculture production of citrus and vegetables has its greatest area importance in these two counties. The similarity of topography and land use puts Hidalgo and Cameron Counties in a class by themselves. The rapid growth of the solid waste problem is worst in Cameron and Hidalgo Counties because of increased population, urbanization, and refuse production increases.

Organization

To attack the Lower Rio Grande Valley solid waste problem, an area-wide organization is recommended. The proposed organization would have the responsibility and authority to organize and operate a two-county regional solid waste collection and disposal system. The name of Solid Waste Management Agency (SWMA) will be used to describe this organization during the rest of this report. The SWMA will be a nonprofit organization controlled by a committee appointed by the locally elected officials. The size of the committee should be held to less than ten or twelve members to be an effective working committee. The committee members should have overlapping terms of four or five years so that long-range programs will have continuance and uniformity even with changing committee members.

The committee position will be a non-salary appointment, and only the expenses incurred during the course of performing the duties of the position will be reimbursed by the SWMA.

The committee should hire the permanent management staff, and in turn the staff can develop a personnel system, plans of operation, and budgets for committee approval. Annual operational and financial reports will be submitted by the staff through the committee to the communities served.

Each community should sign a contract with the SWMA for not less than five years, with a guarantee that the contracts are renewable.

Contracts will be automatically renewed unless the agency has received a written report to terminate the contract before the end of the fourth contract year. The rural families could be covered by a county government contract with the agency to provide access to a disposal site and possibly individual collection if economy permits.

The service charge will be in two parts. All people will pay a fixed fee for the operation of a disposal system. The other part of the service charge would be for collection and should be based on type and cost of service.

The SWMA could operate as a publicly operated and owned utility; it would be a tax free local government organization. County regulations must be passed to prohibit waste disposal at any sites other than the approved SWMA sanitary landfill sites.

Type of Service

The Solid Waste Management Agency would be responsible for collection, transport, and disposal of all solid waste generated in the two-county area. This service would include residential, commercial, manufacturing, industrial, off-farm agriculture, and governmental sources. If collection does not seem feasible in some of the rural areas, the sanitary landfill or transfer stations must be open to these people.

The present collection methods and operations vary greatly among communities in cost and services provided. Families with similar services are often paying different rates depending on the community in which they live. It is proposed that all individual collection operations be done by the SWMA, thus uniform collection practices and uniform service charges can be established. All the present collection equipment will be turned over to the new agency, a private firm will evaluate the equipment, and the contributing city or county will receive credit.

Uniform collection procedure and schedules will be developed by the agency; these will include twice a week collection for residential and six times per week for some commercial. The schedule of services and type of equipment for the best service at an acceptable cost will be developed by the SWMA. The service rates will be as nearly as possible to the cost of that particular operation and schedule. No solid waste producer will be required to pay more than his fair share. One of the big responsibilities of the committee will be the review of the rates versus the services of each type of waste producer.

The collection of special wastes such as abandoned vehicles, fallen trees, bulky furniture, appliances, and large items that cannot be picked up by the regular collection truck will be handled by the trash and brush crews. The schedule of these crews will be flexible. They will depend more on the demand or buildup of this type of waste than on a fixed time schedule like the residential and commercial garbage collection crews.

