

**DECISION AIDS FOR
MUNICIPAL SOLID WASTE MANAGEMENT IN
RURAL AREAS:**

AN ANNOTATED BIBLIOGRAPHY

*Southern Rural Development Center
Solid Waste Management Task Force*

June 1995

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*Southern Rural Development Center
Solid Waste Management Task Force*

*Gerald A. Doeksen
Extension Economist and Regents Professor
Oklahoma State University*

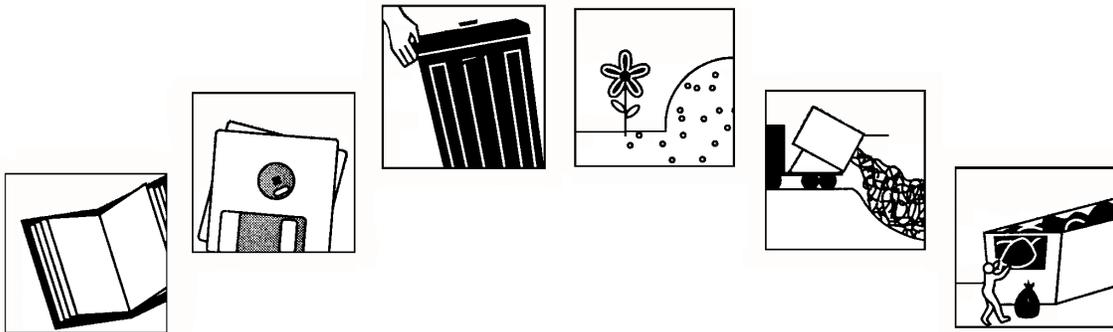
*Barry W. Jones
Editor and Head
Department of Agricultural Communications
Texas A&M University*

*Mitch Renkow
Assistant Professor, Agricultural and Resource Economics
North Carolina State University*

*Richard Warner
Associate Extension Professor, Biosystems and Agricultural Engineering
University of Kentucky*

TABLE OF CONTENTS

INTRODUCTION	1
GUIDEBOOKS	2
COMPUTER MODELS	6
COLLECTION	7
Collection	7
Transfer Stations	9
WASTE REDUCTION	14
Recycling	14
Composting	17
Source Reduction/Waste Prevention	20
Waste-to-Energy	21
WASTE DISPOSAL	22
Landfills	22
FACILITATING SOLID WASTE MANAGEMENT	25
Public/Private Partnerships, Contracting, and Financing	25
Variable Rate/Unit Pricing Systems	26
General Guidebooks	26
Specific Approaches or Programs	27
Regional Cooperation	28
OTHER SOURCES OF INFORMATION	29



INTRODUCTION

Three key realities have created significant challenges for rural communities in the 1990s with regard to municipal solid waste management (MSWM). One has to do with the new federal regulations regarding landfill design and operation and state-level requirements for panning, collection, and recycling. The second is that rural citizens also are demanding opportunities to engage in recycling and other activities that are viewed as part of the "solution" to the solid waste "crisis," as well as more influence over decisions regarding local disposal facility siting and importation of solid waste from other jurisdictions. The third reality is the existence of substantial economies of scale or size with respect to some components of MSWM systems, particularly the processing and marketing of recyclable materials and the disposal of solid waste.

Combined with the inherent characteristics of low total population and population density, and often limited fiscal capacity, these realities have put tremendous pressure on decision makers in rural communities. They face a bewildering array of institutional as well as technical options, and must in some way deal with substantially higher costs. Their overall challenge is to identify an MSWM system that satisfies the demands of federal and state regulations as well as desires of local citizenry. Such systems also must remain within local fiscal constraints.

The idea of the annotated bibliography that follows was to keep these challenges in mind. In 1993, the Southern Rural Development Center funded a Task Force to assess the decision aids available for rural MSWM. This Task Force, made up of six research and extension specialists from land-grant institutions within the Southern region, was an outgrowth of an earlier Southern Extension and Research Activity (SERA) that was established to foster cooperative efforts in the general area of waste management. A variety of means were employed to identify potential decision aids. The task force sought to find those resources specifically targeted to the rural MSWM context, as well as more general materials that could potentially be of some use to rural decision makers. A separate report to the Southern Rural Development Center will detail Task Force recommendations with regard to potentially fruitful research and extension efforts in the Southern region, given an assessment of coverage and usefulness of the decision aids described in this report.

The two-year period of Task Force activity was a dynamic one, during which two major efforts to develop decision aids for rural MSWM were undertaken. One was an effort by the Coastal Georgia Regional Development Center, sponsored USDA's Rural Development Administration, to develop a Regional Planning User Guide for Rural Solid Waste Management and accompanying Sample Regional Plan. The second, also sponsored by USDA's Rural Development Administration, was a joint effort led by the Solid Waste Association of North America (SWANA). With assistance from the National Association of Development Organizations (NADO), SWANA set out to develop a set of guidebooks for rural MSW and present a series of state-level workshops targeted to rural decision makers and

MSW managers, and state or regional agency personnel who oversee or support rural MSWM activities. Five workshops were presented in 1994, and 15 more are planned for 1995. Two of the Task Force members have been actively involved on national review panels for these major efforts, and are also serving as instructors in several of the 1995 workshops.

These recent efforts have changed the "landscape" with regard to rural MSWM decision aids, and the fact that they occurred suggests that others also recognized what the Task Force members observed: as of two years ago, there was a dearth of written material or other types of resources available that specifically addressed the particular context of rural areas. Whether these major efforts will adequately address the needs of rural decision makers and MSW managers remains to be seen. The products of these efforts are reviewed at some length in the first section titled "Guidebooks."

In addition to the comprehensive guidebooks and two computer models that were reviewed, a large number of written materials of various sorts that are more narrowly focused were reviewed as well. Many of these are articles from trade or industry related publications and reports done by state agencies, educational institutions, or non-profit organizations devoted to technical assistance. The annotated bibliographies are organized within four general areas of MSW management activities: collection and transferring, waste reduction, waste disposal, and facilitating. Within these four areas are subsections devoted to ten specific topics. While efforts to identify relevant and potentially useful decision aids were extensive, no claim is made that the set is totally exhaustive. A listing under "Other Sources of Information" should provide guidance in searching for other items that are available or that are published subsequent to the publication of this report.



GUIDEBOOKS

Rural Solid Waste Management: Regional Planning User Guide. Coastal Georgia Regional Development Center(RDC). Brunswick, Georgia, 1994 (Available from 912-264-7363 at a cost of \$65).

This three-inch thick, hard-bound publication represents an attempt to provide a comprehensive guide to planning on a regional basis for rural municipal solid waste (MSW) management. This major project, funded by USDA's Rural Development Administration, involved a staff of several planners at the Coastal Georgia Regional Development Center (RDC), consultants, and a national review panel of about 30 people. This publication has 19 chapters, most of which are 30 to 60 pages in length, and seven appendices with items such as model contracts and educational materials. Summary reviews of most of the chapters are provided below, with the ones excluded being the brief introductory chapter and those on the subjects of household hazardous waste and other special wastes, medical waste management, and geographic information systems.

Chapter 2: Regional Solid Waste Planning Process

An excellent overview of the regional solid waste planning process is provided in this chapter. A positive aspect is that it could be used for county or community solid waste planning as well as regional planning. The chapter clearly defines the role of an advisory committee in carrying out actions to attain a regional plan. A concern is that the process is written for rural areas with more resources than are typically found in sparsely populated rural areas of the Plains. Many of these areas do not have technical staffs and must rely on Extension, substate, community or other technical professionals for assistance. One other concern is that authors suggest that private citizens on advisory committees may be a good way to get good citizen involvement. Instead of "may" private citizens "must" be on the advisory committee to insure the end product is a true regional solid waste plan.

Chapter 3: Analysis of Regional Characteristics

Regional data needs are reflected by the solid waste services provided. This chapter may encourage the advisory committee and planners to collect more data than necessary. For example, if it is clear that the regional system will utilize a landfill outside the region or utilize an incinerator and dispose of ash outside the region, the extent of the data needs on topography, climate, soils, etc., are much less. The past and current economic and population data will be needed to estimate future growth. Two points may have been understated in the chapter: (1) many states have data centers where the data is available electronically, and (2) any population projections should be done with a demographic model and not a linear trend as suggested. The chapter does a good job of specifying data needs, but the purpose of the data must be kept in mind so as to collect only relevant and useful data.

Chapter 4: Waste Stream and Existing Management Analysis

An excellent chapter that discusses waste stream composition and quantity. To create a good plan, the advisory committee and technical experts must know the quantity and composition of the waste stream. The authors do a good job in providing default methods to estimate composition if resources are not available to conduct a hand-sort survey of solid waste. The chapter includes inventory data relative to existing services. Authors stress the need for cost data. However, they do not mention a fact that if local cost data cannot be obtained that there are documents with default data that can be utilized.

Chapter 5: Collection

Influences on collection, steps in planning collection, types of equipment, rural options, transfer stations, yard waste collection and privatization are all discussed in this chapter. Appendix D for the chapter contains an example of along-term disposal contract, "Mailbox" collection contract, a model Request for Proposals for yard waste composting services, and a yard waste composting service contract. Various types of municipal solid waste collection suitable for rural areas, influences on design and implementation of integrated systems, basic equipment and transfer station layout, and privatization options are described. The intent of the chapter is to provide public sector waste managers with information on methods currently being applied in rural areas at the local and regional basis through the use of transfer stations.

A 10-step process is given to assist in designing, evaluating and implementing an appropriate collection system that meets service area needs. Brief discussions and illustrations of collection equipment are provided. A Heuristic routing method is suggested and presented for use by the solid waste manager in setting up routes for municipal solid waste collection. Transfer station technology, advantages, disadvantages and siting considerations are presented. One section is devoted to yard waste collection alternatives. A glossary of terms and good list of references both are provided at the end of the chapter.

Chapter 6: Source Reduction

This chapter provides a good general introduction to the subject of source reduction. After defining the term and describing the type of activities that lead to source reduction, the authors emphasize the critical importance of public information and education efforts. They list a number of recommended strategies applicable to the residential, governmental/institutional, and commercial/industrial sectors. In addition, more extensive discussions of three topics are provided: backyard composting, variable rate user fee approaches, and regulations. The first of these is certainly a very practical and relevant source reduction activity in rural areas. The second may have application in rural areas

as a financing approach that provides incentives for source reduction and recycling, though resistance to user fees of any kind may be strong in some cases. The third topic seems more appropriate to consider at a state or federal level.

Chapter 10: Disposal

This chapter provides an informative overview of landfill and waste-to-energy technologies, as well as a suggested step-by-step planning procedure for assuring disposal capacity. A discussion of Subtitle D regulations and deadlines is also included. Little in the chapter is oriented toward the rural context. Estimated costs associated with landfills of various capacities are addressed in Chapter 13.

Chapter 11: Facility Siting and Permitting

The chapter is a good, general primer on these two related subjects. First, the authors suggest a 15-step approach to siting MSW facilities, particularly landfills. In addition, it provides general recommendations for successful siting and an extended discussion of the role of host community benefits, which may understandably be a critical element in siting landfills to serve a region. While offering no "silver bullet" that will guarantee success, the discussion does identify those matters that must be adequately addressed in a successful siting process. The rest of the chapter provides brief discussions of important considerations in the permitting process for various kinds of MSW facilities.

Chapter 12: Institutional and Legal Analysis

This chapter begins with discussion of six areas within regional MSW management that must be analyzed with respect to their institutional requirements: regional cooperative agreements, waste flow control, system management, facility procurement, facility siting, and risk assessment and assumption. For example, with regard to system management, several alternatives are discussed, including initiative by a lead jurisdiction, use of an existing development agency, establishment of a new regional management agency, or limited regional management of some form. Next comes a discussion of alternative organizational structures for regional cooperation, including intergovernmental agreements, special purpose service districts, authorities, and cooperatives. A number of advantages and disadvantages of each are listed. The current uncertainty with regard to the question of flow control is discussed in view of the May 1994 Supreme Court decision, as are other legal tools such as business licenses or permits and franchise agreements. Finally, the four basic approaches to facility procurement are discussed, with advantages and disadvantages noted, and some "hints" are provided for structuring both facility and collection contracts. This chapter provides a great deal of information that might be very useful to rural community leaders considering options for regional MSW management cooperation.

Chapter 13: Facility, Collection and Transportation Costs

A chapter that covers facility costs, municipal solid waste and recyclable material collection costs, regional transportation costs, preparation of a preliminary cost analysis, regional cost variables, and a sample spreadsheet analysis. The chapter briefly describes the function of various municipal solid waste system

components and provides preliminary, yet detailed cost information. Any cost information would need to be updated and adjusted to fit local situations. Estimated capital and operating costs are presented for three recycling and processing facilities, four composting facilities, two waste-to-energy facilities, three different transfer station sizes [25, 50, 100 tons-per-day (TPD)], three different landfill sizes (150, 300, 600 TPD), and three collection options.

While a tremendous amount of cost information is provided, which could be very useful to rural community waste managers and leaders in evaluating MSW management options, its value is limited somewhat by lack of clarity, documentation, and consistency in some areas. For example, in the tables summarizing the capital and operating costs of convenience centers and transfer stations, an assumed \$40-per-ton tipping fee is included as part of operating costs, which would be clear only if they looked carefully at the preceding detailed tables. Capital costs associated with facilities are not converted into a per ton basis, hampering comparisons across capacities. In the discussion of a "mailbox collection system," the assumed tonnage per household is not documented. Thus, comparison with convenience center cost estimates is not possible. In addition, the range of capacities chosen for facilities may limit the usefulness of the cost estimates for some decisions. For example, the smallest recyclables processing facility's capacity is 25 TPD, which while small by urban standards, would require a population base of at least 100,000, and probably much more, depending upon the level of participation and diversion of materials. Additional cost estimates for smaller capacity facilities would be useful. A glossary of terms in the chapter is very helpful.

Chapter 14: Financing Methods

Financing methods and alternatives is covered by the chapter. Local, state or federal regulations must be followed when any public entity chooses a financing option. General obligation bonds and revenue bonds are discussed in the chapter. Other financing alternatives discussed include: development impact fees - scheduled charges applied to new development to provide revenue for the construction of expansion of capital facilities located outside the boundaries of new development that benefit the development (new development could include residential or commercial sources or both); Certificates of Participation (COPS) a form of lease/rental debt that usually does not require voter approval and does not count toward a municipality's debt limit; interest rate swaps - involves a swap of a fixed interest rate on outstanding bonds for a variable or floating rate. Before any of these financing methods are evaluated, local users should check regulations for applicability and legality. This chapter suggests a team be assembled to develop the financing package. The team should include financial experts, underwriters, environmental counsel, legal counsel and technical engineering and managerial personnel. The glossary of terms at the end of the chapter is very useful.

Chapter 15: Preparing an Action Plan

Chapter 15 is probably the most important one in the guidebook. The action plan is also the most important and most difficult to complete in the planning process. The advisory committee must come to agreement on actions and who and by

when the actions will be completed. The chapter contains excellent examples of monitoring and evaluation. The chapter is well-written and emphasizes the importance of the action plan.

Chapter 16: Public Education and Public Involvement

This 40-page chapter provides an enormous amount of information on the related but distinct subjects of public education and public involvement. After a brief discussion of the significance of a rural and regional context, the authors suggest nine steps for developing and implementing an effective public education effort. Extensive discussion is directed to the advantages and disadvantages of a variety of specific alternatives, as well as a set of criteria for evaluating these alternatives. Cost estimates are even provided for about a dozen typical alternatives. Following this is a discussion of six types of public meetings to foster public involvement, differentiated by their purpose, audience and other characteristics. Suggested room arrangements and formats are provided for several of the types. Finally, a dozen "points to remember" with regard to public meetings are provided, as well as some suggestions for dealing with issues of equity and risk.

