SOLID WASTE MANAGEMENT: A GUIDE FOR RURAL NORTH CAROLINA COUNTIES

by

H. Hazen Blodgett

A paper submitted to the faculty of the

University of North Carolina

at Chapel Hill

in partial fulfillment of the requirements

for the degree

Master of Public Administration

Chapel Hill

February 15, 1993

Faculty Committee:

Dr. Gordon Whitaker
Advisor

Dr. A. John Vogt
Reader

Ed Regan
Reader

ABSTRACT

With the passage of North Carolina's Solid Waste Management Act and the publication by the Environmental Protection Agency of final rules for Subtitle D of the Resource Conservation and Recovery Act, counties in the state are under strict guidelines to implement these rules. Rural counties have additional problems because of a lack of money and professional staff. This paper will provide direction to rural counties by describing solid waste programs their counterparts have implemented.

TABLE OF CONTENTS

I. Introduction

In rural counties, county managers and their department heads "wear a variety of hats." Besides being budget officers, personnel officers, and purchasing agents, county managers may spearhead the county's solid waste efforts. At least one county in northeastern North Carolina does not have a solid waste director's position. Other rural counties may not have the professional staff to keep abreast of new regulations. The audience for this paper is not engineers and solid waste directors, but county managers and other department heads who may be delegated certain solid waste responsibilities and who want to ensure their county's compliance with new solid waste management laws.

All counties are feeling fiscal pressure from supporting Federally mandated welfare programs, adjusting to the rising costs of education, and coping with increases in health care. In Halifax county, human resources represent seventy-four percent of the general fund budget. Needless to say, little money is left for building a high-tech landfill estimated to cost approximately $350,000 per acre.

Nevertheless, even with their financial woes, rural counties are still required to implement the North Carolina Solid Waste Management Act and Federal Subtitle D Regulations. Chapters two and three are designed to give an

overview of these two comprehensive and far reaching laws.

The final chapter in this paper examines successful solid waste management programs in North Carolina. Rural programs have received special emphasis because in many instances they are easily duplicated in other rural counties. However, some waste reduction activities in urban counties of Catawba and Buncombe have been highlighted as well.

II. 1989 North Carolina Solid Waste Management Improvements Act

During the 1989 Session of the General Assembly, the North Carolina Legislature passed the Solid Waste Management Improvements Act. The "Act" established waste reduction/recycling goals, set timetables for banning certain wastes, implemented a scrap tire fee, and initiated planning and reporting requirements for local governments. While this law is regarded as landmark solid waste legislation for North Carolina, it created confusion among local governments until it was clarified in 1991.

Drawbacks of the Original Law

The Solid Waste Management Improvements Act, still commonly known as Senate Bill 111 or S.B. 111, establishes a hierarchy for waste disposal. At the top of the hierarchy is waste reduction at the source as the preferred method.[2] In descending order of perference are the other waste reduction methods of recycling and reuse, composting, incineration with energy production, incineration for volume reduction, and disposal in landfills.[3]

Senate Bill 111 established a goal whereby twenty-five percent of the State's waste would be recycled by January 1, 1993. The original goal only rewarded local governments for recycling. However, in the State's hierarchy of solid waste

management priorities, waste reduction was listed as most important. The vagueness of the law created several problems for cities and counties.

The State Solid Waste Management Plan showed, seventeen percent of the waste stream state-wide being recycled.[4] Under one interpretation of the "Act", local governments would be responsible for recycling an additional eight percent. Thus, with minimal effort the recycling goal could be attained, but at the expense of other waste reduction activities.

A second problem with the recycling goal was it handcuffed local governments that had already implemented bans to eliminate materials from the waste stream. Commercial cardboard is an example of one of these materials. While banning wastes is a waste reduction activity, there was some question whether commercial cardboard could be counted as part of the recycling goal.[5]

A third problem with the original law was that it did not establish a base-line or factor increases in solid waste disposal because of population growth. Suppose a local government met the twenty-five percent goal by January 1, 1993, there is no longer any incentives for additional waste reduction programs. Over time as a jurisdiction's population and waste amount disposed increased, the net reduction of waste disposed in the landfill would lessen[6] and eventually increase.