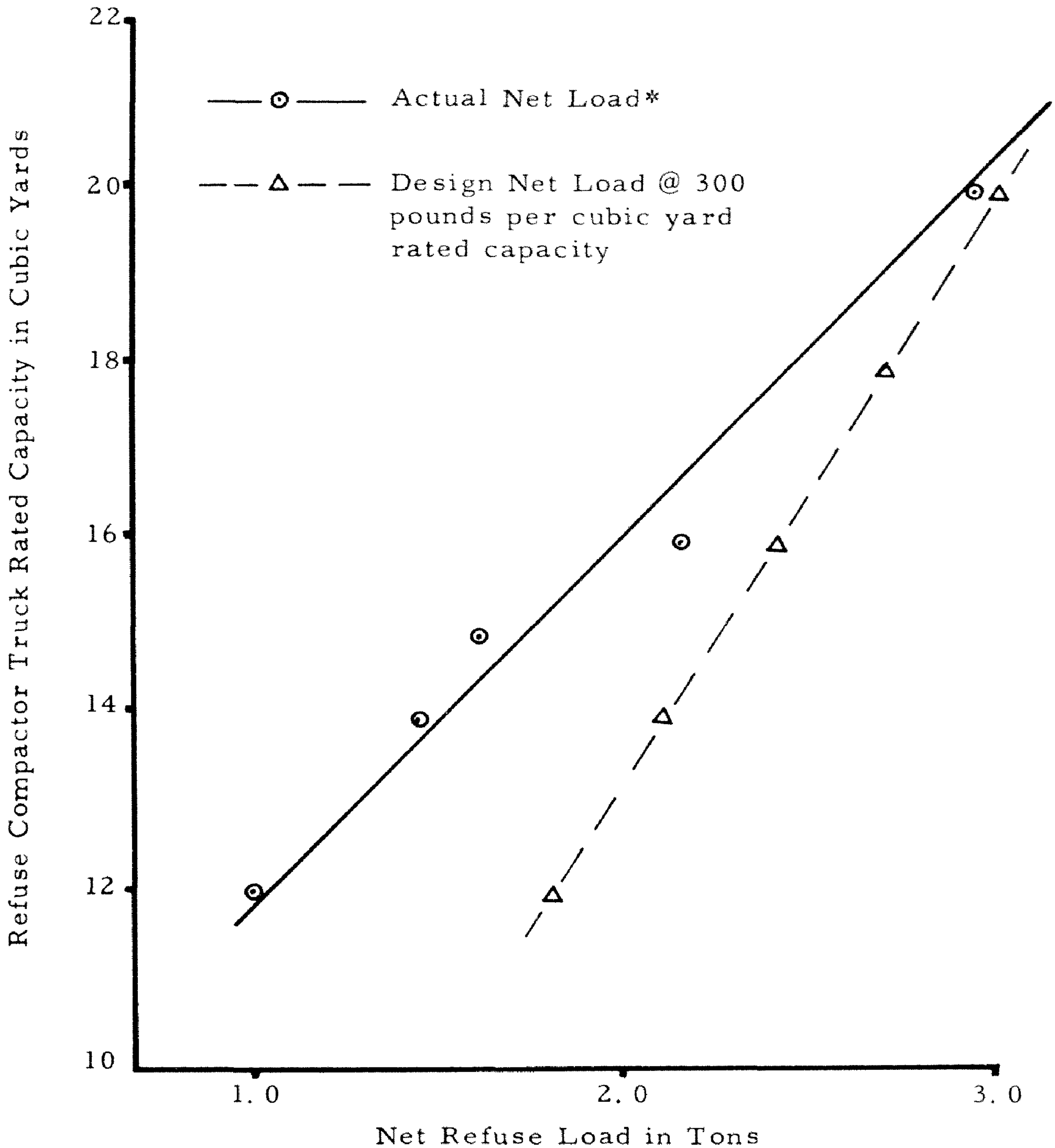
If feasible, the collection schedule of the rural residences will be set according to cost of collection, refuse production, and local conditions. It is recommended that once a week collection but not less than twice a month service be provided as a minimum.

The big emphasis of the collection operations will be the uniformity of services and equality in service charges. The SWMA will also try to develop uniform garbage container standards, improved storage and collection procedures to reduce the cost to the citizens.

The vehicles that are presently used will be operated by the agency. These collection vehicles will be replaced or the fleet increased as the work load dictates. The area-wide assignment of vehicles will enable the agency to assign each type of vehicle to a task to get maximum utilization of the vehicles. The larger operation will permit a lower percent investment in standby equipment and still have better reliability of coverage for emergencies and normal breakdowns.

The collection trucks should be routed for two loads per day with two- or three-man crews. The present three and four loads per day per truck means that too much time is spent in hauling the refuse and too little in the collection operation (32). This can be corrected by selecting the routes and truck size to make two loads per eight-hour working shift. Figure 9 presents loading efficiency data of the present collection compactor trucks.

Lower Rio Grande Valley, Texas
June-July, 1969



*Note: Each point represents the average of 10 loads.

Figure 9. Refuse Compactor Trucks Loading Efficiency

The practice of alternating driver and pick-up man during the eight-hour shift has shown to improve worker efficiency as well as improving working conditions. The purchase of air-conditioned cabs, automatic transmission, diesel engines, and right-hand walk-in cabs have all been shown to be cheaper per ton of collected refuse due to increased worker production. These types of specialized equipment investments will be possible for the regional solid waste organization, whereas the individual communities could never afford such expensive capital investments even though the operating cost per ton may be lower.

The standardizing of collection equipment will give more uniform service to all the people in the Lower Rio Grande Valley. The schedule will be more dependable. The collection cost will be reduced through reduced overhead costs. Specialized equipment can be more efficiently assigned to the particular tasks. Routes can be selected on a larger scale, and the restrictions that cause small expensive routes in certain areas of the individual cities can be eliminated.

Collection and disposal of dead animals could also be provided. Dead animal collection vehicles and containers could be operated to transport the dead animals to a central animal incinerator operated at the sanitary landfill or some central location. The need for this special service should be investigated during the first few years of the SWMA operation.

Transportation

The movement of the refuse from the collection point or area to the disposal area has become an increasingly expensive part of the refuse disposal system. The collection trucks used in the Valley at the present time haul the refuse to the disposal site. Haul distance of less than ten miles and truck capacities of sixteen and twenty cubic yards have made this method practical until recently. The nearby landfill sites are rapidly becoming filled, developed, or use restricted due to local land use. The increasing haul distances make the collection less efficient. When transportation time or mileage exceeds twenty minutes or five miles, respectively, a specialized transport vehicle becomes economically advantageous (33). Truck transports have become about the only type of vehicle used for this operation to date. However, the railroad seems to be the long-term answer for many metropolitan areas. Tractor and trailer transfer units are presently hauling refuse the five to twenty mile one-way trips to landfill sites. For this short range the railroad will have trouble competing. However, when the distance to the nearest landfill exceeds approximately twenty miles, the railroad will become very competitive, according to the estimated rail-haul rates in Figure 10.