The Solid Waste Association of North America (SWANA). Rural Solid Waste Management Series, 1994. (Available from SWANA (301-585-2898) at a charge).

This publication series has four individual guidebooks, each between 20 and 40 pages in length. A description of the information in each is provided below, as is a brief description of the companion workshop that SWANA is presenting in 15 rural states during 1995.

No. 1 - "A Guide to Assuring Capacity for the Future"

This guidebook begins with a very brief description of integrated municipal solid waste management (IMSWM) and the particular challenges facing rural communities in implementing an IMSWM system. The bulk of the guidebook is a fairly general primer on the potential components of such a system, including source reduction, recycling, composting, waste-to-energy, landfills, and collection and transfer stations. There is some emphasis on considerations given the characteristics of the rural context.

No. 2 - "A Guide to Decision-Making in the Public Sector"

A discussion of the relationship between federal, state, and local government responsibilities in Municipal Solid Waste (MSW) management is provided in this guidebook. The guide discusses four factors affecting local MSW decision-making: political influence, public perception, economic and fiscal concerns, and media perceptions. Recommendations for dealing with these factors are included. Following presentation of a list of eight approaches to integrated MSW management, the last one in the list, public-private partnerships, is discussed in some depth. No specific attention is given to the rural context, though the recommended step-by-step procedure for developing a partnership may be useful.

No. 3 - "A Guide to Managing Financial Resources"

A brief discussion of factors that affect the cost of IMSWM systems is provided. Along with three major sections. The first

two are essentially generic primers on basic financial accounting and budgeting within a local government context. The third is an extended, in-depth description of alternative financing approaches. After a general discussion of institutional and legal issues, a description of the three standard public procurement approaches for MSW facilities is provided: the traditional Architect & Engineer (A&E) approach (municipally owned, operated and financed), the turnkey approach (municipally owned, vendor built, operation flexible), and the privatized approach (full service contract with private vendor). Then, after brief attention to taxes and user fees, an extended discussion of debt financing, particularly bonds, is provided. Again, no explicit attention is given to the rural context, though a great deal of potentially useful information is provided.

No. 4 - "A Regional Approach to Municipal Solid Waste Management"

The guidebook begins with a brief discussion of the case for regionalization of MSW management, with some attention to the particulars of the rural context. Discussion is followed by a list of questions that might well be asked by rural communities that are considering regionalization. Next, the alternative institutional structures for regional cooperation are identified, as are some alternative structures for a board of directors. Sections follow that outline the general steps that must be taken to plan and implement a regional MSW management system. An abbreviated discussion of financing options within a regional system is also presented, drawing from the more extensive discussion of financing in Guidebook No. 3. An appendix provides brief organizational descriptions of four regional systems, however none represent what could be considered rural areas. While the information presented in this guidebook may provide a useful general introduction to the idea of regionalization, it does not seem likely to move rural communities very far down the road toward effective regional cooperation for MSW management.

Rural MSWM Workshops

As a companion effort to the "stand-alone" guidebooks, SWANA is presenting one-day workshops in 15 states in 1995. Whether this effort will be extended to other states in 1996 is unknown. A lengthy manual is provided to workshop participants, organized around four basic topics: integrated MSW management, regionalization, rural recycling, and landfill disposal. While the material presented in the workshop is necessarily rather general and thus may not address specific questions peculiar to rural areas in a particular state, the workshops held to date have been productive in clarifying questions and issues, getting people together within states to allow them to gain from each others' experiences, and directing participants to other resources that may help them address specific needs.

U.S. Environmental Protection Agency, "Decision-Makers Guide To Solid Waste Management," Solid Waste and Emergency Response (OS-305), U.S. EPA/530-SW-89-072. November 1989.

First published in 1976, the guide was revised in 1989. This is Volume I of two volumes addressing the solid waste issue. This volume was designed to help policy makers

understand present waste management problems, possible techniques for solving them, and how these solutions influence each other. Thirteen chapters are included which address the following topics: integrated waste management; factors affecting municipal waste management decision-making; the local municipal waste management system; collection and transfer; source reduction; recycling; composting; Municipal waste combustion; land disposal; special wastes; public education and involvement; financing and revenues; conclusions on integrated waste management. Several of these chapters are covered in more detail under the appropriate topic.

A very good review of issues and potential solutions are given in each chapter. This is an excellent resource for a basic understanding of the whole solid waste topic. It provides a discussion of factors that should be considered in framing local decisions. Data and information are presented that are helpful in making decisions. Most of the information is applicable to rural areas, but care must be exercised when volume is required to make a potential solution feasible. Additionally, any cost information would have to be updated. A very useful glossary of terms and acronyms is included at the end of the guidebook.

No cost information was given for the guidebook. Anyone interested in obtaining a copy should contact their state agency responsible for environmental quality.

A Guidebook for Rural Solid Waste Management Services, Southern Rural Development Center, Mississippi State, MS. June 1993.

The purpose of this guidebook is to present data and worksheets to rural solid waste management officials in order to help with the decision making process in light of the new regulations facing landfill operations (i.e. Subtitle D). As long as users of this document understand that it is a general guidebook and that some of its assumptions will not apply to different regions or types of operations, they should find it a very valuable tool.

The stated objectives of the guidebook are to:

- estimate solid waste generation rates in specific areas.
- summarize the costs of Subtitle D landfills.
- compare direct hauling vs. transfer stations.
- estimate the costs of community convenience centers.
- provide a methodology to estimate rural collection costs for different systems
- summarize waste stream reduction methods.

The section addressing the first objective (estimating the volume of waste facing a specific area) is the weakest part of the guidebook. Averages from one county, Delaware County, Oklahoma, are used to develop a formula for all communities. This is potentially very misleading, and probably should not be used if any local data can be obtained. Fortunately, most solid waste managers will have volume figures at hand.

Subtitle D will substantially increase the cost of building and operating new landfills. The section addressing the costs of new landfills provides rough estimates for comparing the costs of old landfills to the new lined landfills; however, these figures are realistic only to the extent that some very restrictive assumptions made at the outset hold. Tables in this section are poorly

constructed and do not lend themselves to direct comparisons as some costs are per acre, some are totals, and some are not labeled.

With hauling costs making up a large portion of disposal costs, the choice of operating a transfer station, compared to hauling directly to the landfill, is a major one. The costs associated with both methods are very well documented, including description of general layout, specific equipment needs and construction methods. Operating and capital costs are similarly well documented. A desirable element of this type of manual should be to point out the choices solid waste managers are likely to face and how to address differences among regions, political climates, and other community specific elements. Unfortunately, the reasons why one method might be preferred to the other are not mentioned - the guidebook constructs estimates for each method for their "example community" but stops there.

The section discussing construction of community convenience centers has a similar problem. The description of the facility is very detailed and the types of equipment needed are described well. However, the "why?" questions are not addressed. For example, a wood chipper is described and the average costs are given but the question of who needs a chipper and why is omitted.

The strongest section of the paper is the description and comparison of different types of collection alternatives. The differences between Green Box systems, convenience centers, and door-to-door collection are nicely laid out, and the benefits and disadvantages of each are clearly presented. Cost estimates are not detailed in this section because differences among communities are so great that any estimates would be virtually useless. However, costs of the different types of equipment are given.

The last two sections focus on waste reduction through recycling and composting. Both provide basic information about the types of systems used in each process, and a general advantage-disadvantage description. No costs at all are given in these sections. Though the details are accurate, the information is too basic to allow for any analysis of the different systems or to compare different technologies.

Overall this guidebook provides useful information about solid waste alternatives. The greatest strength is the detailed descriptions of all the different alternatives in many aspects of solid waste disposal. The comparisons of the transfer station versus direct haul and the types of collection alternatives are very good. There are also many forms included for cost estimating of all the alternatives discussed. These forms, though rudimentary, should provide solid waste managers with a good basis for initial decision making.

Copies can be obtained from the Southern Rural Development Center, Box 9656, Mississippi State, MS. (601), 325-3207.

"Guidelines for Decision Makers: Solid Waste Management," County Technical Assistance Service, The University of Tennessee, November 1991.

The purpose of this publication is to contribute information to local and county officials related to solid waste management issues they will encounter in the near and distant future. It is not intended to specify costs or to recommend practices befitting all situations. Rather, the stated objective of this publication is "to provide initial guidance as to what alternatives might prove feasible to counties or regions in solid waste program planning."

The first two sections are brief overviews of national (Environmental Protection Agency) and state (State of Tennessee) goals and strategies concerning proper management of solid waste. They serve to introduce new legislation and landfill classifications. Appendices outline mandates and latest revised regulations. Appendix A details Subtitle "D" criteria while Appendices B and C review the Tennessee Solid Waste Management Act of 1991 and state regulations regarding solid waste processing and disposal facilities, respectively.

The next two sections address the Municipal Solid Waste (MSW) stream by identifying the sources of MSW and the factors attributing to solid waste generation in Tennessee. A waste composition breakdown illustrates the types of materials generated in the national waste stream and their estimated percentage by weight. Four factors are identified: 1) population; 2) industrial activity; 3) efficiency of collection or convenience of disposal; and 4) population disposal habits.

The section on solid waste collection provides very general guidelines on cost estimating for convenience centers which have been defined as the minimum standard for collection. Monthly household cost trends are included for both publicly operated and publicly contracted convenience centers. Estimated capital costs ranges for construction of convenience centers are furnished.

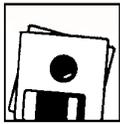
The largest section considers alternatives for managing solid waste. Various designs, costs estimates (operating and capital), and equipment needs for: (1) recycling; (2) incineration; and (3) landfill disposal are discussed. The recycling portion examines drop-off and curbside collection systems and relates the differences in expected costs between rural, urban, and commercial- industrial recycling. An example of an industrial solid waste survey form is included. The economics of incineration is impacted significantly by required capacities in tons per day of incinerated waste. A number of incineration systems are illustrated with estimated costs and tipping fees for different capacities. The landfill disposal portion compares the costs and equipment needs as well as the advantages and disadvantages for landfilling and balefilling.

Quite often, there will be a need for additional assistance. The final section gives guidelines and suggested procedures for selecting and procuring a consulting engineer.

Finally, the focus of the last two appendices is annual life cycle cost analysis of landfilling and balefilling. Twenty cost models in Appendix D representing different levels of daily waste deposit (i.e., tons per day), total capacity (i.e., site acreage), liner type (clay or composite), and financing type (private or public) were analyzed. Appendix E uses cost models

to compare life cycle costs of landfilling to balefilling.

Given the stated objective, this publication accomplishes its mission effectively. It is a useful tool for local leaders to initiate their solid waste discussions to comply with changing legislation. It introduces the important aspects and presents various alternatives for integrated solid waste management programs. Basic cost data are included for preliminary analysis of alternative systems. To develop a local specific budget of solid waste alternatives for any component of the solid waste system, more detailed data are needed. To complete a local detailed budget of alternatives, local decision makers would need an additional guidebook with detailed cost data, easy to use forms, and a clearly defined procedure for analysis. This information could be combined with site specific data to arrive at budgets for solid waste alternatives.



COMPUTER MODELS

**Solid Waste Options for Municipal Planners, Version 1.0,
U.S. EPA Region IV, Atlanta (Available at 404-347-4216).**

This program will be of help to solid waste managers, but care must be taken when interpreting results. It is a very user friendly program that takes the user through a series of steps to identify his or her community's characteristics and the individual needs that must be addressed by the community. The user must identify the size, area and waste production figures for the community (the solid waste figures can be estimated from average values contained in the program or can be directly input by the user). After the community data is inputted, management decisions are chosen. These include recycling, composting, special waste collection, and incineration (for energy recovery or for waste reduction). Within each of these categories there are many options to further individualize the goals of the community. Unfortunately, for each of these options there are substantial restrictions.

For recycling options the program allows for different materials and different types of collection (including curbside, drop-off, comingled, blue bag). However, there is no mechanism for altering the quantities of materials collected through each. Those used are based on national averages that are built into the program. Thus, there is no way for users to gauge the cost implications for local activities (e.g. educational programs) that might alter participation rates. Similarly, the material/collection type cost estimates are based on fixed coefficients.

The composting and incineration scenarios are likewise restricted. A particular limitation is that there is no obvious way in which policies that ban certain materials (e.g. cardboard) from landfills can be "modeled," nor can the program accommodate 25 percent waste reduction mandates.

The details of how the program generates cost estimates are hidden from the user. Capital and operating costs of each activity are output by the program. These are not itemized, however, and presumably these are also based on national averages. Hence, users are restricted in their choices over equipment and manpower for a particular activity. This also may limit the accuracy for particular local circumstances (e.g., for areas of high or low labor costs).

One final problem with the program is that it requires considerable computer power. Users must reconfigure their CONFIG.SYS files in order to make more than 525 KB of RAM available for running the program (also, there needs to be a "Files = 40" statement, not "Files = 30" as indicated in the user's manual).

In conclusion, this seems to be a useful tool for getting solid waste managers to begin thinking about waste reduction. It will provide "ballpark" cost estimates for different types of waste diversion activities. One could conceivably get around some of the limitations in a kind of "brute force" way by doing some tedious sensitivity analysis that would help identify the implicit parameters underlying the cost estimates.

**WastePlan. Tellus Institute, Boston, Massachusetts
(Available at 617-266-5400).**

WastePlan is a comprehensive, micro-computer-based model for use in integrated solid waste planning. It is made up of four interactive modules: waste-stream definition, waste-stream generation, collection, and facilities. A number of states have purchased statewide site licenses for use of WastePlan, as has the Tennessee Valley Authority for its service area. A number of analyses have been performed with WastePlan, both by staff of the Tellus Institute and by research and extension personnel in several states. The verdict on the model's usefulness for rural SWM planning is mixed. Although a revised version is purportedly much improved with respect to ease of use and flexibility, the earlier version suffered somewhat from complexity and inflexibility. An application in Tennessee found it difficult to generate reasonable cost estimates for landfilling, model drop-off collection systems for garbage and recyclables, and perform sensitivity on various scenarios with a large number of collection files. While the model can be employed to analyze the economics of regionalization, a key issue for rural communities, it seems to have been designed, at least originally, with an urban setting in mind. The default data in the model do minimize the need for obtaining a lot of site specific information, but of course national average figures for waste-stream characterization, generations rates, and labor costs, for example, may not be very applicable in many rural areas. However, even with its weaknesses, WastePlan appears to be a very powerful and potentially useful model for comprehensive planning. While one might like to think that a computer model could be used at the individual community level by local solid waste managers, it is apparent that WastePlan is more appropriately employed at the state or sub-state regional level by those in applied research or technical assistance roles. Repeated uses are probably needed to justify the investment of financial and human resources required to "gear up" and obtain the necessary input data.



COLLECTION

Collection

Bumpus, Lewis D., *Solid Waste: Transportation and Other Costs*, County Technical Assistance Service, The University of Tennessee, 1993.

This publication provides very detailed information on collection vehicles and alternative systems. The author contends that it is intended to give general information which should be used for cursory evaluation only. Cost figures are based on a composite of the different public and private facilities which provided statistical information and are not intended to be substituted for or take precedence over detailed cost estimates or more in-depth, situation-specific evaluations. A wide variety of detailed information on capital and operating costs are provided on collection vehicles, transfer stations and convenience centers that might be combined to form a collection system. A procedure is provided for comparison of collection systems. This would be a very helpful resource for decisionmakers. The information was primarily developed for Tennessee, but should be transferrable to other states.

Decision-Makers Guide to Solid Waste Management, U.S. Environmental Protection Agency, Solid Waste and Emergency Response, EPA/530-SW89-072, Chapter 4, pp, 37-45. November 1989.

This chapter addresses both collection options and transfer stations. A very helpful, basic discussion of collection system design, management, and some special issues relative to collection. Suggested performance and evaluation items are especially useful to a beginner in the collection of solid waste. More detailed information is provided on collection equipment and price ranges. However, the 1989 prices would have to be updated for local conditions. This chapter also provides a special section on collection considerations for rural areas. This same guide provides a separate discussion on recycling program collection in Chapter Six.