There was a consensus among local governments that

having only a recycling goal was insufficient. The law needed to be amended in order to provide for a fully integrated system of solid waste management. A waste reduction goal was one way to allow cities and counties flexibility to initiate waste reducing activities in order to meet a state goal.

Waste Reduction Goal

During the 1991 Legislative Session, Representatives Joe Hackney (Orange) and Harry Grimmer (Mecklenburg) introduced House Bill 1109. This bill, which was subsequently approved by the General Assembly, changed the recycling goal to waste reduction goal, established a measurable base-line, and added a per capita growth factor. The date for meeting the twenty-five percent waste reduction goal was changed to July 1, 1993, and a forty percent waste reduction goal was established for July 1, 2001.

A base-line year to measure waste reduction was established from July 1, 1991 to June 30, 1992. July 1,1991, coincides with the provision in the original law requiring scales to be installed at all landfills. A local government may use an earlier base-line year. However, the county or city must prove the scales were already installed and measures had been taken in reducing waste.

The amendment provides for a per capita growth factor. In other words, once a base-line is established, waste tonnages will be converted to a per capita basis. Each local

government will be responsible for decreasing tons per capital by twenty-five percent. In this way, a jurisdiction increasing in population will not be penalized. This approach is used in Rhode Island, Georgia, and Kentucky, and has been proposed in Tennessee, South Carolina, and Mississippi.[9]

Recycling

The Act requires local governments to implement recycling programs by July 1, 1991. However, what constitutes a recycling program has changed.

Originally, the law required that a "majority of marketable materials must be separated from the waste stream prior to disposal."[10] In a North Carolina Recycling Association draft document (March 1, 1991), the association questioned what constituted a "majority of marketable materials." A majority could be just over fifty percent of the number of materials identified as recyclable, or it could require that fifty percent of each material identified be recycled.[11]

Also, the law required by January 1, 1993, a goal of twenty-five percent of waste stream be recycled. A maximum of twelve and half percent of the goal could consist of yard waste, white goods, construction and demolition debris, and tires.

Much of the confusion ceased when during the last Legislative Session the recycling goal was changed to a waste

reduction goal, Section 130A-309.09(a)(2) was repealed, and the twelve and half percent stipulation was omitted.[12]

The present state of the law regarding recyclables reads much different. Local governments are encouraged to separate marketable plastics, glass, metal, all grades of paper, and biomass for recycling.[13] Furthermore, if a city or county can reduce its waste stream by twenty-five percent by composting alone, they would be in compliance with the law.

Composting

The State encourages composting for several reasons. It is a relatively simple technology compared to other waste reduction activities. Composting has the potential for diverting a high percentage of the waste stream. Yard waste alone can represent up to twenty percent of the waste stream in urban counties.[14] The by-product is useful, even marketable. Since the limit of twelve and half percent has been removed, composting alone could provide a substantial portion of the waste reduction goal.

The five classifications for compost are sewage sludge, municipal solid waste, yard waste, agriculture waste, and industrial waste. The standard applied to compost is the "process to further reduce pathogens" (PFRP) with the goal being to produce a hygienic product. EPA has set allowable levels for nineteen priority pollutants for nine heavy metals and ten organic contaminants.[15]

Under S.B. 111, the North Carolina Department of

Environment, Health, and Natural Resources is directed to develop rules to regulate compost and is in the process of doing so. Yard waste compost has been largely exempted from many standards required of other forms of compost. Yard waste is defined as waste from landscaping maintenance, land clearing, and other non-treated wood waste.