The use of the present sixteen and twenty cubic yard capacity compactor collection trucks to transport the refuse to the disposal site reduces the efficiency of this specialized collection equipment. The

Estimated from gravel and sand rates, with reduction based on the Solid Waste Management Agency owning the rail cars. This should be about the best possible rail-haul rate.

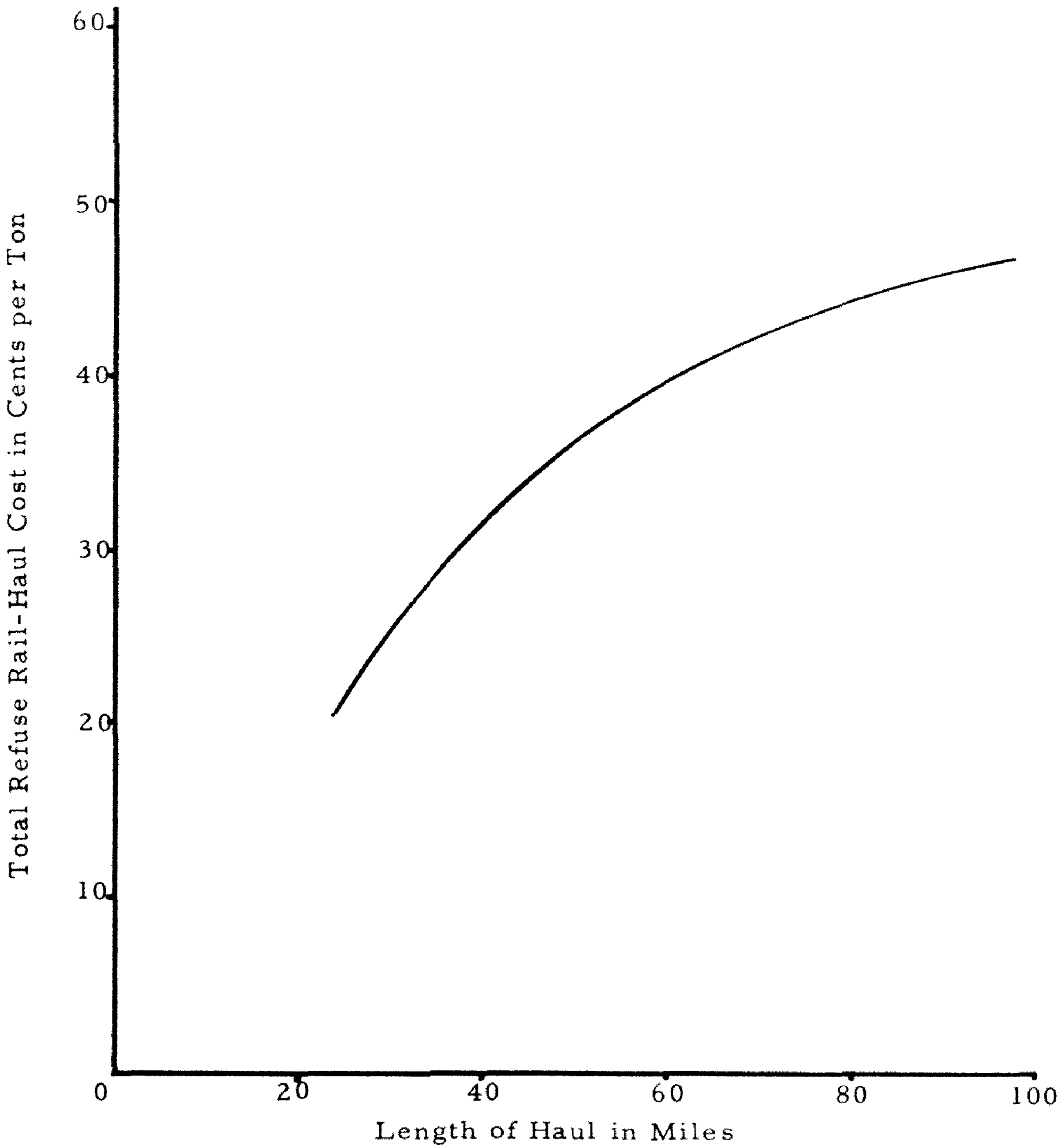


Figure 10. Estimated Refuse Rail-Haul Cost

Valley collection trucks are hauling an average net load far below their rated capacity as illustrated in Figure 9. This reduced pay load increases the cost of collection and transport per ton of refuse. However, the use of 25 and 30 cubic yard capacity compactor trucks, if used effectively, would increase the range of economic hauls. Many of the communities in the Valley have used all the nearby sanitary landfill sites. Now these communities are looking for new locations out in the county. The use of a transfer station and special transport units are in the near future for the Valley. When the distance between the collection area and disposal site becomes too great for transporting by the collection vehicle, a transfer station is required. A transfer station would be required for the transfer from collection vehicle to truck, railroad, barge, or pipeline transportation means. The details of the proposed transfer station will be developed and described later in this report.