Doeksen, Gerald A., Joseph F Schmidt, Kyle Goodwin, Gordon Sloggett, Dave Cummins, *A Guidebook for Rural Solid Waste Management Services*, SRDC Publication Number 174, Southern Rural Development Center, Mississippi State, MS. June 1993.

The study reported in this guidebook assimilates information useful to decisionmakers in evaluating the economic feasibility of alternative solid waste systems in small communities and rural areas in the South. Forms are provided that assist users in organizing and summarizing pertinent information for their situation. The guidebook provides information that is useable for those not knowledgeable about solid waste management, as well as those who have worked in this area.

One section of the guidebook is devoted to rural solid waste collection alternatives. The user is provided with a general discussion of three collection systems as well as typical capital and operating costs for each alternative. A local decisionmaker can use forms provided to record cost data provided in the study

or site specific information to use in the evaluation process. This guidebook can be transferred to other areas as long as costs and parameters used are appropriate for the area utilizing the methodology.

Evaluating Residential Refuse Collection Costs: A Workbook for Local Government, Columbia University Graduate School of Business, International City Management Association, Public Technology, Inc. 1978.

The authors claim that the workbook is for elected officials, public administrators, and line officials responsible for the delivery of refuse collection services to their communities. It was designed to help: (1) determine the cost of refuse collection, and (2) identify approaches for reducing the cost of this service. The findings on which the book are based reflect the results of a three-year effort to observe how residential refuse collection is performed in American cities located in metropolitan areas. Data on the costs of collection and types of collection were gathered from nearly 1400 cities.

The project sought to measure the extent of use of various service arrangements for refuse collection in metropolitan areas, to determine the costs of alternative service arrangements, and to identify and measure the extent to which operational differences affect the costs of refuse collection. Three types of collection arrangements existing in cities are described: (1) Municipal collection, by a city agency; (2) Contract collection, where a city hires and pays a private firm for the service, and (3) Private collection, where the individual householder hires and pays a private firm. Franchise collection is discussed.

Applicability of the findings to rural areas are questionable. Only cities with populations between 2,500 and 750,000 in metropolitan areas were included in the study. The study dealt with collection costs only and does not address final transfer or disposal.

The workbook can help a city estimate its collection costs and compare these costs with other cities. It also suggests some ways to improve an unfavorable cost picture. A comprehensive set of worksheets are provided for use by other cities.

Hailey, Geneil, *Guidelines for Decision Makers: Solid Waste Management*, County Technical Assistance Service, The University of Tennessee, pp. 14-16, November, 1991.

A three-page section of this guide is devoted to a brief description of the collection situation in Tennessee. Variables are identified to help evaluate collection program alternatives. Convenience centers were the focus of this discussion and provided some useful guidelines on cost estimates. Transferability to other states and situations should be done cautiously with respect to cost estimates, but useful general information is provided.

Kohrell, Mary, Charles Rhyner, Robert Wenger and John Katers, "Choosing the Best Method for Collecting Recyclables," Cooperative Extension System Waste Management National Initiatives Fact Sheet, University of Wisconsin, Green Bay, Wisconsin (Copies may be obtained from the Cooperative Extension Service waste management contact in each state).

Readers are provided with guides to selecting a collection method in this fact sheet. It is not specifically written for rural areas, but many of the principles apply to rural situations. Six curbside collection systems, drop-off collection, and buy-back centers are briefly discussed. Environmental, political and social factors of collecting recyclables are highlighted. A complete section is devoted to the economic analysis of collection alternatives, with emphasis on five computer models to assist in making decisions about recycling alternatives and collection options.

A computer program called "RecycleWare" was used to compare five collection alternatives. The model was run for a small (12,000 population), medium (80,000 population) and a large (450,000 population) city. Cost and contact information is provided for each software package mentioned in the fact sheet.

Moeger, Cathy Berg, Solid Waste Management Planning Guidebook, Waste Management Division of Solid and Hazardous Waste, Minnesota Pollution Control Agency, 1986.

The guidebook provides a basic planning process for local officials, planners, consultants, and citizens in the Greater Minnesota Area (outside the Metropolitan Area) to use in developing a comprehensive solid waste management plan for their counties. It is divided into five parts: (1) Introduction to comprehensive solid waste management planning; (2) Process for counties to assess capacity for planning; (3) Step-by-Step explanation of specific sections of a plan; (4) Review process for plan approval; (5) Description of resources and assistance available to develop the solid waste management plan.

The process is transferable to other locations, but local data will be needed to develop site specific estimates.

Myles, Albert E., A Guide to Understanding Solid Waste Costs, Publication 1638, Cooperative Extension Service, Mississippi State University. June 1988.

This publication provides a brief, general discussion of various elements of the costs of solid waste services. Under collection costs, five items are identified as the major decisions with cost implications. Sample budget forms are provided for decisionmaker use in specific situations. No cost data are provided, so that the user must have data for the specific situation.

O'Connor, Patrick B., Convenience Centers, Memphis State University (under contract to the Tennessee Valley Authority, 1987 (For further information contact: Tennessee Valley Authority, Knoxville, Tennessee. Inside Tennessee 1-800362-9250; Outside Tennessee 1-800-251-9242).

A guide designed to transfer rural collection technology.

Contents cover three types of convenience centers, their advantages, design and implementation. A very brief description is provided for three types of convenience centers: one with only large (4-to-8 cubic yards) dumpsters (green boxes); a combination of green boxes and open-top, roll-off containers (40 cubic yard) for bulky items; and a compactor convenience center which uses open top containers for bulky items and closed top containers with compactors for household waste. The remainder of the guide provides general guidelines for location of convenience centers in a rural setting, suggested design layout for each type of center including operation and staffing. Hints on implementation of the collection plan also are included. This is a very useful publication for those unfamiliar with solid waste collection principles for rural areas. It provides helpful guidance for a rural community planning this type collection method.

Solid Waste Collection Practice, Institute for Solid Wastes of the American Public Works Association, Fourth Edition, Slavik Printing Co., Chicago. 1975.

This authoritative text covers in great detail sophisticated management methods and innovative technology employed by knowledgeable solid waste officials and private contractors. The book concentrates on increasing efficiency and on various methods of measuring and improving the productivity of collection operations. The book proclaims that it is the most comprehensive work available for solid waste administrators.

Information appears to be more applicable to urban than rural conditions. However, valuable detailed information would also be useful for rural systems. Cost information certainly needs to be updated.

Transfer Stations

"ASTSWNO/WasteAge Survey Finds Nearly 1,300 Transfer Stations," Waste Age, pg 69-70. February, 1985.

An article listing reported transfer stations by state in 1985. The purpose is to provide a statistical breakdown of transfer operations currently in use. In 1985, there were 1,278 transfer stations reported to be in operation. About 77 percent handled 50 tons per day or less. Only 70 transfer stations (6 percent) had a capacity of 300 tons per day or more. Over half of the transfer stations were green box stations. California, New York, and Washington were the states that reported the most numbers of transfer stations. The data indicates that if the facility is enclosed, it will have compaction equipment, and if it is open, it will not have compaction.

Brockway, Christian; and Casey, Brian. "The Next Transfer Stations," American City & County. January, 1992.

An article describing the evolution of transfer stations into materials recovery facilities. The purpose is to identify trends in transfer station design and operation. The solid waste transfer station has evolved in three generations. The first generation stations were small, open-air transfer stations for rural residents. Second generation stations were enclosed structures capable of large capacity waste transfer. The third generation transfer stations known as material recovery transfer

facilities (MRTF's) are complex, integrated waste management facilities. Many modern transfer stations include recycling, composting, and production of refuse-derived-fuel. Incoming waste is often sorted mechanically. Aesthetics and appearance are very important to help blend the transfer station into the surrounding community. Technology may make future MRTF's more efficient by improving waste stream processing and separation capabilities.

Chang, Terrill J. "Transfer Stations: Designed With the Future In Mind," World Wastes, pp. 96-100. March, 1991.

An article that describes the layouts of modern convenience centers that minimize the impact on surrounding residents. The purpose is to demonstrate to communities how to build a transfer station that residents will not object to. Providing residents a place to dispose of large bulky items and drop recyclables accommodates residents as well as reduces the amount of trash taken to the landfill. The transfer station should be designed to be pleasant looking, well maintained, provide adequate roadway space, and control odor, noise and dust. The transfer station must educate the public through schools and public forums to ease public resistance. The building at the transfer station should be designed for durability, safety, and convenience. Ample excess capacity must be built in to allow for future solid waste volume increases.

Child, David. "Transfer Stations End Long-Haul, High-Cost Refuse Collection," American City & County, pp. 83-87. June, 1979.

An article supporting that the distance waste is hauled may be more important economically than the volume generated. The purpose is to describe the benefits of transfer stations versus directly hauling solid waste to the landfill. Small and large solid waste operations both may benefit from constructing and operating a transfer station. The decision to build a transfer station is based on economics. The least costly method of hauling solid waste should be used. The four basic requirements of a transfer station include land, a building, a stationary compactor, and trailers. Direct dump, a stationary compactor, a push pit, or a conveyor may be used to load waste into the transfer trailers. An inset to this article gives an example of the cost comparison between transfer station hauling costs and direct haul hauling costs.

Clark, Glenn, J. Transfer Stations: A Viable Tool in Municipal Solid Waste Management. Paper presented at Natl. Association of Environmental Professionals. May 1993.

A paper giving general information on transfer station operations. The purpose is to give information on various transfer station subjects to solid waste handlers. There are three types of transfer station systems, and two loading methods are discussed. The paper provides a breakdown of the materials present in the municipal waste stream. Recyclable materials are easily identified in the waste stream at any transfer station. The responsibility of recycling rests with the individual. There are three types of transfer facilities; compactors, open top trailers, and balers. Advantages and disadvantages of each type are identified. A formula to compute the capacity of a transfer station is provided. The biggest benefit of a transfer station to

the community is the reduction in costs. A formula to compute the amount of waste that can be transferred per hour is provided. Education, waste reduction, and recycling are key elements to the future of transfer station operations.

"Dallas Does Transfer," Waste Age, pp. 203-206. September 1989.

An article that outlines the modernization of the Dallas, Texas, transfer station operation. The purpose is to explain to communities ways to upgrade existing transfer stations. Dallas has completed the modernization of two transfer stations with another in progress. By using new drop-bottom transfer trailers, the city has increased the trailer capacity by nearly three tons per load, and decreased loading time to save nearly \$12.50 per load, or nearly \$168, 750 per year. Professional engineers working for the Dallas Street and Sanitation Department have identified seven major benefits of operating a transfer station. The seven advantages include: (1) economies of haul; (2) reduced collection fleet size; (3) labor savings; (4) less wear and tear; (5) greater versatility; (6) improved landfill operations; and (7) better acceptance.

Decision-Makers Guide to Solid Waste Management. Chapter Four, United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. November, 1989.

A guidebook that provides a detailed analysis of the entire solid waste handling process. The purpose of this chapter is to give a general overview of collection and transfer operations. Transfer stations are centralized locations where solid waste is consolidated to decrease the cost of hauling to a disposal facility. Transfer stations involve planning to ensure that the waste is managed according to local goals and objectives. Several transfer station design alternatives are presented with advantages and disadvantages of each. Transfer vehicles come in two basic designs; open top and enclosed trailers. Developing and operating a transfer station involves several costs but, cost savings may result from implementation. Demands of the local system must be met when evaluating a transfer station operation. Siting and integration of the transfer station with the rest of the solid waste system are two other important issues involved with a transfer station. Transfer stations also serve as an excellent site to receive and sort recyclable materials.

Dempsey, John; and Kulik, Ann. " Transfer Stations Evolve to Meet Community Needs," World Wastes, pp. 48-53. June, 1991.

An article describing the changing roles of community transfer stations. The purpose is to point out the functions beyond waste transfer that a modern transfer station serves. To provide the best functional facility possible, a community must consider its own special needs before building a transfer station. Careful siting and design can prevent an unacceptable perception of the facility by residents. Increased environmental concerns have placed more emphasis on strict zoning ordinances for transfer stations. Economic viability includes three factors, transportation, transfer station operation, and transfer station capital. The optimization of the various cost factors is the key to financial stability. Two tables are presented that provide payload and cost estimates. The simple rule for

analysis is transportation costs decrease as payloads increase. A modern transfer station is an entire integrated program inside the solid waste system that will provide cost savings.

Estimating Solid Waste Transportation Costs. Guide #2 in a series of municipal solid waste planning guides. Bureau of Solid Waste Management, Department of Environmental Resources. Commonwealth of Pennsylvania.1980. (Out of print, but available at most libraries).

A guidebook that outlines all steps required to estimate the costs of building and operating a solid waste transfer station. The purpose is to provide a comprehensive guidebook to solid waste system coordinators who are considering construction of a transfer station. The most important consideration in comparing the costs of direct haul to the costs of transfer is the time necessary to travel the distance to the disposal site. Two types of transfer stations are discussed; direct dump, and compaction systems. Advantages and disadvantages of each type of transfer station are listed. The type and design of the transfer station will depend on the needs of the waste system. The number of transfer vehicles purchased initially should be based on the maximum daily quantity of solid waste expected during the initial years. To accurately estimate the total cost of a transfer station, capital expenditures, labor and other operating costs, and maintenance of the transfer operation must be included. When comparing direct haul to transfer, each system should be analyzed with its own requirements. An example, glossary, and additional blank forms are included in the guidebook to help estimate and compare the costs of direct haul and waste transfer.

Flander-Good Associates Ltd. Transfer Station and Recycling Plant Cost Analysis. Prepared for the New Brunswick Department of the Environment, Canada. August 1990. (\$10)

A guidebook prepared for solid waste system operators in eastern Canada. The purpose is to provide an estimate of the unit costs associated with transfer station and recycling facilities. The analysis is assumed to be for a transfer station handling about 20,000 tons per year. A 5,200 square foot metal building with reinforced concrete floors and driveways would be set on ten acres of land. An example floor plan is provided. It is estimated that capital costs for the facility would be about \$1 million. The total annual capital and operating costs for this facility is estimated to be \$344,945. An example transfer station with a recycling operation is also provided. The recycling operation involves six types: glass, aluminum cans, plastics, newsprint, cardboard, and fine paper. It is estimated that 11.7 percent of the 20,000 annual tons, or 2,340 tons, will be recycled. A floor plan of the transfer station with an enclosed recycling facility is provided. The capital costs associated with this facility are estimated to be \$1.9 million. The annual capital and operating costs are estimated to be \$629,760. The per ton cost of operating a transfer station is estimated to be \$17.25 for a regular facility, and \$31.49 for a facility offering recycling.

"Focus on Transfer Floors, Trailers and Tipppers," World Wastes, pp. 46-47. December, 1989.

A list of manufacturers of transfer trailers used in a transfer station operation. The purpose is to provide a list of equipment manufacturers to decision makers. General specifications and

design features are provided with each manufacturer.

"Garner's Simple System Yields Big Results," World Wastes, pp. 36-37. October 1989.

An article detailing a least-cost transfer station and collection system in Garner, N.C. The purpose is to show communities do not need to spend a large amount of money to use a transfer operation. The Garner transfer station consists of a one-third-acre lot on the edge of town. The collection vehicles are side loading, eight-cubic-yard trucks with detachable bodies. When the collection trucks are full, the bodies are unloaded at the transfer station. The full bodies are then dumped by a front loading collection vehicle provided by a private solid waste collection company on a contract basis. The front loaders can hold three full collection bodies. The establishment of a transfer station has reduced the number of collection trucks needed from twelve to eight. The town has also realized a dramatic reduction in the amount of wear on the collection vehicles because of the cessation of directly hauling to the landfill.