Banned Materials

The Solid Waste Management Act banned several materials from landfills. This action was taken on several grounds: potential of environmental damage, hindrance to effective operation of landfill space, and market-ablility of material. Materials banned from municipal landfills are whole tires, used oil, white goods, lead-acid batteries, construction and demolition debris, and yard waste.

1. Whole Tires. As of March 1, 1990, burial of whole tires was prohibited in municipal solid waste landfills. Whole scrap tires are a nuisance because they tend to float to the surface. They hold water and become a breeding ground for mosquitos, and tires are harmful to the environment should they catch on fire.

2. Used Oil: As of October 1, 1990, used oil was banned from landfills. Oil indiscriminately dumped in landfills can pollute the groundwater. Used oil is a marketable commodity. The United States generates about 1.4 billion gallons of used oil, annually.[16] Of that amount 800 million gallons is recycled, ninety percent is reused for

fuel and ten percent is reused as industrial lubricants.[17]

3. White Goods. "Historically, white goods have been recycled for scrap metal."[18] In 1979, EPA restricted PCB levels in white good capacitors. The result was instead of extracting the PCB oil and recycling the appliances, white goods were simply discarded in the landfill.[19] One explanation is that white good recyclers and scrap metal dealers did not want to handle the disposal of the PCB oil.

As of January 1, 1991, white goods are no longer permitted in landfills. Their bulk takes up valuable landfill space. Banning them conserves landfill space. Furthermore, white goods without capacitors and Freon are recyclable.[20]

4. Construction and Demolition Debris. After July 1, 1991, construction and demolition debris must be separated from the waste stream and stored at a separate facility. Typically, construction and demolition debris are stumps, concrete, brick, wood, and uncontaminated earth. House bill 1131 passed by the General Assembly in the summer of 1991 permits demolition asphalt to be deposited with other construction and demolition debris until July 1, 1993.[21] After that date, demolition asphalt along with other special construction and demolition debris as designated by the Solid Waste Section must be deposited in a sanitary landfill.

5. Lead-acid Batteries. On January 1, 1992, lead-acid batteries were banned from landfills. This action was taken

because of the amounts of mercury, cadmium and other heavy metals in batteries. The average lead car battery contains about eighteen pounds of recoverable lead.[22] House bill 620 requires businesses that sell lead-acid batteries post a notice that they accept used batteries.

6. Yard Trash. After January 1, 1993, yard waste is banned from the sanitary landfill. Yard waste typically poses no environmental threat in municipal landfills, but because of its percentage of the overall waste stream, up to twenty percent by weight, valuable landfill space can be saved.

Other Requirements

Starting January 1, 1990, every tire sold in the state, except bicycle and retread tires, pays an additional one percent fee.[23] This tax is known as the scrap tire fee. Ten percent of the revenue from the fee goes into a Solid Waste Management Fund, which is used to promote and enhance waste reduction and recycling activities through North Carolina. Ninety percent of the net proceeds of the scrap tire fee is remitted back to counties on a per capita basis to pay for the disposal costs of tires.

Under S.B. 111 local governments are required to make a full-cost determination of their solid waste activities. The Solid Waste Management Act "encourages"[24] local governments to establish their solid waste system as an enterprise fund accounting system. The goal being to operate solid waste

including collection, disposal, recycling, and composting as a public utility, like water and sewer.

Whether or not local governments choose to operate a solid waste enterprise fund, the law requires cities and counties to determine the full-cost of solid waste services for an annual period and to report those costs to the residential and commercial customers they serve.[25] This requirement does not go into effect until one year after the Commission has established final rules.

Local governments that operate a landfill are required "to ensure the availability of financial resources for proper closure of the landfill."[26] Counties can either provide for direct charges at the landfill with increased tipping fees or surcharges, or they can provide other forms of financial surety. Other forms of financial surety are surety bonds, certificates of deposit, securities, letter of credit, corporate guarantees, or other forms of financial proof that show sufficient money for proper landfill closure.