Rail-haul appears feasible when the one-way distance from center of refuse production to disposal site exceeds approximately twenty miles. Because of the economy of scale, a single large sanitary landfill is proposed for the Valley as the final solution. The transportation system will be made up of the following:

(a) a series of direct dump transfer stations with hydraulic rams for compaction;

(b) covered railroad cars of 80-ton and 400- to 450-cubic yard capacity, capable of being loaded from the top at transfer station and discharging the load along the side of the track at the sanitary landfill;

(c) rail cars which will be spray-cleaned as they leave the landfill site and return to the transfer station;

(d) rail-haul equipment owned by the SWMA who pays the railroad company only to move the cars

Disposal Methods

The disposal of 1000 tons of refuse per day that is produced by the 390,000 population of the Lower Rio Grande Valley will be no small task; however, many communities in the United States have solved very similar problems. Sanitary landfill is recommended as the refuse disposal method for the Valley. Sanitary landfill has been the most widely used refuse disposal method in the State of Texas. The condition that makes the sanitary landfill method economical is the simplicity of operation. The training and experience required for an adequate sanitary landfill operation are minimum but are definitely important. The equipment is available and relatively inexpensive to operate as compared to the operation of an incinerator or composting plant.

Anti-pollution controls such as fences, earth dikes, small operating face of fill, site selection to prevent ground water pollution, good seal, and finish grade to prevent surface run-off or infiltration from standing water, are usually the precaution in operation of the landfill. These operational procedures and precautions have little expense but require a good understanding of earth work and ground water contamination.

The availability of land at less than $500 per acre with some large tracks of salt flats priced at less than $50 per acre supports this choice. The average value of farm land in the Valley was $300 per acre for Cameron County and $132 per acre for Hidalgo County, according to the Texas Almanac, 1968-69. There is a good chance of no cost leases for large tracks of land. The owner would be paid through the increased value of the land by its increased elevation. Land use leases have become very common and serve the purpose of both parties. The land investor increases the value of his holdings and the city disposes of its refuse. Lease terms of 10, 20, and 50 years are real common, but short leases could be just as effective if these are easier to obtain. Trench and pit sanitary landfill operation may cause some ground water pollution in the flat irrigated regions of the Valley. This problem can be overcome by above ground landfill operations or locating the landfill sites in the higher ground north and west of the Valley. It is recommended that both the salt flats near San Benito and Brownsville and the mesquite covered higher dry land northwest of the Valley be used for landfill operations. The operation of several locations during the early phase of operation is recommended for several reasons. First, to reduce haul distance by locating landfill sites as close to production areas as possible. Second, during the first few years of operation the agency will have to use the numerous small pieces of equipment available from the individual cities during the organization of the regional solid waste disposal agency.

The transition period will be completed in several stages so that as much flexibility as possible can be maintained with little interruption of services to the citizens. The transition phase will be the training period for the operation personnel, the management, and the planning staff. The operation of several locations and types of sanitary landfills will guide the agency in the type of replacement equipment to purchase and the most efficient landfill operations and sites.

Locating and purchasing suitable land, as well as designing and building of transfer stations, will take several years. Thus the local landfills must continue to operate until the transfer stations are completed. The availability of low cost land in the vicinity of most cities eliminates the need for transfer stations at the present. Therefore, time is available for the construction of transfer stations. As local landfill sites are filled and the distance to new sites becomes greater, transfer stations will be required. The planning staff will have adequate time to make the programmed transition from present disposal methods to the smooth collection and disposal operations in the near future.

The cities will be permitted to transfer land and equipment to the agency as part of their capital investment during the start-up period to help the cities that have invested recently in land for sanitary landfill sites. The land must be adequate for a sanitary landfill, and the present fair market value will be credited to the contributing city.

Transfer Station

The transfer station will become an important part of the refuse management system as the urbanization and population increase continue along with the exhausting of local landfill sites. The transfer of the refuse from the collection vehicle to a transport unit reduces the cost of operation by utilizing a low cost haul unit and reduces the collection fleet operating expense.

The operation cost of the transfer station must be kept low or the system will not be practical. Again simplicity is the key to reliability of operation and minimum operating cost. The use of direct dump transfer stations is recommended. The size of the station will be determined by the area served.

The existence of numerous unused sidings throughout the Valley communities should minimize the cost of transfer station sites. The location of a transfer station in the industrial areas of a city will minimize the complaints and the sites are usually the most accessible to the collection trucks.

Transfer stations will have elevated concrete floors from which the collection trucks can dump directly into rail cars. A hydraulic boom will be located at each station. This boom will produce the desired compaction of the refuse in the rail cars by exerting a downward pressure on the piles of refuse; the boom can also be used to load or unload large items such as automobiles and demolition waste. The tipping area is recommended to be covered both for the protection of equipment and air pollution control.

One of the central transfer stations will also include a shop for truck maintenance and repairs. Collection fleet parking could be provided at each transfer station.