Gatti, Carl. "Spec'ing Aluminum Trailers for Optimum Productivity," World Wastes, pp. 24-27,34. April, 1991.

An article that outlines specifications needed to guarantee maximum transfer trailer capabilities. The purpose is to inform transfer station operators of the need to customize transfer trailers to fit their operation. Factors to consider include, the type of materials hauled, distance to the landfill, daily tonnage, and hauling terrain. There is some trade off between trailer weight and strength. The lightest trailer is not necessarily the best alternative. Transfer station operators should consider the following factors before purchasing a transfer trailer: sidewall strength, top rail thickness, tailgate effectiveness, push-out ram durability, suspension type, and lighting effectiveness.

Kellen, John; and Kelley, Murl. "Choosing Flexible Equipment for Your Transfer Station," World Wastes, pp. 58-65. August, 1991.

An article that identifies equipment needs to insure future requirements are met. The purpose is to advise transfer station operators of the factors involved in selecting proper transfer station equipment. Building size, volume and type of waste, number of shifts, and handling methods are important in determining the size and type of equipment chosen. Refuse buckets for the loader are larger and wider than standard earth-moving buckets. Small utility machines are very useful for light stock-piling and cleanup. Selecting the correct tires will increase machine performance and extend the life of the tires. Track-machines are found in many operations but requires that waste be handled against a hard surface with no dirt or mud beneath. Hydraulic excavators may be considered for stationary or point loading operations. It is also important to choose a dealer that will provide support before and after the sale, and has a solid understanding of the operation.

"Materials Recovery at Transfer Stations," BioCycle, pp. 26-27. March 1989.

An article which describes adding material recovery to transfer station operations. The purpose is to show alternative uses for transfer stations. In the past, transfer stations were

designed only for the transfer of waste for transport to the disposal facility. However, with the recent surge in recycling, transfer stations have become the logical place to recover recyclable material. Many operations simply stack recyclables in a certain area of the site, and when a large enough volume has been collected, they are loaded into a transfer trailer for transport to a recycling center. At the other end of the spectrum is a fully integrated system with total material separation. One transfer station operator estimates that 70-to- 75 percent of material accepted at transfer stations can be recycled. By incorporating material recovery at transfer stations, expected landfill life can be greatly increased.

Mattheis, Ann H. "Small Transfer Success: Pick the Right Loads," Waste Age, pp. 119-122. December 1988.

An article explaining how one transfer station in Scott, Indiana, evolved to become a successful material recovery and recycling operation. The purpose is to provide an example recycling system for existing transfer stations. The transfer station evolved from an agricultural commodities hauling business. After hauling small loads of refuse for a fee, the operator noticed a lot of cardboard in the waste. The company revamped an old school house and began separating waste, and sending only non-recyclable items to the landfill. To hold down costs, the station operated only used equipment at first. By carefully selecting commercial accounts that contain a large percentage of recyclables, the operation has remained very profitable. The transfer station sends about 16 tons of cardboard to the recycler and only one 30-yard roll of box to the landfill per week. Future plans include building a buyback center for bottles, cans, paper, and eventually plastic.

Meade, Kathleen. "The Transfer Station Down the Street," Waste Age, pp. 82-84. October 1990.

An article describing the expansion of a construction and demolition (C&D) debris transfer station in Boston, Mass. The purpose is to show alternative uses for transfer station technology. Jet-A-Way waste company is investing \$10 million dollars to construct a state of the art C&D transfer station. The facility will be built in two stages. The first stage is the construction of the building and sorting system, which is brought in from Switzerland. The second phase will be the construction of a raw materials processing plant. To keep noise and dust to a minimum, the entire facility will be enclosed. The transfer station charges a \$105 per ton tipping fee. The city of Boston is happy to have the facility, because as the only licensed C&D transfer station in Boston, it will greatly reduce the amount of debris taken to an already strained landfill.

Meade, Kathleen. "Transfer Stations as Fuel Producers," Waste Age, pp. 78-84. December 1988.

An article describing resource recovery techniques at transfer station operations. The purpose is to explain the process of obtaining refuse-derived fuel (RDF) through material separation at transfer station operations. Although no current transfer station has currently been adapted into an RDF facility, the potential is there. After mechanical and hand separation, the remaining mixed waste paper, wood, some plastics, and other combustible materials will produce excellent RDF raw material. An RDF transfer facility in Canada is expected to produce about 25,000 tons of RDF material in its first year of operation.

A transfer station in Portland, Oregon, is being targeted as the first RDF transfer facility in the United States. The RDF/transfer station idea began in 1986 through corporation mergings. In Canada, the government and the private sector have combined to form an efficient working relationship. Although the Canadian landfill is a long distance from large populations, backhauling RDF makes the system profitable.

"Oregon Facility Retrofits for Bigger Waste Volumes," World Wastes, pp. 40-42. March 1990.

Article describes the renovation of an existing transfer station in Forest Grove, Oregon to handle a larger volume of waste. The purpose is to show how a community may improve a sub-standard transfer station with equipment and site purchases to handle current and future demands. The transfer station added a crane, changed the method of transfer, and made improvements to the transfer building. The owner estimates that the cost of renovation was about 20-to-50 percent higher than if the improvements would have been incorporated into the original design in 1985. The transfer station has gone from a low-volume station to one that handles 250-tons per day, with capacity up to 500 tons per day.

Peluso, Richard A., and Ruckert, Ernest H. "Waste Transfer: The Basics," Waste Age, pp. 88-92. December 1988.

A series of eight articles beginning with the above citation and running until July, 1989 in Waste Age magazine. The purpose is to provide step-by-step instructions on the planning, designing, construction, and operation of a transfer station. The eight articles are: (1) Waste Transfer: The Basics; (2) A Look at Waste Transfer Options; (3) How to Site a Transfer Station; (4) How to Get Transfer Station Permits; (5) Designing for Smooth Transfer Operation; (6) How Much Will Transfer Cost?; (7) Managing Transfer Station Data; (8) Transfer Stations Can Recycle, Too!. The articles provide comprehensive plans, operation alternatives, and helpful information from conception to operation about transfer stations.

Risk Assessment Guidelines, Nevada Division of Environmental Protection.(Out of print)

A guidebook for owners and operators of rural municipal solid waste handling systems. The purpose of this chapter is to provide solid waste operators with cost estimates of various transfer station equipment. The estimates are made from data collected in Nevada. Transportation costs are estimated to be \$5 per cubic yard for up to a 35-mile radius, and \$8 per cubic yard for a 35-to-100 mile radius. Hauling costs are estimated to be \$1.50 per mile. Estimates of transportation costs and drop-box container costs are presented. Regionalization of sparsely populated areas are recommended. A hypothetical example is provided which shows the estimated cost of operating a solid waste transfer station.

Salimando, Joe. "The Berry Street 'Transfer Station' Mall," Waste Age, pp. 115-116. December 1988.

An article detailing a transfer station that sells merchandise found in collected waste. The purpose is to show the flexibility of transfer station operations. The Berry Street Mall, owned by

Bill Finger, is really a transfer station which also sells pre-owned items pulled out of everyday waste. The items for sale include lawnmowers, clothes, dishes, and toys. Although not all items are in working condition, they can provide parts for other machines. The transfer station has evolved since the 1940's from a dump to a state-of-the-art landfill, to the current facility. The transfer station is a 15,500-square foot facility designed by a local architect. The cost of construction was about \$1.1 million. Currently, the transfer station hauls about 75 tons per day to a landfill over 30 miles away. Finger estimates there are more than 100,000 items for sale in the mall. Besides saving many bulky components from the waste stream, the transfer station also removes silver from air conditioners and gold from discarded computers.

"Satellite Vehicles, Satellite Transfer," Waste Age, pp. 157-160. September 1989.

An article describing a low-cost transfer station in Beaverton, Oregon. The purpose is to provide communities with alternatives to large capacity transfer stations. The transfer station is operated by a private solid waste firm, Miller's Sanitary Service. Miller's collection operation uses small, six-cubic-yard packer trucks, each operated by one man crew. The collection vehicles are capable of servicing 250 to 300 households per day. The transfer station site is simply a large open space near the company headquarters. When the collection vehicles are full, they empty their load into large, self-compacting containers. Each large container holds about five full collection vehicle loads. The large containers are then removed and disposed of by conventional roll-off trucks. By using the small collection vehicles, many problems such as weight, driver recruitment, and excess taxes may be avoided. This type of transfer operation makes it possible for small communities that are unable to finance a large transfer station.

Schaper, Laurence T. "Transfer of Municipal Solid Waste," The Solid Waste Handbook, Chapter 9, pp.195-214. John Wiley and Sons, New York, N.Y. 1986. (\$110)

A book dealing with all aspects of the solid waste handling industry. The purpose of Chapter 9 is provide a detailed analysis of transfer stations including location, design, process options, transfer vehicles, materials handling equipment, maintenance, and cost analysis. Formulas are provided to estimate the capacity of a transfer station. Advantages and disadvantages of different types of transfer stations are presented. Several types of equipment and processing options are discussed. Cost savings associated with transfer haul are possible to do reduction in mileage traveled by collection vehicles, and reduction in non-productive crew time during the haul by collection vehicles. The decision to utilize a transfer system is tied to an anticipated reduction in costs. Case studies are presented to aid the understanding of constructing and operating a transfer station. This chapter provides a comprehensive overview of transfer station development.

Sloggett, Gordon, and Doeksen, Gerald. Solid Waste Transfer Stations for Rural Oklahoma. Oklahoma State University Cooperative Extension Service. Fact Sheet #881. 1992 (Single copies are available free upon request).

A fact sheet containing cost estimates for building a transfer

station in rural Oklahoma. The purpose is to give solid waste system operators an example cost estimate for constructing and operating a transfer station. The location, size, and design of the site must be carefully considered to minimize cost and maximize the convenience and function of the transfer station. The size of the transfer building will depend on the type and volume of the material accepted. A wide variety of equipment is available with two methods of transfer being most common. Most transfer stations use either roll-off boxes hauled by a special truck or trailers pulled by semi-trucks. There are also two common methods of compacting solid waste for transfer to the disposal facility. First are self contained compactor trailers, and second are stationary compactors. The equipment chosen must meet the requirements of the station. Estimates of the capital and operating costs required to implement a transfer station in Oklahoma. An example transfer station is provided to help solid waste system operators estimate their own costs.

Smith, David W., and Stagg, Elizabeth. "Bergen County Bales Out of a Disposal Emergency," World Wastes, pp. 40-41. January, 1990.

An article to outline what Bergen County, N.J. did when the local landfill closed. Options available to communities whose landfills have closed are described. In 1987, a local landfill stopped taking waste from Bergen County. To dispose of the nearly 3000 tons of solid waste produced per day in Bergen County, a transfer station was built that included baling solid waste. The transfer station was built in four phases to allow continual operation. Phase I included clearing and grading the transfer station site. Phase II was the construction of roadways, foundations, and other site work. A 300,000-square-foot metal building was constructed in Phase III. Finally, Phase IV included the construction of permanent mechanical and electrical systems. The total cost of the transfer station was about \$57 million. The transfer station began operation within nine months and was fully completed in 13 months.

"Transfer Stations in Regional Recycling," BioCycle, pp. 38-40. February 1993.

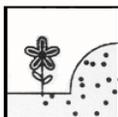
An article explaining a new use for transfer stations in recycling operations. The purpose is to show alternative uses for transfer technology. Because transfer stations are so basic, they can be applied to a variety of situations. The use of a transfer station in a recycling operation allows the same cost reductions as in a solid waste operation. There are two basic transfer designs used in recycling operations; split levels, and dumping floors. Split level simply deposits recyclables down into lower level transfer vehicles, and dumping floors use loaders to place recyclables into transfer trailers. The costs of constructing a transfer station for recyclables range from \$4,000 to around \$1 million. The type of containers used in transfer depend upon the type and volume of material being hauled. Smaller sites often use roll-off containers, while large capacity operations use 45-foot open-top transfer trailers and semi-trucks. An attendant is usually required to help the public, and inspect incoming loads. The biggest problem with transfer stations handling recyclables is with glass breakage due to additional handling.

Transfer Stations. Michigan Department of Natural Resources, Waste Management Division. RRS #25.1984.

A study that describes the methods and economics associated with operating a solid waste transfer station. The purpose is to provide a general information base for community leaders when considering a transfer station as a solid waste disposal alternative. The factors involved with developing a transfer station include design considerations, capacity requirements, and licensing. There are basically two types of transfer station designs; gravity dumping and compactors. Several advantages and disadvantages of each type are outlined. The costs of constructing and operating a transfer station must be compared with the costs of directly hauling waste with collection vehicles to determine which alternative would be most economical. Tables are included that provide rough estimates of operating, depreciation, and capital costs. An example community is provided to show the comparison between transfer station and direct haul costs. Appendices include transfer station equipment manufacturers, licenced Michigan transfer stations, and case studies of seven state transfer stations.

"Waste Transfer Products," Waste Age, pp.123-124. October 1988.

A list of products and manufacturers of transfer station equipment. The purpose is to give transfer station operators a variety of equipment choices. General specifications are given with each type and manufacturer of equipment.



Recycling

Ardis, Dan, "Success Stories in Rural and Remote Areas,"
Resource Recycling, July 1992, pp. 87-90.

This article describes a cooperative effort between 26 small towns in rural Ontario, Canada. It provides a good example of the benefits of regional cooperation in processing, particularly for small towns dispersed over a large geographic area. The main cooperative effort focused on the processing and education programs, with collection the responsibility of individual towns.

Chertow, Marian R., Garbage Solutions. A Public Official's Guide to Recycling and Alternative Solid Waste Management Technologies, National Resource Recovery Association, The United States Conference of Mayors, Washington, DC, June, 1989.

This publication was designed to provide a roadmap for public sector participants through programs and technologies for recycling, composting, and mixed waste processing. Alternatives are assessed and programs are described in a non-technical way. Chapters are included on source separation, processing separated waste, recycling special wastes, composting, and processing mixed solid waste. Additionally the last two chapters deal with trends and ideas related to waste management alternatives and hints on implementation.

A great deal of basic information and data are included in this publication. These would be helpful in developing an orientation or educational program. Applicability to rural areas will take special effort by the user. There is no special effort to address issues of rural waste management alternatives.

Cole, J. Timothy, "Buy-back Recycling in Rural North Carolina." Resource Recycling, June 1990, pp. 64-67.

The article focuses on the efforts of a small community to establish a recycling program. It asserts that demand for recycling in the community was great enough to offset funding problems. The author finds that the main predictors for participation are distance and, to a lesser extent, socio-economic status. The article does not include any specifics on costs and the tone of the paper suggests that there are substantial losses in the operation.

Community Recycling: A Decision-maker's Guide, Roy F Weston, Inc. Georgia, 1991.

This manual is a companion text to workshops held across Georgia. It provides a summary of workshop topics, information on recycling resources and contacts throughout Georgia, and how to use these resources. The focus of this manual is the recycling decision process. The role of recycling in an integrated solid waste management system is discussed. Additionally the manual provides information on designing, implementing, evaluating and refining a recycling program. The manual was designed for local decisionmakers, recycling

program managers, solid waste program managers, interested community leaders, and people providing assistance to local decisionmakers.

The manual is not designed strictly for rural areas, and care should be taken applying the information to these areas. However, this manual provides a terrific basic education source for any community considering a recycling program.

Cosper, Stephen, William Hallenbeck, and Gary Brenniman, "Case Studies in Rural Recycling." Public Service Report No. OSWM-14 Office of Solid Waste Management, University of Illinois at Chicago. Chicago 1994. (Available free of charge, contact [312] 996-6927).