III. Federal Subtitle D Regulations for Municipal Solid Waste Landfills

On September 9, 1991, the United States Environmental Protection Agency (EPA) published new standards for existing and future municipal solid waste landfills. These new regulations, known as, 40 C.F.R. part 258 in Subtitle D of the Resource Conservation and Recovery Act (RCRA) of 1976, established minimum Federal criteria[27] for location, operation, design, ground-water monitoring, closure and post-closure, and financial assurances for municipal landfills.

While these new rules are promulgated through Subtitle D, local governments are responsible for planning and implementing these directives. The regulations authorize states to devise programs which if approved by EPA will enable them to enforce Subtitle D. North Carolina's Solid Waste Management Section is in the process of writing applicable rules and anticipates EPA approval by October 9, 1993.[28]

Applicability

All municipal solid waste landfills that stopped receiving waste before October 9, 1991, are exempt from Part 258. Municipal solid waste facilities that receive waste after October 9, 1991, but close before October 9, 1993, are

required to only meet the final cover requirements. New landfills and landfills expanding horizontally that receive waste after October 9, 1993, must meet operation, closure and post-closure, design criteria and some location criteria.[29]

Other deadlines include financial assurances for all operating landfills by April 9, 1994. Ground-water monitoring systems must be in place by October 9, 1994, for landfills within one mile of drinking water intakes. Ground-water monitoring systems are required by October 9, 1995, for landfills between one and two miles of drinking water intakes, and ground-water monitoring systems are required by October 9, 1996, for all other landfills.[30]

Some small landfills, those receiving less than twenty tons of waste per day, are exempted from the design and ground-water monitoring criteria. Other criteria to meet in order to eligible for an exemption are that the landfill receives twenty-five inches or less of rainfall per year or has a minimum of three months of impassable roads per year.[31] No landfills in North Carolina meet these criteria.

Location Restrictions

Part 258 sets out six restrictions on landfill location.[32] All six of these location requirements affect new landfills and lateral expansions, while three of these restrictions also affect existing landfills.

1. Airports. Existing, new, and expanding landfills within 10,000 feet of an airport runway used by turbojet

aircraft or within 5,000 feet of an airport runway used by only piston-type aircraft have to demonstrate the landfill is not a bird hazard to airplanes. New and expanding landfills within five miles of an airport must notify the FAA (Federal Aviation Administration).

2. Floodplains. Existing, new, and expanding landfills within a 100 year floodplain must show the state that the landfill does not reduce the water carrying capacity of the floodplain and will not result in solid waste being washed out of the landfill. The airport and floodplain location restrictions have been in Part 257 since 1979 and should have minimal effect on existing landfills.[33]

3. Unstable Areas. Existing, new, and expanding landfills located within unstable areas must be designed to withstand adverse impacts to the State's satisfaction. Unstable areas have soils that are subject to large amounts of settling or to large movements like rock slides, avalanches and mud slides. Other areas considered unstable have highly erodible bedrock, known as karst terraces.

Existing landfills that are a bird hazard to airports, adversely affect the 100 floodplain, or exist in unstable areas must be closed by October 9, 1996. States may grant two year extensions provided certain findings are made.[34]

The following three location restrictions apply only to new and horizontally expanding landfills:

4. Fault Areas. New and horizontally expanding

landfills can not be within 200 feet of a fault area that has been active since the Holocene geologic period, or the last 11,000 years. This location restriction can be waived. However, the landfill owner must demonstrate to the State's satisfaction that in case of an earthquake the area within 200 feet the landfill will not be damaged.

5. Seismic Impact Zones. New and horizontally expanding landfills can not be located in seismic impact zones, unless the landfill operator can prove to the state's satisfaction that the landfill is designed to withstand the "maximum horizontal acceleration in lithified earth material,"[35] which is ground motion from earthquakes.