The design of all transfer stations will be kept as simple as possible with the idea of maintaining good sanitation practices around and in the transfer stations.

VII. SPECIAL PROBLEMS WITH DEVELOPING PLAN

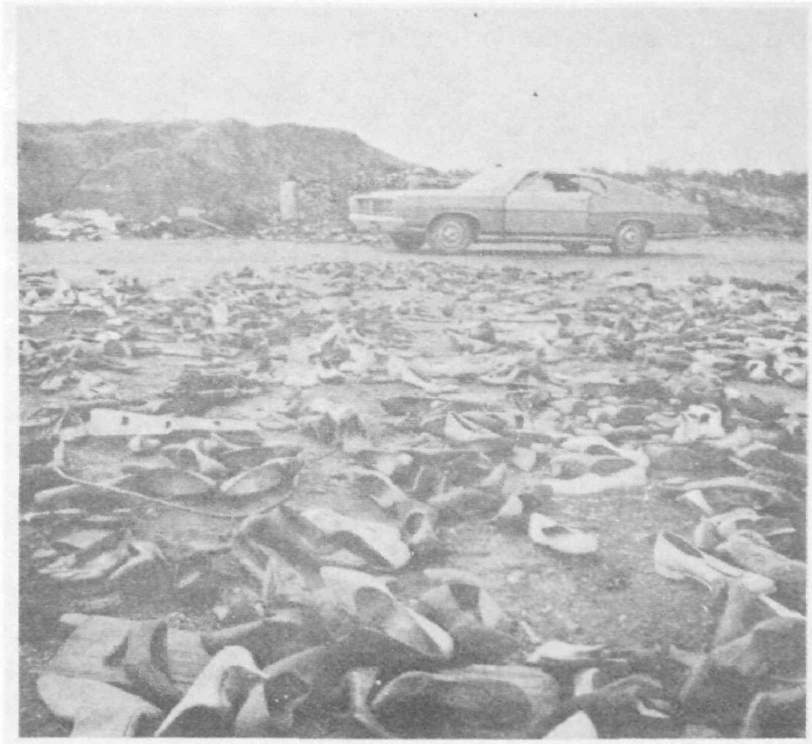
The regional refuse management approach to solving the solid waste problem for Cameron and Hidalgo Counties, although economically feasible, may have serious problems during the organization phase. The competitive spirit among the communities does cause problems when the populace try to get together for a common purpose.

Several years ago, Valley-wide water distribution and sewage collection and disposal systems were recommended. These systems failed to be adopted because some communities felt they could do the job cheaper themselves or they were not willing to pay the price for the quality of service recommended.

The quality of service is the second major factor that may interfere with the development. Some communities are willing to pay for a high quality of refuse handling service while another community would prefer less service at a lower cost. One of the advantages of a regional plan is the equality of service charges versus service received. A public information program covering the cost of each type of service would help overcome this problem. Many of the people do not realize that their small service charge does not cover the total cost of refuse collection and disposal. Once the public understands that they are paying for it just through some other tax plan, a uniform service charge could be developed for all the communities.

Another problem is the quality of the disposal; some of the communities feel that they are saving the tax payer a lot of money by reducing the landfill operation cost. Most of these savings have been in the form of reduced quality of landfill operation as illustrated in Figure 11. The task of refuse collection and disposal is not just the removal of the nuisance but also the protection of public health. The operation that will assure this protection must first be determined. The minimum quality of disposal that is acceptable must be established. Any reduction of this operation will fail to give the public what they assume their elected officials are providing. Operations that give added convenience and service are employed as the customers are willing to pay. The citizens should be informed of the cost of minimum service as well as of the added services that are requested or demanded. Often when the citizens know the cost of the added convenience, they would rather do without the additional service. The public in recent years has overwhelmingly supported projects that protect their health. The ability of a regional organization to give better environmental protection should be one of the major public selling points.

Many of the cities in the Valley are at the limit of bond debt; therefore, a bond issue would be a very difficult method of starting the regional plan. The cities have rather tight budgets although the area is growing rapidly. Allowing the cities to transfer their refuse



Scavengers Cause Landfill Problems

A Valley Landfill Entrance

Figure 11. Existing Sanitary Landfill Conditions

equipment as a part of their capital investment in the regional agency will help solve the initial problem of lack of funds.

The ground water pollution potential of landfill operations in the high water table areas of the Valley will be a serious problem. If the state enforces the water pollution laws, the cost of hauling the refuse out of the area will cause a significant increase in the service charges. If this increase in charges occurs during the early takeover period of the new regional agency, the citizens and officials will be turned against the new organization. This increased cost may be for less than that which each city would have had to pay if it had worked independently, but unfortunately this is often overlooked or misunderstood.

The forming of the districts that will send a committee member to the regional agency will be a difficult problem. All the cities and towns will want to be represented, but a large committee could not work effectively. The regional solid waste management program will affect the whole Valley, thus an organization that has planning and co-ordinating responsibility for the region should take the lead in developing the organization. The local Council of Governments office would be a good organization to establish the district boundaries and develop public support.

The interest and awareness of the public in refuse disposal in the last few years should help the implementation of a regional plan.