This publication describes 14 rural recycling programs located in Illinois, Iowa, Minnesota, Colorado, Tennessee, and Ontario. For each program there is a brief description of the program's history and the kind of recycling activities engaged in, followed by a discussion of specific problems that have been encountered (and attempts to overcome them). These case studies should be of some value to local recycling coordinators who are grappling with many of these same issues. A final section of the report summarizes and discusses key problems that emerge from the individual program descriptions - sparse population, small and/or shrinking tax bases, marketing difficulties due to geographic isolation, and difficulties in conducting public education and information dissemination activities. This latter discussion is a succinct, yet comprehensive overview of issues that are unique to rural recycling.

Decision-Makers Guide to Solid Waste Management, U.S. Environmental Protection Agency, Solid Waste and Emergency Response, EPA/530-SW89-072, Chapter 6, pp. 59-80. November 1989.

This chapter provides a basic understanding of the planning and implementation required for a successful recycling program. Local planners are encouraged to develop an understanding of recyclable materials markets, setting realistic goals, and fostering public participation. A brief discussion is also provided on commonly recycled materials. This helps local decisionmakers evaluate the potential recyclable material in their waste stream.

The implementation section provides an excellent description of collection methods and storage. It also provides hints on local ordinances to enhance the recycling program. Costs and benefits, environmental effects, and the role of recycling in waste management options are discussed in very general terms.

Most of the information in this chapter is applicable to rural recycling programs. The discussion on availability of markets, collection methods, and setting realistic goals are especially applicable. This chapter provides a very good beginners discussion of recycling.

Goldman, Matthew and Richard Keller, "Rural Recycling: Not Just Another Curbside Recycling Collection Program," Resource Recycling, July 1992, pp.62-69.

This article points out major differences between rural and suburban recycling programs. It enumerates a number of factors distinguishing rural areas from suburban areas, including lower population and population density; more seasonal waste generation (particularly in rural areas with significant tourism); significantly less industrial waste; and limited collection options (both public and private). The article then summarizes the ways to design and implement rural recycling programs that accommodate these differences (as opposed to attempting to operate programs modeled on suburban programs).

Goodwin, Kyle, Gordon Sloggett, Gerald Doeksen, and Joe Fitzgibbons, "Rural Community Solid Waste Recycling Systems," OSU Extension Factsheet No. 888, Oklahoma Cooperative Extension Service. 1992 (Available free of charge. Contact: [405] 744-6083).

This factsheet identifies commonly recycled materials, reviews collection alternatives, and discusses the key ingredients to successful implementation of a rural recycling program. The section on program implementation stresses planning, public education, and commitment on the part of local officials. The importance of markets for recyclables is appropriately highlighted as a key component of minimizing program costs. While the title of the factsheet implies that it is directed at rural recycling, the discussion throughout generally ignores differences between urban and rural recycling programs.

Lariniere, Ray, "Rural Recycling in Southeast Colorado," Public Works, May 1993, pp. 57-60.

This article describes a successful drop-off program initiated by several rural communities in Colorado. It chronicles funding, contracting, and implementing issues that have been addressed, as well as the ways in which initial lack of support from local governments was overcome. This article provides a useful blueprint for smaller communities attempting to institute a pilot recycling program.

Lightle, Michael, "The State of the State: Recycling in Montana," Resource Recycling, March 1991, pp. 141-146.

The article provides an overview of the recycling industry in Montana. The purpose is to show that significant gains in waste reduction can be made with community involvement and some slight modifications to existing processing operations. After a short introduction describing existing collection agencies, the article focuses on the recent initiatives designed to enhance the desirability of recycling. The article concludes with a discussion of local non-profit organizations that have come into existence in order to deal with solid waste management and reduction.

Morrissey, Janice, "Waste Management Problems in Rural Areas: Limits To Citizen Participation In Decision making," in Proceedings of the Tennessee Valley Authority Rural Waste Management Symposium, Knoxville, TN: Tennessee Valley Authority Valley Resource Center. 1992 (Available free of charge. Contact: [615] 632-8179).

This paper focuses on a case study of a Tennessee landfill site location decision. It gives a detailed description of the case and the community reaction to the proposal. Using the case study as a point of reference, the author identifies the methods behind current site planning and licensing by the waste authorities. Attention is focused on the process whereby the government makes siting decisions, and how it might be changed to better involve those most directly affected by the landfill. Alternative procedures for solid waste licensing (and means of implementing them) are also discussed.

National Solid Waste Management Association, Recycling in the States: 1990 Review, Washington, DC: NSWMA. 1991 (Available at a cost of \$7.50 plus \$3 shipping. Contact [202] 364-3714).

This document reviews solid waste diversion options (with special emphasis on source reduction and recycling), providing an overview of what steps have been taken by various states and regions. It begins with comprehensive review of states that have established guidelines for recycling and waste reduction. Disposal bans are discussed in considerable detail. Different types of grants and loans available for financing recycling and waste reduction projects are discussed (including several state profiles). The final section details the wide disparity in solid waste management policies between states and offers some suggestions on how to increase waste diversion in states that lag behind.

Park, William M., "An Overview of Solid Waste Management Issues Facing Rural Communities," in Proceedings of the Tennessee Valley Authority Rural Waste Management Symposium, Knoxville, TN: Tennessee Valley Authority Valley Resource Center. 1992 (Available free of charge. Contact: [615] 632-8179).

A simple summary of the solid waste decisions made by rural solid waste authorities with a special focus on recycling is presented. Three specific activities are covered: collection, processing and marketing. The recyclable processing section focuses on whether it is cost effective for counties to begin regionalizing their processing or maintain the facilities themselves. Many of the parameters of the decision are discussed, though none at length.

Platt, Brenda, "Four Small Communities Recover More Than 40 Percent of Their Household Wastes," Resource Recycling. June 1993 pp. 47-52.

This article describes successful recycling programs in four very small towns, ranging in size from 2,000 to 5,000 people. The main contention of the article is that with sufficient community involvement a large percentage of the waste stream can be diverted from landfills via recycling. This article is a good summary for small communities interested in setting up a recycling program.

Platt, Brenda A., Naomi Friedman, Carolyn Grodinsky, and Margaret Suozzo, In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results. Volume 1: Rural Communities. Washington, D.C., Institute for Local Self-Reliance. 1992 (Available at a cost of \$18 plus \$3.75 shipping. Contact: [202] 232-4108).

This report documents the characteristics of composting and recycling programs in eight rural communities across the nation. Communities selected for the study represent a mix of program types (public and private collection, separated and commingled set-out, mandatory and voluntary participation, and volume-based versus flat fees), as well as differing levels of waste recovery. Program descriptions include portraits of model drop-off centers, salvage/reuse operations, co-collection of refuse and recyclables, small-scale processing centers, food waste recovery programs, and collective marketing techniques. A common methodology for gathering and documenting data facilitates comparison of different types of programs. However, there is no effort made to synthesize the results or evaluate the desirability of different options.

Renkow, Mitch "The Cost of County Recycling Programs in North Carolina," Publication No. AREP948, Applied Resource Economics and Policy Group, Dept. of Agricultural and Resource Economics. North Carolina State University (Available free of charge. Contact: [919] 515-5179).

This research bulletin presents the results of a survey of 11 county recycling programs in North Carolina. Information on costs of collection, processing, and disposal of recycled materials for a variety of recycling programs - convenience centers, drop-off sites, curbside collection, and special programs - is presented. This information should be of use to solid waste planners, both as a benchmark against which to compare their own existing programs and as a rough guide in choosing among alternatives (e.g., curbside pickup versus convenience centers).

Shaw, Lowell K., and William M. Park, "The Economic Feasibility of Rural Recycling: Three Case Studies," Research Report 89-15, Department of Agricultural Economics and Rural Sociology, The University of Tennessee Agricultural Experiment Station. University of Tennessee, Knoxville, August 1989.

This study recognizes some special issues that rural areas face relative to recycling. Rural communities cannot generate a large volume of recyclable materials to help them take advantage of the significant economies of size in recycling operations. Relatively high transportation costs of moving recyclables to urban materials markets also complicate recycling efforts in rural areas. The objective of this study was to describe and analyze the economic experience of rural communities with buy-back recycling programs. Specifically the study set out to: identify the expenditures necessary to be begin recycling operations; determine the economic feasibility of recycling operations; investigate the extent to which economies of size exist for recycling operations; identify factors associated with the volume of recyclable materials collected; and document the perceptions of those managing recycling operations regarding factors influencing performance.

Case studies of recycling centers in three Southeastern states were evaluated (Alabama, Tennessee and North Carolina). Each was located in largely rural areas with total county populations below 50,000. The smallest county population for the case studies was slightly over 17,000.

Detailed information is presented for each recycling center on the cost of establishing each center as well as operating cost and recyclable material collected. These would be extremely useful to decisionmakers contemplating establishment of similar recycling centers.

The study concluded that stable markets for recyclable materials was an extremely important factor affecting feasibility. Economic feasibility, when comparing only revenues from recyclable material sales and full costs of operation would be extremely difficult to achieve in rural communities the size of those in the study. However, the authors suggest that other factors such as reducing landfill costs by diverting material from the waste stream should be considered in the evaluation. Other local benefits cited were income provided to participants, aesthetic improvements and community pride.

The study suggests that local governments may consider outside funding and subsidies for labor costs to help reduce net costs of operation. However economic feasibility may be improved best by increasing the volume of recyclable materials to a more efficient level.

This study specifically addresses rural recycling and provides excellent guidelines on issues facing rural areas. Additionally, cautions and concerns that public officials must understand as they evaluate a recycling project.

Stedge, Gerald D., John M. Halstead, and Douglas E. Morris, "An Economic Analysis of Alternative Recycling Systems," Research Report Number 127, New Hampshire Agricultural Experiment Station, University of New Hampshire. Durham, New Hampshire. March 1992.

This study uses a case study approach to examine three types of collection methods. It hypothesizes that the bag-based system should capture a larger share of the waste stream because of its efficient collection and separation system, paired with its convenience.

The bag-based system was compared to a curbside sort program and a drop-off program. Time/motion analysis, garbage composition study, a household survey and recording of set-out rates for a sample of dwelling units were used to estimate the efficiency of each method. Efficiency was defined as the ability to minimize the ratio between the cost per ton of operating the system and the percentage of the residential waste stream diverted, while maintaining a given minimum diversion level. The efficiency of the bag-based system was also estimated for three areas with distinct household densities in order to determine if the bag-based system is more efficient in more populated areas.

The curbside-sort system was found to divert a larger percentage of the residential waste stream than the bag-based system. However, the cost per ton of the bag-based system was

much lower and pronounced to be the most efficient of the three systems.

The drop-off system had a very low cost per ton; however, it failed to divert the minimum acceptable level of the waste stream (15 percent of Residential Solid Waste). The study found the bag-based system to be more efficient in areas with higher household densities.

The size of the municipalities (10,000 - 30,000) prevents the results of this study from being directly applicable to small rural towns and open country areas. However the detail coverage of the three collection systems would provide any decisionmaker with a sound understanding of alternative systems. Cost data are also included which would be useful for planning, as long as costs were updated as needed.

Waste Management of North America, Inc., "America Turns To Recycling," Oak Brook, IL: Recycle America Program. 1992 (Available free of charge. Contact: [708] 572-2457).

This is a promotional document designed for the consumer and aimed at sparking citizen interest in recycling. It provides a good overview about general types of recycling and how certain materials are easier to recycle than others. Some basic figures are given showing the difference between what can be recycled and what is being recycled. The document encourages consumers to pressure local leaders to take more aggressive steps to institute recycling programs. In general this is a good educational tool for consumers, not waste management planners.

Composting

Alexander, Ronald and Rod Tyler, "Using Compost Successfully," Lawn & Landscape Maintenance, November 1992, pp. 23-34.

This article describes the major markets for compost uses, including landscaping, nursery growers, sports turf, topsoil blending, land reclamation, and roadside maintenance. Product uses within each market are explained, along with the desired compost characteristics for those uses. The article highlights the fact that composts exhibit a wide range of characteristics and qualities, and the article does a good job of explaining the applicability of different kinds of compost for different applications. This information is potentially useful to municipal compost producers in determining likely outlets for their compost products and the degree of technological sophistication needed to produce a marketable product.

Bader, Charles D., "Co-Composting: A Down to Earth Approach." MSW Management, March/ April 1993, pp.52-61.

Experiences of several communities in overcoming public resistance to sludge co-composting facilities are discussed. The main barriers discussed are odor problems and environmental regulations associated with sewage sludge. The article argues that public fears of noxious odors from these facilities is not warranted - an argument contradicted by the fact that one of the facilities cited as a success story in the article was later forced to close because of odor complaints. Federal, state and local regulations affecting the use of sewage are viewed as a more

formidable obstacle to co-composting, although the author argues that existing facilities are well within the limits of pollutant levels proscribed by water quality regulations (such as the EPA Part 503 Rule). Several different co-composting projects of differing scale and state of completion are reviewed, as are a few small demonstration projects.

BioCycle staff, The BioCycle Guide to Composting Municipal Wastes, Emmaus, PA: JG Press, Inc. 1989. (Note: This publication is now out of print).

This collection of 35 separate articles on various aspects of composting is widely regarded as the "bible" of municipal composting. The articles are grouped into separate sections on facility design and operation, end product stability and maturity, health and safety issues, markets and utilization, co-composting solid wastes, leaf and yard waste composting, and biological treatment of industrial and hazardous wastes. The section on yardwaste composting is fairly brief, those interested in this area should refer to a companion volume entitled The BioCycle Guide to Municipal Yardwaste Composting that is devoted exclusively to yardwaste composting. Given the breadth of coverage, this document is a valuable source document for solid waste managers with an interest in composting. Particularly useful is a directory of firms selling composting equipment and systems.

Derr, Donn A., "Estimating the Cost of Leaf Composting," in Peter F Strom and Melvin S. Finstein (eds.), Leaf Composting Manual for New Jersey. New Jersey Department of Environmental Protection. Trenton, NJ, 1992 (Available from the author. Contact: [908] 932-9161).

This paper discusses how municipalities can assess the costs and benefits associated with leaf composting, with particular emphasis on costs. The specific cost estimates are for a 30,000-cubic-yard- per-year facility, but the discussion of the various cost components is relevant to facilities of any size. This information is of value to waste managers in assessing the cost effectiveness of leaf composting as a part of their solid waste management system. The author appropriately emphasizes the opportunity cost of alternative disposal methods as the major benefit of municipal composting.

Derr, Donn A., Daniel Kluchinski, and Jennifer Morgan, "Developing Successful Public/Private Partnerships - The Case of Leaf Mulching," Paper presented at the 48th Annual Meeting of the Soil and Water Conservation Society. Fort Worth, Texas. 1993 (Available from the author. Contact: [908] 932-9161).

This paper examines current and potential opportunities for increasing land application of leaf mulch to farmland through public/private partnership arrangements. The paper reviews the positive effects of leaf mulches on agricultural productivity, ways in which the state can promote on-farm mulch use, and the relative costs of alternative leaf management systems (municipal composting, regional composting, on-farm composting, on-farm mulching, and commercial composting). The authors find that on-farm leaf mulching and on-farm composting can represent significant cost savings to municipalities by reducing their waste management burdens.

Dunning, Rebecca, Robert L. Degner, and P.J. van Blokland, "Municipal Solid Waste Composting: Issues Facing Communities," Florida Agricultural Market Research Center Staff Report No. 93-1, University of Florida Institute of Food and Agricultural Sciences. 1993 (Available free of charge. Contact: [904] 392-1871).

This publication summarizes a great deal of information regarding Municipal Solid Waste (MSW) composting as a waste management alternative. Separate sections discuss technological issues, economic issues, and political issues in the context of community waste management goals. The section on technological options is fairly rudimentary. The section on political considerations is a generic (and brief) overview of some siting and ownership issues common to a number of waste management options. The section on economic issues does a nice job of laying out the kinds of information needed for a community to adequately evaluate the desirability of committing to MSW composting; however, it does not contain specific cost information. Perhaps the most useful information in the document is a comprehensive listing of existing MSW composting facilities (including contacts) and organizations capable of providing more information.