6. Wetlands. New and horizontally expanding landfills are not permitted in wetlands, unless several standards can be demonstrated.[36] The Subtitle D regulations use the Army Corps of Engineers definition of wetlands.[37] The purpose of this locational restriction is to guarantee a "no net loss of wetlands."[38]

Design Criteria

The municipal solid waste landfill design criteria for new and expanding landfills in EPA approved State programs are performance-based criteria. Landfills in unapproved states are required to install composite liners and leachate collection systems. North Carolina is not presently an approved state. The Solid Waste Management Section is in the process of writing applicable rules and anticipates EPA

approval before October 9, 1993.

This, however, is not to say in approved state programs liners and collection system will not be required. EPA requires that approved states focus on "Maximum Containment Levels (MCL's) not to be exceeded at the relevant point of compliance."[39]

EPA has designated twenty-four (24) chemicals and their MCL's.[40] Besides insuring that no designated MCL's are violated, approved states shall consider hydrogeologic characteristics, climactic conditions, and volume and chemical makeup of leachates in landfill design. The point of compliance shall be on land owned by the owner/operator and cannot be greater than 150 meters from the landfill itself.[41]

In non-approved EPA states composite liners and leachate collection systems are required. The composite liner must have a 30-mil flexible membrane liner, or a 60-mil polyethylene liner, above two feet of compacted soil. The permeability of the compacted soil must be equal to or less than 1 * 10-7 cm/sec. The leachate collection system must be designed so that no more than 30-cm of leachate will be above the liner.[42]

Operational Requirements

The Subtitle D- Operational Requirements are similar to North Carolina's managements rules already in effect.[43] Nevertheless, the regulations outline ten operating

criteria.

1. Prohibiting Hazardous Waste. Regulated hazardous wastes are prohibited in landfills. Landfills are required to establish a program that would detect hazardous wastes. Programs required include random inspections of waste loads brought to the landfill, training landfill personnel on what constitutes a hazardous waste, keeping records of inspections, and reporting to the state any hazardous wastes found.

2. Cover Materials. Solid waste must be covered with at least six inches of cover material daily in order to control disease vectors, litter, odors, and fires. Alternatives to dirt cover can be used provided effectiveness is proven to State Director's satisfaction.

3. Disease Vector Control. Municipal solid waste landfills (MSWLFs) must prevent flies, mosquitoes, and animals, typically associated with landfills from spreading disease.

4. Explosive Gases Control. Landfills have to implement a methane gas monitoring program for two required areas. These areas are the landfill facility structures and property boundary. In landfill structures the gas must not exceed twenty-five percent of the lower explosive limit. At the landfill boundary the lower explosive limit can not be not exceeded. Monitoring must be done at least quarterly. All violations must be reported to the State Director, and

plans for solving such violations must be implemented within sixty days.

5. Air Criteria. MSWLFs must comply with applicable portions of the Clean Air Act which includes no open burning of solid waste, except emergency burning of agricultural, silvicultural, and land clearing debris.[45]

6. Access Restrictions. Landfills must control public access and prevent unauthorized traffic from entering the facility.

7. Run-on/run-off control systems. Landfills must operate run-on and run-off control systems. The run-on system will be designed to prevent water from running into the active portion of the landfill during a twenty-five year storm. The run-off control system shall be designed to collect and control water run-off from the active portion of the landfill from a twenty-five year storm. The run-off system must comply with surface water requirements.

8. Surface Water Requirements. MSWLFs shall not pollute water or wetlands in accordance with the Clean Air Act.

9. Liquids Restrictions. Liquid wastes are prohibited from being disposed in the landfill with several exceptions. These exceptions are household liquid wastes excluding septic waste, leachate from the landfill, and, subject to state approval, small liquid containers typical in size to household containers.

10. Record keeping Requirements. Landfill operators must record in a permanent record:[46]

a. Any location restrictions as may to applicable to the landfill;

b. Documentation of inspections, training, and general procedures on how hazardous waste are kept out of the landfill;

c. Results from the gas monitoring tests;

d. Documentation of State approvals for recirculating leachate back through landfill;

e. All applicable ground-water monitoring data;

f. Document the closure and post-closure care plans; and

g. Estimate and proof of financial assurance availability.