The existence of the solid waste committee that has been investigating the scope of the solid waste problem of the Valley and looking for possible solution has provided the opening for the development of a regional solid waste management organization.

BIBLIOGRAPHY

1. Anon., "Collection and Disposal of Solid Waste for the Des Moines Metropolitan Area--An Interim Report," U. S. Department of Health, Education, and Welfare, Environmental Control Administration, Bureau of Solid Waste Management, Cincinnati, Ohio, 1969.

2. Anon., "Bureau Attacks Nation's Solid Waste," Environmental Science and Technology Journal, Vol. 3, No. 8, pp. 705-707, August, 1969.

3. Anon., "Quad-City Solid Wastes Project," U. S. Department of Health, Education, and Welfare, National Center for Urban and Industrial Health, Solid Wastes Program, Cincinnati, Ohio, 1968.

4. Anon., "Solid Waste Disposal Study, Genessee County, Michigan," U. S. Department of Health, Education, and Welfare, National Center for Urban and Industrial Health, Solid Wastes Program, Cincinnati, Ohio, 1968.

5. Korbitz, W. E., "Looking to the Future with a Regional Refuse Disposal Plan," Public Works, pp. 120-121, June, 1967.

6. Fritz, D., "County Sets Practical Goals for Refuse Disposal," Public Works, pp. 68-69, April, 1969.

7. Anon., "Centre Regional Sanitary Landfill," The American City Journal, July, 1968.

8. Gilbertson, W. E., and R. J. Black, "A National Solid Waste Program Is Created," Compost Science Journal, Vol. 6, No. 3, pp. 4-7, Autumn-Winter, 1966.

9. Smith, M. L., and J. F. Malina, Jr., "Solid Waste Production and Disposal in Selected Texas Cities," Technical Report, EHE 08-6801, Environmental Health Engineering Research Laboratory, The University of Texas at Austin, p. 222, August, 1968.

10. Anon., "Texas Almanac and State Industrial Guide," The Dallas Morning News, 1968-69.

11. Gazda, L. P., and J. F. Malina, Jr., "Land Disposal of Municipal Solid Wastes in Selected Standard Metropolitan Statistical Areas in Texas," Technical Report EHE 69-13, Environmental Health Research Laboratory, The University of Texas at Austin, April, 1969.

12. Anon., "Composting: Is It Economically Sound?" Refuse Removal Journal, July, 1966.

13. Wiley, J. S., and O. W. Kochtitsky, "Composting Developments in the United States," Compost Science, Vol. 6, No. 2, pp. 5-9, Summer, 1965.

14. Anon., Municipal Refuse Disposal, American Public Works Association, Chicago, Illinois, 1966.

15. McCollam, J. G., "Refuse Composting in St. Petersburg, Florida," Compost Science, Vol. 7, No. 2, pp. 3-6, Autumn, 1966.

16. Anon., "What Went Wrong at Phoenix," Compost Science, Vol. 5, No. 3, p. 3, Autumn-Winter, 1965.

17. Anon., "Houston Sets Up Research Program for Waters," Compost Science, Vol. 6, No. 1, pp. 9-10, Spring, 1965.

18. Texas State Department of Health, Clean Air Act of Texas, 1967, Approved June 18, 1867.

19. Anon., "Municipal Incineration of Refuse: Foreword and Introduction--Progress Report of the Committee on Municipal Refuse Practices," Proceedings, ASCE Journal of SED, Vol. 90, No. SA3, p. 3942, June, 1964.

20. Anon., "A Hill of Municipal Refuse," Civil Engineering Journal, ASCE, Vol. 36, No. 8, p. 50, June, 1968.

21. Moore, E. J., The Grande Plan for Refuse Disposal for the City and County of Denver, The Denver and Rio Grande Western Railroad Company, Denver, Colorado, September, 1967.

22. Anon., "Philadelphia Will Sign Deal to Dump Trash in Mines," Philadelphia Enquirer, September 21, 1967.

23. Anon., "Refuse Trains: Reading Sees Cash in Trash," Railway Age--The Transportation Weekly, August 14, 1967.

24. Anon., "Rail Transport of Solid Waste," U. S. Department of Health, Education, and Welfare, Consumer Protection and Environmental Health Service, Environmental Control Administration, Bureau of Solid Waste Management, Cincinnati, Ohio, 1969.

25. Information obtained from Railroad Company personnel in Texas, Colorado, and Washington, D. C., August, 1969.

26. Anon., "Refuse Bales at 40-90 Pounds per Cubic Foot," American City, p. 36, July, 1969.

27. Gilbertson, W. E., "Scope of the Solid Waste Problem," Proceedings, ASCE Journal of the Sanitary Engineering Division, Vol. 92, No. SA3, June 1966.

28. Anon., "Transfer Stations Assist Refuse Disposal," Public Works, pp. 74-76, January, 1969.

29. Anon., "Rail-Haul Refuse Disposal," American City, August, 1968.

30. Texas State Department of Health, Solid Waste Division, Solid Waste Survey, 1968-69.

31. "Pipeline Transport and Incineration," Water Works and Wastes Engineering, September, 1965.