Goldstein, Nora, David Riggle, and Rob Steuteville. "Sludge Composting Maintains Growth," Biocycle. December 1992, pp. 49-56.

This survey article discusses the status of sludge composting in the United States. It provides a very detailed overview of co-composting facilities currently in operation and the different types of composting systems employed. The effectiveness of various types of odor filters is reviewed, along with brief discussions of marketing strategies, new technologies, and new materials that can now be composted. The article contains numerous tables, including one giving the location, status, type, and volume per day of all sludge composting facilities in the U.S.

Goodwin, Kyle, Gordon Sloggett, Gerald Doeksen, and Joe Fitzgibbons, "Rural Community Yardwaste Composting Systems," OSU Extension Factsheet No. 887, Oklahoma Cooperative Extension Service. 1992 (Available free of charge. Contact: [405] 744-6083).

This factsheet provides a brief overview of municipal yardwaste composting. Topics covered include collection system alternatives, various yardwaste composting methods available to community planners, site requirements for municipal facilities, and marketing considerations. The authors emphasize the importance of community cooperation and good management in the successful implementation of a composting program. Despite its title, the factsheet is equally relevant to urban and rural settings.

Henry, Charles L. and Robert B. Harrison, "Comparing Yardwaste and Sludge Compost," Biocycle. February 1993, 42-47.

This article presents the findings of a study comparing the chemical components and the growth enhancement capabilities of different types of composts: yardwaste compost with sludge added, yardwaste compost without sludge added, and sludge-woodchip compost. Moisture holding characteristics, elemental composition, pH, and cation exchange capacities of each

compost are discussed, and the results of growth experiments with tomatoes, lettuce, Douglas firs, carrots, and lawn grass. In general the composts were found to have positive effects on plant growth. There were, however, some cases in which plants did not respond well (relative to control plots), probably due to nitrogen deficiencies - a result prompting the authors to conclude that inconsistency of compost products will likely have a negative impact on market acceptability.

Jesitus, John, "Economics, Siting Top Composters' Concerns," MSW Management. September/October 1993, pp. 58-68.

This article describes in some detail three successful municipal composting programs - one yardwaste composting operation, one Municipal Solid Waste (MSW) composting operation, and one MSW/sludge co-composting operation. The articles emphasizes marketing, cost effectiveness in production activities, and quality control of the final product as key components of a successful program. Particular attention is paid to the ways in which solid waste managers have tailored these programs to local circumstances - be it making use of a local organic waste stream dominated by an unusual item (fish entrails) or taking advantage of available market outlets.

May, James H. and Thomas W. Simpson, The Virginia Yardwaste Management Manual. Publication 452055, Virginia Cooperative Extension Service. 1991 (Note: This publication is now out of print).

The handbook offers an excellent treatment of virtually all aspects of designing and operating a municipal yardwaste facility. It contains quite detailed information that can provide guidance to facility managers on day-to-day operation. The summary of construction and operations requirements for different types of facilities is a valuable aid for assessing the kind of facility that best fits particular local circumstances. Also highly valuable are worksheets for estimating annual processing costs (including labor, machinery, and capital costs), for summarizing benefits and costs of prospective facilities, and for monitoring daily production operations. The handbook also includes an equipment price list that, while somewhat out of date, is comprehensive enough to provide realistic information on equipment needs.

Minnesota Extension Service, Municipal Solid Waste Composting: Is It Right for Your Community? Extension Bulletin No. NR-BU-6179-S, University of Minnesota. 1993 (Available at a cost of \$3.95. Contact: [612] 625-8173).

This bulletin provides an overview of virtually all aspects of Municipal Solid Waste (MSW) composting. Topics covered include waste stream characterization, separation, composting methods, product quality, facility siting and operation, financing, and public education. Particularly impressive is the balanced presentation of the pros and cons of composting vis-a-vis other disposal options, and the pros and cons of different types of composting facilities and composting methods. The discussion should equip solid waste managers considering MSW composting to ask the right questions. A videotape that accompanies the bulletin is also available.

O'Leary, Philip, Patrick Walsh, and Aga Razvi, "Solid Waste Composting," Correspondence Course articles reprinted from various editions of Waste Age.1989-1990 (Available free of charge. Contact: [608] 262-0493).

This collection of eight articles, reprinted from a correspondence course in Waste Age magazine, address various aspects of composting, and is available from the Engineering Professional Development program at the University of Wisconsin, Madison. Topics covered include technical aspects of MSW and yardwaste composting, yardwaste collection, facility design and operation, integration of composting into other solid waste management activities, and marketing. Throughout, the presentation of technical information is quite accessible to a lay reader. The article on marketing is particularly useful, providing numerous suggestions for identifying and maintaining stable outlets for compost products.

Platt, Brenda A., Naomi Friedman, Carolyn Grodinsky, and Margaret Suozzo, "In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results. Volume I: Rural Communities.," Washington, D.C., Institute for Local Self-Reliance. 1992 (Available at a cost of \$18 plus \$3.75 shipping. Contact [202] 232-4108).

This report documents the characteristics of composting and recycling programs in eight rural communities across the nation. Communities selected for the study represent a mix of program types (public and private collection, separated and commingled set-out, mandatory and voluntary participation, and volume-based vs. fiat fees), as well as differing levels of waste recovery. Program descriptions include portraits of model drop-off centers, salvage/reuse operations, co-collection of refuse and recyclables, small-scale processing centers, food waste recovery programs, and collective marketing techniques. A common methodology for gathering and documenting data facilitates comparison of different types of programs. However, there is no effort made to synthesize the results or evaluate the desirability of different options.

Renkow, Mitch, Charles Safley, and Jeff Chaffin, "A Cost Analysis of Municipal Yard Trimmings Composting," Compost Science & Utilization. Spring 1994, pp. 22-34.

Cost estimates for municipal yardwaste composting facilities of different sizes and levels of technological sophistication are provided. Types of facilities considered range from very simple "minimal-tech" operations with minimal labor and equipment needs to more sophisticated "medium-tech" operations using specialized equipment (e.g., compost turners, shredders, and screens). Facilities handling 25,000, 100,000, and 200,000 tons per year are considered. The analysis focuses exclusively on processing costs - neither collection nor marketing (revenue-generating) activities are considered. The cost estimates indicate that processing costs of yardwaste composting compare favorably with the costs of operating a state-of-the-art sanitary landfill. Fixed costs (particularly debt service) are the largest cost component of annual operating expenses. The authors found evidence of significant economies of scale in yardwaste composting.

Richard, Tom L., Peter B. Woodbury, James W. Gillett, Ellen Z. Harrison, and Vincent T Breslin, "MSW Composting Factsheet Series," Cornell Waste Management Institute, Cornell University. 1993 (Available at a cost of \$7. Contact [607] 255-2080).

This is a series of seven factsheets on various topics related to composting municipal solid waste. Each factsheet addresses one of the following topics: Physical processing, biological processing, strategies for separating contaminants, potential effects of heavy metals on plants and the environment, worker health and safety issues, policy and regulation issues, and quality assurance. Taken as a whole, the information contained in these factsheets provides a comprehensive overview of the technical (engineering) aspects of Municipal Solid Waste (MSW) composting. This information is valuable for waste managers in that it should help them make informed decisions in the design and purchase of MSW composting systems. Unfortunately, these factsheets do not contain information on the costs of various options, and therefore cannot help waste managers decide whether MSW composting is an economically viable component of an integrated municipal solid waste management system.

Sherman, Steven, "The Economics of Yardwaste Composting in Westchester County, New York," Agricultural Extension Bulletin No. 89-30. Cornell University, Ithaca, NY (Available free of charge. Contact [607] 255-2102).

This bulletin provides an evaluation of the economic costs and benefits of yardwaste composting, leaf composting, and home composting for a county in New York. The author finds that while the costs of yardwaste composting are very high (especially leaf collection costs), composting is a cost effective option. This is primarily due to the fact that landfill disposal costs in the county are extremely high. The discussion of costs is quite useful - particularly the emphasis on the opportunity cost of disposing of yardwaste in landfills.

U.S. Environmental Protection Agency, "Composting," Chapter Eight in Decision-Makers' Guide to Solid Waste Management, Office of Solid Waste and Emergency Response Publication No. 530-SW89-072. November 1989 (Available free of charge. Contact: [800] 424-9346).

This chapter offers a broad review of various aspects of municipal composting. Most of the discussion focuses on yardwaste composting, with brief references to Municipal Solid Waste composting and sludge composting. Topics covered include types of composting technologies, costs of centralized facilities, marketing compost products, and environmental effects of composting. The section on costs lists the major cost items, but is short on actual cost estimates. The section on marketing includes a balanced discussion potential markets, obstacles to successful marketing, and some strategies for overcoming these obstacles. The section on environmental impacts of composting facilities focuses primarily on water quality and public health concerns.

Source Reduction/Waste Prevention

Fishbein, Bette K. and Caroline Gelb. Making Less Garbage A Planning Guide for Communities. INFORM, Inc. 1992. 179 pp (Available from INFORM, Inc. at 212-689-4040 at a cost of \$30.00; nonprofit and other discounts available).

This publication begins with four chapters covering "the essentials of source reduction planning. The first provides a brief introduction, the second a discussion of the concept of source reduction within the U.S. solid waste management problem, the third a discussion of policy, goals, and measurement, and the fourth a discussion of administration and budget matters. The remainder of the guide is dedicated to description of source reduction initiatives in the government and institutional sectors, as well as government programs and strategies to stimulate source reduction in the private sector, among both households and businesses. Separate chapters are devoted to education, economic incentives, and regulation. A final chapter focuses on reducing toxic materials in solid waste. Also included are a "source reduction planning checklist" and an extensive bibliography. While the guide is not oriented to the rural context specifically, and some of the discussion is more relevant to a state policy level, it does contain a good bit of what could be very useful information.

Harrison, Ellen Z. and Angell, Richard J. Waste Prevention Tool Kit for Local Governments. Cornell University Waste Management Institute. December 1992, 172 pp (Available at 607-255-1187 for \$14.95).

A compendium of materials from many sources including surveys, articles, case study descriptions, model programs, and camera-ready educational materials. Begins with short articles on the "what, why, and how" of waste prevention and general options. Organized by chapters on government planning, financial incentives, bans and regulations, business and institutional planning, procurement, education, and publicity and public relations. Includes lengthy list of references and sources of additional information. Though not strictly oriented toward rural communities, a good bit of the material would be relevant.

Waste Prevention, Recycling, and Com-posting Options: Lessons from 30 Communities. U.S. EPA EPA530-R-92-015. February 1994, 168 pp (Available from the RCRA hotline at 800-424-9346 at no charge).

This report draws lessons from the experience of 30 communities with either high material recovery rates or model waste reduction initiatives. Eight are considered to be rural communities, 12 to be suburban areas or small cities, and 10 to be large urban areas. This report is organized around seven chapters addressing: (1) materials generation and recovery rates, (2) waste prevention strategies, (3) comprehensive source-separation composting programs, (4) improving residential recycling levels, (5) improving commercial and institutional recovery levels, (6) targeting construction and demolition debris for recovery, and (7) the costs of recycling and composting. The report contains an enormous amount of quantitative information as well as qualitative assessments of strategies. While much of the emphasis is on the type or scale of programs that may not be relevant to most rural communities or areas, such as curbside

recycling, there certainly is a lot of information that would apply in the rural context. This report draws on detailed case studies of the 30 communities, which are published in a three-volume set by The Institute for Local Self-Reliance. One of the volumes covers just the eight rural case studies and is listed and reviewed elsewhere.

Waste Reduction Strategies for Rural Communities.

Prepared by The MaCC Group with support from Tennessee Valley Authority for the American Plastics Council. March 1994 (Available from TVA at [615] 632-3023 or The American Plastics Council at [202] 371-5319 at no charge).

This report presents case studies of 10 different communities or waste management programs, ranging from a single municipality to an eight-county cooperative, in the southeast region of the country. The report focuses on the resourcefulness of people in rural communities in development of successful waste reduction programs that can potentially be duplicated in other parts of the country. A brief comparative overview of the case studies is presented initially. Each case study is described in detail, according to a uniform outline that includes the following topics: community profile, solid waste system, waste diversion strategies, feature program, and lessons learned. Under the topic of waste diversion strategies, any waste reduction, recycling, and composting activities are described. With respect to the feature program, the subjects of development, implementation, financial information, and barriers and solutions are discussed. Personal contacts at the program level are provided for each case study. In the appendices, contacts are provided for about 30 communities or programs which were considered for inclusion, along with a very brief description of their notable feature(s). Quite a few photographs are also included in an appendix, typically 3-to-5 from each case study. The report would appear to be a useful resource for rural communities looking for creative waste diversion strategies.

Waste-To-Energy

Ditz, Darryl, "A New York State Perspective: Combustion of Municipal Solid Waste," Waste Management Research Report No. 7, Cornell Waste Management Institute. Cornell University, Ithaca, NY, Winter 1989 (Available free of charge. Contact: [607] 255-7535).

This article discusses issues related to energy recovery. Topics covered include ash management, air emissions and associated health risks, emerging incineration technologies, and pollution control equipment. The discussion is non-technical and does not go into much depth on any of the subjects.

Ditz, Darryl, "Just How Compatible Are Incineration and Recycling," Cornell Waste Management Institute Viewpoint No. 3, Cornell University, Ithaca, NY. Summer 1990 (Available free of charge. Contact: [607] 255-7535).

This factsheet considers energy, environmental, and economic implications of recycling and incineration, and finds potential for both complementary and conflicting interactions between these two solid waste management options. The basis for potential conflict between these two activities is that

recycling may divert waste from energy facilities. This will reduce the revenue obtained through energy recovery facility tipping fees, and hence the ability to cover the very high fixed costs of these capital-intensive facilities. In addition, for communities having "put or pay" contracts requiring minimum amounts of waste flow into energy recovery facilities, successful waste diversion through recycling can cause additional financial difficulty. At the same time, the factsheet points out the potential for complementarity if recycling activities are targeted to collecting materials that have low energy content (e.g., glass) can improve incineration efficiency, while removal of metals can reduce potential air emissions and ash management difficulties.

Halley, Geneil, Guidelines for Decision Makers: Solid Waste Management. County Technical Assistance Service, The University of Tennessee, Knoxville, 1991 (Available at a cost of \$20. Contact: [615] 242-0358).

The section on energy recovery facilities in this guidebook describes the major kinds of incineration facilities (mass burn systems, modular systems, and refuse-derived fuel systems). It also provides "ballpark" estimates of the costs for facilities of different sizes. These cost estimates include operating expenses, construction costs, and capital (finance) costs.

National League of Cities, Waste-to-Energy Facilities: A Decision-Maker's Guide. Alexandria, VA: National Publishing, 1986 (Available at a cost of \$15 plus \$3 shipping. Contact: [301] 725-4299).

A collection of articles on a various topics related to energy recovery facilities. Areas covered include planning, contracting and facility procurement, siting, types of energy recovery technologies, environmental impacts, and financing issues. The articles are geared directly at public officials, providing a balanced presentation of the various issues (some highly controversial) surrounding the siting and operation of these kinds of facilities. Given its 1986 publication date, the book is somewhat dated in some respects (especially the discussions of environmental regulations and pollution control equipment). However, the sections on siting, contracting, and financing are comprehensive reviews of available options that are highly relevant.

Nemeth, Diane M., The Resource Recovery Option in Solid Waste Management: A Review Guide for Public Officials. Office of Renewable Technology Publication No. 20156-T, U.S. Department of Energy. 1983 (Available at a cost of \$17.50 plus \$4 shipping. Contact: [800] 553-6487).

This guidebook outlines institutional problems and alternatives related to implementation of resource recovery projects. It is directed at informing public officials and citizens regarding issues of waste supply markets, economic viability, siting, financing, and environmental concerns. Although much of the information on environmental issues is out of date, the discussion of financing alternatives, economic risks, and operations options remains relevant. Particularly valuable is the balanced presentation of the pros and cons of alternative ownership arrangements (public versus private) and financing instruments (general obligation bonds versus municipal bonds versus industrial development bonds).