Ground-water Monitoring

MSWLFs have to establish ground-water monitoring programs that sample, analyze, and detect contamination at the landfill. If one of the sixty-two designated constituents[47] is found, other more drastic measures must be taken by the landfill operator.

Ground-water monitoring systems are installed so as to determine water quality of ground-water upgradient from the landfill, and water quality of the uppermost aquifer downgradient from the landfill.[48] The location of the monitoring system is specified by the State Director.

Ground-water sampling and analysis have to reflect water

quality at the upgradient or background and downgradient wells. The landfill operator must document sampling and analysis procedures. Water quality for background wells has to be assessed against all constituents as designated in Subtitle D Regulations.[49]

The detection monitoring program monitors sixty-two constituents[50] in all wells located at the landfill. Wells must be monitored at least semi-annually during both the active and post-closure life of the landfill. At least four samples from every well must be taken and analyzed during the first semi-annual sampling. At least one sample from every well must be taken and analyzed during the second sampling period. In approved states, the Director has some discretion over specific constituents monitored and sampling frequency provided there is just cause.[51]

If the operator finds a statistically significant increase in a monitored constituent over a background well, the operator must notify the state director within fourteen days and establish an assessment monitoring program within ninety days.

In the case of finding a significant increase in a monitored constituent, the operator has ninety days to prove a sampling error took place, another source contaminated the monitoring well, or a natural variation in ground-water quality occurred.[52] A qualified ground-water scientist or the state director must report such a finding in the landfill

operating record.

In the assessment monitoring program, the landfill must begin evaluating water quality against 212 constituents.[53] If the landfill can determine the contamination is not from the landfill, the county may resume a detection monitoring. The state director must approve of this determination. If, however, it is found the ground-water contamination is coming from the landfill, corrective measures must begin.

The corrective assessment shall include standards such as "remedy effectiveness, performance reliability, ease of implementation, costs, state requirements, and public acceptability."[54] A public meeting must be held to discuss the results of the corrective measures assessment.

The next step is to select a remedy which at a minimum will protect human health and the environment, protect ground-water quality standards, reduce or eliminate additional polluting constituents.[55] In choosing a remedy several criteria must be evaluated such as effectiveness of the remedy, practical capacity of owner to effectively implement remedy, and degree to which community concerns were addressed. A schedule must be established to remedy contamination. The operator may not have to begin corrective measures if he can prove the contamination did not come from the landfill, or the ground-water is not and will not be used for drinking water. The state director approves the proposed remedy and may require additional remedies in order to

minimize contamination.[56]

When corrective action is utilized, the landfill must be compliance for three consecutive years using statistical measures listed in the Subtitle D Regulations.[57] After that time the county can resume the detection monitoring program and be released from financial assurances.[58]

Closure and Post-Closure

The closure criterion requires two layers of cover, known as final cover. The two layers are erosion and infiltration layers. The infiltration layer must be at least eighteen inches of earthen material with a permeability factor equal to or less than 1 * 10-5 cm/sec. The erosion layer must be at least six inches thick and suitable for native plant growth.[59]

Closure plans must be placed in the operating record no later than October 1, 1993.[60] Closure plans must begin thirty days after the final receipt of waste, and the operator/owner has one hundred eighty days to complete the closure process. A registered professional engineer or state director must certify the landfill has been closed according to the plan. The landfill must be noted on the property deed.

Post-closure care is required for thirty years after the final cover is placed on the landfill. The post-closure procedures include maintaining and repairing the final cover, operating the leachate collection system, monitoring ground-water quality and gas monitoring.[61] The thirty year

post-closure period may be shortened or lengthened by the state director depending on the risk to human health and the environment. The post-closure plan must be placed in the operating record when the landfill unit initially receives waste.