32. Anon., "Transportation System," Compost Science, Spring, 1968.

33. Brigman, V. L., "Time and Motion Studies Aid Solid Waste Collection," Public Works, pp. 84-85, February, 1969.

34. Information obtained from City and County Employees in the Lower Rio Grande Valley.

35. Anon., "Refuse Collection and Sanitary Landfill Operational Methods," Texas State Department of Health, 1956.

36. Williamson, R. B., The Lower Rio Grande Valley of Texas, Bureau of Business Research, The University of Texas at Austin, 1966.

37. Heaney, F. L., "Regional Districts for Incineration," Civil Engineering, American Society of Civil Engineers, Vol. 36, No. 8, p. 69, August, 1968.

38. Anon., "Disposal of 21,000 Tons Daily," Refuse Removal Journal, October, 1966.

39. Anon., "A Study of a Metropolitan Solid Waste Program," Public Works, pp. 78-79, March, 1969.

40. Smith, D. I., "Refuse Collection Fleet Updated for Efficiency," Public Works, pp. 67-68, January, 1969.

41. Anderson, J. R., and J. N. Nornbush, "Influence of Sanitary Landfill on Ground Water Quality," Journal, American Water Works Association, Vol. 59, No. 4, April, 1967.

42. Anon., "Rules and Regulations Regulating the Disposal of Refuse, Garbage, Rubbish, or Junk," Texas State Department of Health, May, 1964.

43. Ehlers, V. M., and E. W. Steel, Municipal and Rural Sanitation, McGraw-Hill, New York, 1965.

44. Anon., Refuse Collection Practice, American Public Works Association, Chicago, Illinois, 1966.

45. Anon., "Sanitary Landfill," Manuals of Engineering Practice, American Society of Civil Engineers, No. 39, New York, 1959.

46. "The Solid Waste Disposal Act," Public Law 89-272, S. 306, Washington, D. C., October, 1965.

47. Sort, T. J., and H. L. Hickman, "Sanitary Landfill Facts," SW-4ts, U. S. Department of Health, Education, and Welfare, U. S. Public Health Service, Solid Wastes Program, Cincinnati, Ohio, 1968.

APPENDIX A

NET LOADS OF REFUSE COMPACTOR TRUCKS AND OPEN-BED BRUSH TRUCKS IN LOWER RIO GRANDE VALLEY, 1968-1969

Truck tare weights were measured each day during the sampling period. The public truck scales were used for this study.

I. Harlingen, Texas

The city of Harlingen conducted a two-week Refuse and Brush Study in 1968. Results:

Garbage: 346,570 pounds in 77 truck loads for an average of 4,501 pounds per truck.

Brush: 313,760 pounds in 96 truck loads for an average net load of 3,268 pounds per truck.

The city uses 16- and 20-cubic yard capacity refuse compactor trucks and two-ton open-bed brush trucks.

II. Mission, Texas

	15-Cubic Yard Refuse Trucks Net Load in Pounds
	3,165
	1,840
	4,140
	3,795
Average	3,235

	Two-Ton Brush Trucks Net Load in Pounds
	2,025
	3,085
	2,095
Average	2,401

III. Edinburg, Texas

20-Cubic Yard Refuse Trucks Net Load in Pounds	
5,170	6,050
4,810	4,060
4,400	3,010
4,020	3,650
4,200	1,500
4,240	5,110
4,000	2,400
9,360	5,150
9,520	6,440
8,540	3,820
8,610	8,120
Average 5,281	

	16-Cubic Yard Refuse Trucks Net Load in Pounds
	3,510
	4,570
	3,730
Average	3,937

Two-Ton Brush Trucks

Net Load in Pounds	
3,100	4,670
4,200	4,200
6,100	3,770
2,620	3,860
3,290	4,980
Average	4,089

IV. McAllen, Texas

Net Load in Pounds

	20-Cubic Yard Refuse Trucks		16-Cubic Yard Refuse Trucks
	4,767		4,820
	3,884		4,894
	8,870		3,730
	6,815		3,510
	6,921		4,570
	6,868		
Average	6,354	Average	4,305

15-Cubic Yard Refuse Truck	14-Cubic Yard Refuse Truck
3,235	2,910

Two-Ton Brush Trucks

3,490	2,720	3,520
1,050	2,540	4,140
2,520	2,160	2,220
3,720	2,330	2,820
2,840	1,950	3,310
3,810	2,270	1,810
2,800	2,560	2,750
1,670	2,940	2,070
2,030	2,220	1,960
4,830	2,370	4,390
		4,050
Average	2,760	

V. Pharr, Texas

Net Load in Pounds

Size of Refuse Trucks Not Known Approximately 14 Cubic Yards	Two-Ton Brush Trucks	
2,500	2,480	1,360
5,000	1,640	1,540
2,880	2,060	2,700
3,580	2,040	2,420
3,160	1,640	1,460
1,700	1,020	2,420
2,840	1,620	1,780
2,440	1,740	1,740
2,120	Average 1,850	
2,880		
Average 2,910		

VI. Brownsville, Texas

Refuse trucks are both 16- and 20-cubic yard capacity. Records of brush truck net weights were not available.