Robinson, William and Sergio Martinez, "Waste Disposal/Resource Recovery Plant Costs," in W.D. Robinson (ed.) The Solid Waste Handbook: A Practical Guide. New York: John Wiley & Sons, 1986.

This chapter provides ranges of net costs for various types and sizes of energy recovery facilities. Finance charges, construction costs, operating costs, and revenues are discussed in some detail. Specific (somewhat dated) cost figures are presented for a wide range of facility sizes, thereby providing a rough idea of differences in the cost of incineration between high volume urban areas and low-volume rural areas. Moreover, the thoroughness of the description of the types of costs incurred by local governments should be quite useful for local solid waste managers.

U.S. Environmental Protection Agency, "Municipal Waste Combustion," Chapter Eight in Decision -Makers' Guide to Solid Waste Management, Office of Solid Waste and Emergency Response Publication No. 530-SW-89-072. November 1989 (Available free of charge. Contact: [800] 424-9346).

This chapter reviews various aspects of energy recovery. Topics include planning, siting and sizing of facilities, environmental concerns (including air pollution control and ash management), and net costs of energy recovery facilities. Proper planning -taking into account ownership decisions, engineering and legal decisions, contractor selection and coordination, markets for electricity or steam generated by the facility, and sources of financing - is emphasized as critical for long-run success. The section on costs and revenues lists key cost (revenue) components, but is short on actual estimates.

Walsh, Patrick W. and Philip R. O'Leary, Implementing Community Waste-to-Energy Systems. University of Wisconsin Extension Bulletin 63450. 1989 (Available free of charge. Contact [607] 262-0943).

This publication describes waste-to-energy technology alternatives, discusses legal, technical, financial and regulatory issues that communities face in developing a waste-to-energy plant, and suggests a ten-step process for implementing a waste-to-energy system. The discussion of the potential risks of various ownership and financing options is balanced and well-presented. The publication is available free of charge from the Solid and Hazardous Waste Education Center at the University of Wisconsin.



WASTE DISPOSAL

Landfills

Anon, "Decision-Makers Guide to Solid Waste Management," U.S. EPA EPA/530-SW-89-072. November 1989.

Provides a brief introduction to landfills including formation and control of leachate and methane gas, closure and post-closure care requirements, siting a landfill and landfill costs.

Anon. "Rural Solid Waste Management: Regional Planning Users Guide," Coastal Georgia Regional Development Center.

This two volume publication presents extensive step-by-step procedures for all aspects of solid waste management. Chapters 10 and 11 cover disposal options and facility siting and permitting. Chapter 15 lists items needed in the preparation of a detailed work plan and chapter 16 addresses public involvement. The use of geographic information systems is introduced and explained in chapter 19. The publication has been developed to provide a sequence of steps to be followed. For example successful facility siting is addressed in sixteen steps which include from public hearing through development and implementation of a site ranking system. Charts and examples are useful. The publication is most useful in providing direction to public officials who need training in what sequence of topics to consider.

Anon. "Sites for Our Solid Waste: A Guidebook for Effective Public Involvement," U.S. EPA EPA/ 530-SW-90-019. March 1990.

The document provides a framework for establishing public involvement in the siting of facilities. Two case studies are described to generate ideas about how the public involvement process can be successfully implemented. General principles of public involvement are listed that encompasses identification of the public, planning for public involvement, informational and participatory techniques, communicating risk, technical information acceptance, and mitigating potential negative impacts.

Anon. "Siting Solid Waste Facilities: Seven Case Studies," Management Information Services V01 24. No. 10. International City Management Association. October 1992 (Available at 202-289-4262).

The article describes the siting of seven solid waste facilities. For each case study a general background is provided, a description of the controversy, major parties, siting strategy, public involvement, the time frame and results are summarized. Lessons learned encompass community communications, keeping elected officials informed, addressing host community concerns, flexibility in responding to negative aspects, and seeking creative solutions.

Anon. "Solid Waste Management Decision Makers Series," North Carolina Alternative Energy Corporation. Spring

1990.

Although this publication is directed toward waste-to-energy facilities it does provide facility siting considerations and a discussion of needed project consultants which is also useful for landfill design.

Anon. USDA Training Module Four: Sanitary Landfills. (Draft) 1994.

The document provides a detailed description of Subtitle D landfill regulations. It provides information on locational criteria, operation requirements, design, groundwater monitoring, closure and post-closure care, and financial assurance. Information is presented such that the reader, who has limited knowledge of landfills, can rapidly gain an overview and perspective of the interrelationships among landfill design and operational components. A series of slides for use as overheads or slides are provided which are useful for instruction.

Bagchi, A. Design Construction, and Monitoring of Sanitary Landfill, 1990. John Wiley & Sons, Inc. New York. 1990.

The book provides detailed design information for solid waste landfills. Topics include site selection, leachate and gas generation and control, waste characterization, design and construction details, landfill operations, monitoring methods and requirements, and economic analysis.

Gamman, J.K. and J.C. Jostes. "Facilitated Negotiation: A New Solution for Dealing with Public Siting Controversies," Municipal Solid Waste Management, 1994.

The authors detail problems with current siting strategies and then present a methodology that integrates siting solid waste landfills with a process to increase the overall capacity of communities to resolve difficult problems and build lasting relationships. The process described follows several steps including internal team-building, developing objective criteria to guide the project, joint fact-finding, and seeking mini-agreements. Issues are refrained from adversarial option-making to a cooperative search for solutions.

Himmelberger, J.J., S.J. Ratick and A.L. White. "Compensation for Risks: Host Community Benefits in Siting Locally Unwanted Facilities." Environmental Management Vol. 15, No. 5, pp. 647-658.

The article examined the association between the type and amount of compensation paid to host communities by facility development and the size and characteristics of a facility, timing of negotiated agreement, and size and socioeconomic status of the host community. Host community benefits were found to be positively associated with percentage of total facility capacity dedicated to host community use and larger for public than private municipal waste landfills. Data from 24

facilities were evaluated. A listing of nine host community benefits is provided and illustrated. The most predominant form of community benefit was free or reduced tipping fee and represented about two-thirds of the total compensation.

Hirshfield, Stephen, P. Aarne Vesilind and E.I. Pas. "Assessing the True Cost of Landfills", Waste Management & Research. (1992).10, 471-484.

The article proposes an approach to estimating the external costs arising from the development and operation of a landfill. External costs are separated into physical and social components. The physical costs are considered additional controls necessary for added protection of the environment to reduce leachate and gas migration. In the article leachate costs are simple determined by adding a second composite liner system and a leachate collection and treatment system. Social costs result from increased traffic, noise pollution, and fugitive dust. These social costs are addressed by evaluating depreciation of property values as a function of distance from the landfill. Eight real estate appraisers were provided a map of a hypothetical town in which a landfill was placed among several neighborhoods with predetermined value. The appraisers developed functional curves relating initial house value to distance from a located landfill.

Malia, James E. and Janice Morrisey. "Rural Communities and Subtitle D: Problems and Solutions," Tennessee Valley Authority, Center for Rural Waste Management. December 1994, 99 pp (Available from U.S. EPA- Region 4 at (404) 347-2091 at no charge).

A well-written report that presents eight case studies documenting how rural communities in the Southeast have adjusted to the solid waste management challenges they are facing as a result of Subtitle D requirements regarding landfill disposal. The focus of case study descriptions is on how these communities are dealing with one or more of the issues of cost, control, and cooperation. Three of the case studies relate the experience with formal cooperative efforts among several counties. Others relate how individual counties are adapting through use of transfer stations, volume-based user fees, and creative planning and financing to support a small-scale landfill. Each case study presents an overview, a detailed discussion of key elements, and a list of lessons learned. Pertinent quantitative information on solid waste volumes and costs is included where appropriate. Overall, this report appears to be potentially useful to local decision-makers in rural communities who are evaluating options for dealing with the impacts of Subtitle D.

Maznanian, D. and D. Morell. "Facility Siting and the Failure of Democratic Discourse," Municipal Solid Waste Management. July/August 1992.

Although the focus of this article is on superfund sites the concerns addressed are also applicable to siting solid waste landfills. The authors focus on the differing perceptions of risk by project proponents, government scientist, elected- officials and citizens and environmentalist. Risks are viewed as calculated return on investment, statistical potential adverse impacts, political threat to re-election, and in terms of health and safety. Principles of equity and justice are described to find acceptable solid waste siting solutions.

Nelson, A.C., J. Genereux and M. Genereux. "Price Effects of Landfills on House Values," Land Economics. 68(4): pp.359-65. November 1992.

The article applies a model to estimate the price effect of one Minnesota landfill on the value of 708 nearby houses during the 1980s. Forms of nuisance associated with nearby properties include noise, hours of operation, traffic, odors, debris, and appearance. Landfills use setbacks and buffer zones to achieve physical separation between the landfill and nearby residences. Families equate landfill proximity with diminished environmental quality of life and this is reflected in depressed housing prices. Result of the assessment is an empirical formula that indicates that a landfill adversely affected home values in the range of 12 percent at the landfill boundary and 6 percent at about one mile. Beyond about 2-to-2.5 miles adverse effects are negligible.

Opaluch, J.J., S.K. Swallow, T. Weaver, C.W. Wessells, and D. Wichelns. "Evaluating Impacts from Noxious Facilities: Including Public Preferences in Current Siting Mechanisms," Journal of Environmental Economics and Management. pp. 24, 41-59 (1993).

The researchers used a paired comparison survey method, in which respondents choose between two hypothetical landfill sites, described in terms of generic attributes or characteristics. Attributes evaluated included on-site acreage of wetlands, woodlands and farm land; quality of groundwater; wildlife habitat; number of houses in the vicinity of the landfill; and the presence of schools in the surrounding community. Results of the paired comparison ranking methodology indicate the a high value for both surface and groundwater was realized. Among the locational attributes the presence of schools and farm land appear to be the most significant factors.

Pigg, K. (ed.) Community Issues Gathering: A Tool for Resolving Controversy. CD Practice. No. 1. 1994. Community Development Society.

The article describes a step-by-step procedure for moderators that helps people deal with controversial issues that require some deliberation or critical thinking on the part of the community. Controversial issues are addressed in ways that do not destroy relationships. Discussions, ideally, can create a sense of "we" where public knowledge emerges and people move toward common ground. The goal of the moderator is to work with a group and frame the issues in a way that might be more helpful to deliberative public talk. The refrained issue is developed to reflect the diverse interests (rather than positions) in the community. The article provides a methodology framework that encompasses how to write an issue brief which provides three options, evaluation of the brief, site selection for the gathering, suggested rules and goals for the gathering session, analyzing the highlights of each choice, methods to achieve common ground and some moderate do and don't.

Ready, R.C., A. Pagoulatos, and W.M. Park. "Economics of Solid Waste management in the 90s," Southern Regional Information Exchange Group10 SRIEG-10 No. 30. April 1993.

The document is the proceedings of a regional workshop on the subject of solid waste economics. Twelve papers are

presented that describe federal framework and state initiatives, what does local solid waste management really cost?, landfill site evaluation based on public preferences, assessing the negotiation processed in solid waste landfills, and research needs.

Robert R.K, P.V. Douglas, and W.M.Park. "Estimating External Costs of Municipal Landfill Siting Through Contingent Valuation Analysis: A Case Study," Southern Journal of Agricultural Economics, Dec. 1991.

A willingness to pay assessment was conducted in the siting of a landfill in Tennessee. Estimated annual external costs were \$227 per household. Where drinking water supplies were at risk of contamination an increase in the willingness to pay of \$141 was reported compared to household who used city or bottled water.

Robinson, W.D. The Solid Waste Handbook: A Practical Guide. John Wiley & Sons. New York, NY. 1986.

The text is a comprehensive description of solid waste components. Case studies are used throughout. Landfill siting, design, operation and monitoring aspects are addressed. Engineering principles are provided.

Sara, M.N. Standard Handbook for Solid and Hazardous Waste Facility Assessments. Ann Arbor, MI. 1994.

The book is a comprehensive assessment of siting for solid waste facilities. Chapters two and three provide very detailed information on all phases of site assessment detailing use of regional maps groundwater information, soils, surface water, climate, land use, etc. A major attribute of this publication is the listing of information sources and how to use information acquired. Geology and groundwater are emphasized throughout the book.

Tchobanoglous, G., H. Theisen and R. Eliassen. Solid Wastes Engineering Principles and Management Issues. McGraw-Hill. New York, NY 1977.

Although somewhat dated the book provides useful information on solid waste generation estimation methods, leachate and gas movement; both with respect to engineering and management techniques.



FACILITATING SOLID WASTE MANAGEMENT

Public-Private Partnerships, Contracting, and Financing

Alternative Financing Mechanisms for Environmental Programs. U.S. EPA. August 1992, 122 pp.

This guide outlines a range of alternative financing mechanisms (AFMs), including economic incentives, public-private partnerships, bonds, loans, and grants. Over 80 AFMs are described in terms of advantages, disadvantages, appropriate uses, and additional references that provide further information. Relevant to both state and local levels.

Financing Models for Environmental Protection. U.S. EPA H3304. September 1992, 88 pp.

Reports on experiences of EPA's Public-Private Partnerships Demonstration Program, in which six models of financing arrangements are being tested across a wide spectrum of environmental programs, including solid waste management. These models include privatization, regionalization, bond pools, cooperatives/circuit riders, pollution prevention partnerships, and market-based incentives. A number of case studies are discussed.

Gehr, William and Brown, Michael. "When Privatization Makes Sense," BioCycle, July 1992, pp. 669.

The article provides a description of the following five alternative types of public/private partnerships: contract services, turnkey facilities, developer financing, privatization, and merchant facilities. Discusses how these alternatives differ with respect to division of responsibilities. Assesses merits of these alternatives on the basis of the following criteria: ability, timeliness, cost and risk.

International City/County Management Association. "Making Environmental Partnerships Work," MIS Report, Vol. 22/No. 9. September 1990, 24 pp. (Available at 202-289-4262 at a cost of \$13.95).

This publication provides information on environmental partnerships from both the public and private perspective. Contains a collection of experiences of local government officials and private sector representatives who have been directly involved in such partnerships. Also, examines the benefits and risks of cooperative efforts.

International City/County Management Association. Service Contracting A Local Government Guide. 1992 (Available at 202-289-4262 at a cost of \$48).

This publication assists local governments in planning, developing and administering efficient and effective service contracting programs. Ways to organize and improve service contracting programs evaluate bids and proposals, negotiate, and monitor performance are suggested. A glossary of common

contracting terms is included.

National Solid Wastes Management Association.

"Privatizing Municipal Waste Services; Saving Dollars and Making Sense," 1991 (Available at 202-659-4613 at nominal cost).

This short publication presents arguments as to why municipalities can expect to save money by privatizing solid waste services. References are made to several case studies covering collection, recycling, and disposal.

Note: The following five publications are available at no charge from the U.S. EPA's Environmental Financing Information Network (EFIN) at (202) 262-0420.

Public-Private Partnership Case Studies Profiles of Success in Providing Environmental Services. U.S. EPA PM-225. September 1990. 118 pp.

This publication outlines 22 case studies of public/private partnerships. Two of the case studies focus on regionalization of solid waste management efforts, both involving mass burn incinerators.

Public-Private Partnerships for Environmental Facilities: A Self-Help Guide. U.S. EPA H3304. July 1991, 39 pp.

This publication gives local officials an overview of the issues and decisions they face in developing a partnership option. Included is an action checklist of the major steps required in a public private venture.

Solid Waste Contract Negotiation Handbook. U.S. EPA. May 1992, 76 pp.

Designed to help develop successful public-private partnerships and intergovernmental agreements. Provides sample provisions and guidelines.