Net Load in Pounds in Refuse Trucks

7,300	4,800	6,200
2,400	3,980	5,460
3,980	3,960	5,580
5,920	3,920	5,440
3,220	5,520	5,080
6,380	6,500	5,440
3,920	3,960	5,240
7,880	4,040	5,500
5,200	3,940	7,400
4,380	2,820	6,200
5,800	2,960	4,900
6,040	5,160	4,240
4,860	4,780	5,900
6,000	5,580	5,320

Average 5,074

APPENDIX B

COST ANALYSIS OF REGIONAL REFUSE RAIL-HAUL DISPOSAL SYSTEM

I. Cost of hauling refuse to present sanitary landfills and proposed rail-haul transfer stations.

Community	Annual Refuse in Tons	Distance to Present Sanitary Landfill in Miles	Distance to Proposed Transfer Station in Miles	Present Annual Cost	Proposed Annual Cost
Brownsville	54, 100	5. 5	0. 0	59, 500	-0-
Harlingen	56, 000	6. 5	0. 0	73, 000	-0-
San Benito	25, 000	4. 0	4. 0	10, 000	10, 000
La Feria	5, 000	2. 0	9. 0	2, 000	9, 000
Weslaco	22, 000	2. 0	0. 0	8, 800	-0-
Mercedes	22, 000	3. 0	4. 5	13, 200	19, 800
Donna	12, 000	2. 5	4. 5	6, 000	10, 800
Alamo	5, 000	3. 0	8. 0	3, 000	20, 000
McAllen	39, 700	3. 0	2. 0	23, 820	15, 880
Edinburg	23, 000	2. 5	4. 0	11, 500	18, 400
San Juan	6, 500	2. 5	4. 0	3, 250	5, 200
Pharr	35, 000	2. 0	2. 0	14, 000	14, 000
Mission	16, 500	2. 5	8. 0	8, 250	26, 400
			Total	$236, 320	$159, 480

Collection truck cost of $0. 20 per ton-mile was used for calculations based on the estimated cost of operation developed from a Harlingen, Texas, study. Costs in other cities in the United States are around $0. 30 and $0. 40 per ton-mile.

II. Rail-Haul Refuse Transfer Station Cost.

Four transfer stations are recommended for the Regional Solid Waste Management Agency to serve both Cameron and Hidalgo Counties. Two transfer stations will be located in each county.

Capital Cost

4 Buildings--10, 000 square feet each--@ $10. 00 per square foot	$400, 000
Truck scales at each transfer station @ $5, 000 each.	20, 000
Compaction equipment, hydraulic electrical @ $5, 000 each	20, 000
Property and railroad siding @ $10, 000 each site . .	40, 000
	480, 000
plus 10%	48, 000

Capital investment for 20-year design life	$528,000
Annual capital cost @ 5%	42,240

Operation Cost

Personnel, 2 full time and 1 part time at each transfer station, total annual cost	$ 60,000
Utilities @ $50.00 per month per station	2,400
Maintenance and Miscellaneous 10%	6,240
Annual Operating Cost	$ 68,640

Total Annual Cost of Transfer Stations	$110,880

III. Cost Analysis for Rail-Haul from Transfer Stations to Sanitary Landfill and Return Empty Cars.

	Annual Refuse Tonage	Rail-Haul Distance Miles	Rail-Haul Rate per Trip per Ton	Annual Costs
Station # 1				
Brownsville	54,100	22	21¢	$11,360.00
Station # 2				
Harlingen	56,000			
San Benito	25,000			
La Feria	5,000			
	86,000	20	20¢	$17,200.00
Station # 3				
Weslaco	22,000			
Mercedes	22,000			
Donna	12,000			
Alamo	5,000			
	61,000	40	32¢	$19,520.00
Station # 4				
McAllen	39,700			
Edinburg	23,000			
San Juan	6,500			
Pharr	35,000			
Mission	16,500			
	120,700	56	36¢	$43,450.00
Total Tons	321,800		Total Annual Costs	$91,530.00

V. Sanitary Landfill Cost of Operation

Proposed sanitary landfill cost of operation for a single landfill operation, 1000 feet wide, handling on the average of 100 tons per day, should operate at $0.60 per ton including cost of land @ $50.00 per acre.

Total Annual Cost: 321,800 tons x $0.60/ton = $193,080.00

Present Sanitary Landfill Cost of Operation:
16 separate landfills serve the 13 communities
The estimated cost of sanitary landfill operation--$1.20/ton
321,800 tons annually x $1.20 = $386,160

VI. Rail-Haul Refuse Disposal vs Present Operation

Annual Cost of Proposed System		Annual Cost of Present System	
Collection Fleet	$159,480	Collection Fleet	$236,320
Transfer Station	91,530	Sanitary Landfill	386,160
Rail-Haul	131,980		-
Sanitary Landfill	193,080		-
Totals	$576,070		$622,480

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