Variable Rate/Unit Pricing Systems

General Guidebooks

Charging Households for Collection and Disposal: The Effects of Weight or Volume-Based Pricing on Solid Waste Management. U.S. EPA. 1991 (Available as document PB91-111 484 from NTIS (703-487-4650) at a cost of \$26).

Provides a conceptual rationale for unit pricing systems and a framework for assessing their effectiveness. Reports findings from three in-depth case studies, two of which were small communities with less than 10,000 population. Uses case study evidence to draw conclusions and identify unresolved issues. Written as more of an analytical discussion than as a guidebook for decision makers.

Pay-As-You-Throw: Lessons Learned About Unit Pricing.

U.S. EPA 530-R-94-004, April 1994 (Available from the EPA RCRA Hotline (800-424-9346) at no charge).

Designed to help local solid waste administrators and planners, elected officials, community and civic groups, environmental and business organizations, and others find an answer to the question, "Is unit pricing a viable option for our community, and, if so, how do we implement it?" This is a very user-friendly guidebook that is organized in four parts as follows: Part I: Is Unit Pricing Right for Your Community, Part II: Building Consensus and Planning for Unit Pricing, Part III: Designing an Integrated Unit Pricing Program, and Part IV: Implementing and Monitoring Unit Pricing. A large number of specific and practical questions are addressed in Part III, relating for example to volume versus weight-based approaches, billing and payment systems, and handling multifamily housing. An appendix presents the transcript of a roundtable discussion by experts of specific questions relating to getting started, program options, issues, and experiences, integrating unit pricing and complementary programs, and accommodating groups with special needs. Insights from case studies are scattered throughout the document. The primary weakness of the document from the standpoint of rural SWM is the absence of any attention to the drop-off collection context that is relevant to many rural counties throughout the country.

Skumatz, Lisa A. Variable Rates for Municipal Solid Waste Implementation Experience Economics and Legislation. **43 pp. 1993 (Available from the Reason Foundation (310-391-2245) at a cost of \$15).**

Describes various types of variable rate systems and assesses advantages and disadvantages of each. Discusses implementation issues that must be addressed. Summarizes impacts of variable rate systems from case study experiences. Summarizes state-level initiatives to require or encourage adoption of variable rate systems. Describes methods for evaluating effectiveness of programs. Views variable rate systems within overall context of local solid waste management. A good primer on the subject.

Variable Rates in Solid Waste: Handbook for Solid Waste Officials. U.S. EPA 530/SW-90-084a. 1990 (Volume II - Detailed Manual is available as document PB90-272 063 from NTIS (703-4874650) at a cost of \$44.50. Volume I - Executive summary available from EPA RCRA Hotline (800-424-9346) at no charge).

This comprehensive manual is based primarily on the experience with variable can rates in Seattle, Wash., and thus is oriented toward the large urban area setting. However, it does provide in-depth discussions of a number of subjects including feasibility, rate design considerations, conducting a solid waste rates analysis, and operational changes. In addition to the detailed information on the experience of Seattle, the manual includes a summary comparing characteristics of 15 other unit pricing programs, most of which require residents to purchase special bags. A comprehensive bibliography of materials published before 1990 is also provided. The Detailed Manual would be appropriate only for those who have definitely decided to implement a variable rate system and are seeking detailed guidance on specific aspects of implementation. The Executive Summary, itself 37 pages in length, will suffice for those at the

exploration stage.

Specific Approaches or Programs

Becker, Jeanne and Browning, Marilyn. "Volume-Based Garbage Collection Fees: An Analysis of 10 Illinois Programs," Resource Recycling. March 1991, pp. 97-103.

This article summarizes the experience of ten small cities in Illinois, all serving between 2,000 and 12,500 households, that implemented either a bag or sticker program between 1988 and 1990. In all cases, private haulers are responsible for collection of refuse, yardwaste, and recyclables. Discussion focuses on the cost and distribution of the bags or stickers, the impact on the amount of recyclables collected, public information efforts, and problems encountered such as illegal dumping, excessive compaction, and insufficient or uneven revenue flows. An assessment of the seriousness of these problems and how they were dealt with is provided.

Bracken, Robert. "North Carolina County Institutes Sticker System," BioCycle. February 1992, pp. 35-37.

This article summarizes the experience to date of North Carolina's Craven County, N. C., which in November of 1991, implemented a volume-based user fee system and extended curbside collection of garbage and recyclables to all 30,000 households in the county, including residents in the six municipalities and in unincorporated areas. The system uses stickers priced at \$1.25 for a 33-gallon bag, although each household receives a monthly allotment of four stickers at no charge. The system faced significant opposition at the time it was initiated, though few problems with illegal dumping have occurred. Operational problems have been minimal, and the impact on recycling participation and the tonnages of materials collected has been quite large.

Harder, Greg and Knox, Linda. "Implementing Variable Trash Collection Rates," BioCycle. April 1992, pp. 6-69.

This article provides limited information on 36 communities, all except two with less than 20,000 population and most with less than 10,000 population, that were operating volume-based user fee systems in Pennsylvania as of 1991. Only one had been implemented before 1985. Three types of systems were predominant: bag, tag, and fee plus bag. From a survey of program managers, the most common problems encountered were associated with inadequate public information, illegal dumping and burning, and the bags themselves (e.g., tearing by animals and counterfeiting). Four programs are discussed at some length, including one that was not successful for a variety of reasons.

Hultgren, Lon. "Volume-Based Rates in a Small Community," Public Works. April 1992, pp. 60-62.

This article documents the experience of Mansfield, Conn., a suburban-rural community of 3,000 households, with a volume-based rate system that was implemented in October 1990. The system applies to those residents who subscribe for collection by a private hauler and the 40 percent who self-haul to the town's transfer station. The article provides information on the cost for various levels of subscription service and the

percentage of households choosing each. Rates for multi-family units and for self-haulers at the transfer station are also provided. There are also discussions of obstacles, initial publicity, and enforcement issues, as well as conclusions, recommendations, and lessons learned.

Park, William M. "Using Volume-Based User Fees in Rural Areas: How Do They Work?," Resource Recycling, January 1995.

This article summarizes findings from detailed case studies of five rural counties and one town that have implemented volume-based user fees in a drop-off collection system, in which self-haulers bring their solid waste to a convenience center or transfer station. The systems vary substantially in terms of the fee mechanism employed, with two requiring purchase of special bags, two requiring a purchased sticker or token, and two requiring cash payment at the site. Comparison of the systems is provided with respect to fee levels and the importance of the user fee in overall solid waste management system financing, treatment of recyclables and special wastes, impacts on recycling participation and tonnages of material collected, and experience with expected problems such as illegal dumping or burning and administrative feasibility or cost.

Skumatz, Lisa. "Introducing the Hybrid Variable Rate System," BioCycle, November 1993, pp. 38-40.

This article discusses the potential advantages of a hybrid system for financing local solid waste management. While the discussion is set in the context of a curbside collection system for garbage and recyclables, the idea would appear to have merit in both a curbside collection context in small rural communities and a drop-off collection context in rural counties. The idea is to provide some base level of service through general property taxes or a flat fee, and then charge by the bag or can for amounts above the base level. In a drop-off collection context, the base level service might include so-called special or problem wastes such as white goods and bulky items such as furniture, with point-of-disposal fees only for bagged household garbage. The key advantages of these hybrid financing systems are the reduced risks of (1) receiving too little revenue to cover the total costs of the system and (2) illegal dumping or burning in response to the per bag fee. At the same time, an incentive is still provided at the margin for source reduction and recycling.

Regional Cooperation

Bixby, Sarah L. and Phillips, James M. "Regional Recycling Leads to Cost Savings," BioCycle, pp. 38-41. January 1993.

A case study description of cooperation among four rural counties in Iowa for the processing of recyclable materials. Chronicles the development of the effort, which began with collection of recyclables and establishment of a 30-ton per day MRF in Carroll County. Later three neighboring counties formed a regional solid waste agency, began to collect recyclables, and decided to contract with Carroll County for processing and marketing. As a result of the increase in material flow from about 5 tons per day to 15 tons per day the net cost of processing fell from \$115 per ton to \$63 per ton. This case study provides a lot of detail with respect to costs, characteristics of the contract agreement, and difficulties in holding the

arrangement together.

DeBoer, Larry. "Issues to Consider in the Solid Waste Management District Decision," EC-656, Purdue University Cooperative Extension Service. West Lafayette, Indiana. 8 pp.

Though written specifically to assist Indiana county commissioners in a decision that had to be made by July 1, 1991, with respect to formation of single- or multi-county districts, this paper provides an excellent discussion of ten questions that should be addressed in the similar process that rural communities in many states are going through or will go through. The author makes an important distinction between counties' political function, figuring out what citizens want, and their managerial function, delivering the services decided upon.

Joining Forces on Solid Waste Management: Regionalization is Working in Rural and Small Communities, U.S. EPA 530-K-93-001. October 1994 (Available from the EPA RCRA Hotline (800424-9346) at no charge).

This guidebook is the product of a joint venture with the National Association of Regional Councils and includes fairly general discussions of the following topics: why regionalize, how to get started, and alternative types of regional organizations. It also provides brief descriptions of five regional case studies and lists federal agency and public interest organization contacts. Perhaps most valuable is the annotated bibliography of publications from various sources on regionalization, privatization, and financing of solid waste management systems.

"Multicomunity Collaboration: An Evolving Rural Revitalization Strategy." Conference Proceedings published by the North Central Regional Center for Rural Development at Iowa State University in Ames, Iowa. 1992.

Excellent set of 39 papers by economists, political scientists, sociologists, and others, that includes a number of overview/perspective pieces, as well as a variety of cases study discussions. Emphasis is on economic development efforts, although there is some attention given to public service provision. One chapter by Larry DeBoer discusses preliminary findings from an analysis of factors associated with formation of solid waste districts in Indiana. Implications for policy, as well as research and extension programs are outlined.

Park, William and Jeffrey Case, "An Analysis of Regionalization Scenarios for Solid Waste Management in the Upper Cumberland Development District Using the WastePlan Computer Model," Waste Management Research and Education Institute Report No. SW-10-93, University of Tennessee. 1993.

This study has two purposes: to analyze the potential cost savings from regionalization of solid waste facilities in a 14-county area of middle Tennessee, and to assess the usefulness of the WastePlan computer program in conducting this sort of analysis. With regard to the first of these objectives, the authors find that regionalization would lead to significant cost

savings under even the most conservative scenarios. With regard to WastePlan, the authors' assessment is quite guarded, but generally positive. They do note that the data requirements necessary for running the program - as well as the large amount of time and effort needed to learn the program - are potentially offputting to local officials.

Park, William, Jeffrey Holt, and Roland Roberts, "Regional Coordination for Processing of Recyclables from Rural Areas: A Case Study of the first Tennessee Development District," Waste Management Research and Education Institute Report No. SW-5-91. University of Tennessee. 1991.

This report analyzes economic tradeoffs involved in establishing a regional processing facility for recyclables in an eight county region of eastern Tennessee. Using a combination of survey information and expert estimates of processing and transport costs, the authors find that for the region as a whole a regional system of recyclable processing would yield significant cost savings over a system whereby each county processes and markets its recyclables individually. However, further analysis indicates that for some more remote counties, large transport costs may in some situations cancel out cost savings from tying in a regional processing facility. The report does a nice job of presenting the tradeoff between scale economies in processing and the cost of distance.

Schoenrich, Lola. Case Studies of Seven Rural Programs Cooperatively Marketing Recyclables. 150 pp. and Appendices. April 1994. (Available from the Minnesota Project at (612-645-6159) at a cost of \$15.00. A 12-page Synopsis is available at no charge).

This well-written report provides detailed description and in-depth analysis of seven programs involved in the cooperative marketing of recyclable materials collected in rural areas. Several of the programs are involved in processing and transporting of materials as well as activities related to securing contracts for their sale. The case studies range in size or scope from one serving about 100,000 people in four counties to one serving several million in five southwestern states. Most, however, are nearly like the former than the latter. After an Executive Summary, short summaries of each case study are presented. Then, observations are presented, organized around the following topics: goals, operations, organizational structure, and budgets and finances. A summary of the benefits and challenges is provided and conclusions are drawn. Then detailed descriptions of each case study are presented, averaging over 10 pages in length. Finally, a great deal of useful information is provided in the nine appendices, including samples of factsheets and newsletters, job descriptions, intergovernmental agreements, price sheets and tracking information, RFPs from buyers, contracts with buyers, and contracts and agreements with program participants. An extensive bibliography is also provided.

Schoenrich, Lola, and Mary Kohrell. Analysis of the Results of the 1993 Survey of Cooperative Marketing Groups in the United States and Canada. 24 pp. April 1994 (Available from The Minnesota Project at (612-645-6159) at no charge).

Schoenrich, Lola, and Mary Kohrell. Results of the 1993 Survey of Cooperative Marketing Groups in the United States and Canada: Peer Match Directory and Individual Program Summaries. 160 pp. April 1994 (Available from The Minnesota Project at (612-645-6159) at a cost of \$15. The information in this report is also available as a data base on IBM compatible disk with a user's guide for \$15).

These two reports resulted from a project of the Cooperative Marketing Network, which was formed in 1992 at the National Recycling Congress. The project involved a survey of programs involved in cooperative marketing of recyclable materials. While not strictly limited to rural areas, the 64 programs from which responses were received predominantly serve communities in rural areas. The first report provides a comparative summary of the findings from the survey, with discussions of the following topics: services provided, program structure, program operations market relationships, program planning and initial organizing, finances, and benefits of cooperative marketing. The report is well written, effectively uses a variety of charts and tables, and is highly informative. The second report includes a peer match directory that lists contacts for each of the 64 programs and indicates (1) whether they are willing to host visitors or travel to other areas to speak about their program, (2) their areas of experience and expertise, and (3) the type of geographic area(s) served. A companion data base on IBM compatible disk is also available, which should allow users to more efficiently search for specific information. A brief and very readable four-page user's guide is included with the disk.

Shanahan, Eileen. "Going It Jointly: Regional Solutions for Local Problems," Governing, pp. 70-76. August 1991.

A general discussion of the growing trend toward service sharing agreements among local governments, with brief mention of numerous examples. Not specific to rural communities or solid waste management, although a few of the examples do relate to rural solid waste management.

"Solid Waste Management: Exploring Regional Roles," National Association of Regional Councils, Special Report No. 143, 7 pp. 1988.

A summary report based on research by the Institute of Environmental Studies at the University of North Carolina that produced a technical report and five concept papers on the following issues: regional waste characterization, functional watershed delineation, determining institutional structure in regional solid waste management, economic issues in regional solid waste management, and technical assistance models in regional solid waste management. The discussion in this summary report is fairly general and indicates that the concept papers were intended to "stimulate discussion and set the stage for further research."

Emphasis is on the role of councils of governments in the process of regionalization.

SOURCES OF OTHER INFORMATION

National Agricultural Library
Rural Information Center
1-800-633-7701

Resource Conservation and Recovery Act (RCRA) Hotline
1-800 424-9346

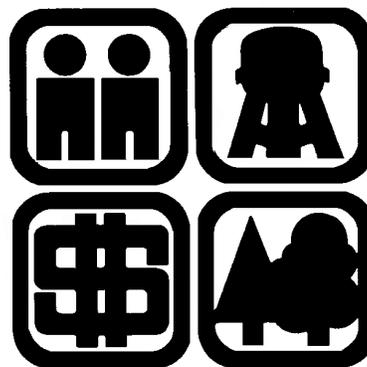
Solid Waste Association of North America (SWANA)
301-585-2898

Solid Waste Database
Auburn University
(334)844-4181

Solid Waste Information Clearinghouse (SWICH)
1-800-67SWICH

Waste Management Institute
Cornell University
607-255-1187

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**Southern Rural Development Center
Box 9656
Mississippi State, MS 39762**

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