Financial Assurances

The operator/owner of the landfill must have a detailed written estimate in current dollars of the cost for a third party to close the landfill.[62] The estimate must be based on final closure of the largest landfill cell open. The estimate must be entered into the operating record and updated annually to reflect current dollar values.

The landfill owner must have on record a detailed written estimate in current dollars of the cost for a third party to conduct post-closure care. The cost estimate for post-closure care must be for the post-closure period, a minimum of thirty years.[63] The cost estimate must be adjusted annually.

In cases where a corrective action is required, as described in the previous subsection, the county must have a detailed written estimate in current dollars of the cost for a third party to perform the corrective action. The financial assurance must cover the entire cost of the corrective action plan. The estimate must be adjusted annually. The financial assurance will continue until the

corrective action has been completed and approved by the state or a qualified ground-water scientist.

Financial assurances must be initiated beginning April 9, 1994 or before the initial receipt of waste to meet the costs of closure, post-closure, and corrective actions for known releases. The allowable financial instruments include trust fund, bond, letter of credit, insurance, and other state-approved instruments.[64]

A local government may choose to establish a trust fund. Trust fund payments are made annually for the remaining life of the landfill cell. Payments cover the closure and post-closure costs. These payments must be sufficient to insure enough funds are on hand to cover all costs.

If corrective action is required because of a known release, the first payment in the trust fund must be equal to one-half of the estimated cost to complete corrective action.[65] Subsequent payments are divided into equal payments, factoring in inflation and other changes, for the remaining life of the permitted unit.

IV- Existing Solid Waste Programs in Rural North Carolina Counties

Having had an overview of S.B. 111 and Subtitle D, this chapter will examine specific solid waste programs in operation throughout the state. The programs cited will generally be from rural counties because in many instances they are easily duplicated in other rural counties. The four major sections in this chapter are waste reduction/recycling, financial arrangements, collections systems, and disposal.

Waste Reduction/Recycling Programs

Waste Reduction/Recycling programs are individualized to each county's needs. This section will highlight a few rural counties and their overall waste reduction and recycling efforts, examine specific programs in counties that have proven effective, and present programs in urban counties that can be applied to rural counties with minimal effort and expense. Composting programs will also be examined as a waste reduction activity.

Chatham county has implemented an integrated recycling program with a full-time recycling department. Presently, the county has four unattended recycling centers which accept newspapers, glass, aluminum cans, steel cans, corrugated cardboard, and plastic bottles.[66] The county handles the marketing of its recyclables which is an ongoing challenge

because of the constant flux in markets.[67]

A second ingredient in Chatham county's recycling program is education. The county has focused its educational efforts on school children. Every school in the county participates. The youngsters recycle paper in class, visit the landfill, and are taught a set curriculum on waste reduction. The adult community also receives recycling information in a weekly newspaper article called, "waste watch." The recycling department makes presentations to local community groups and churches.

A third aspect of Chatham's waste reduction program is commercial recycling. The county collects office paper, computer paper, and mixed paper from the county offices. Other businesses can deposit recyclable paper at special locations in Siler City and Pittsboro. The department performs a waste audit for local businesses and monitors the industrial waste stream looking to find waste that other businesses can use. The county has instituted a ban on corrugated cardboard at the landfill.[68]

Other Chatham county programs include the collection of Christmas trees to create artificial fish habitats in Lake Jordan, and a plan to compost chicken manure with mixed office paper.

Johnston county uses a fairly typical system to collect its recyclables. The county has constructed twelve manned convenience centers. These centers take household waste and

recyclables. Since the sites are staffed, the attendants insure all recyclables are properly sorted. The centers take aluminum, glass (clear, brown, and green), plastic (PET and HDPE), newspaper, corrugated cardboard, tires, batteries, white goods, and waste motor oil. Johnston county markets these materials itself, but counties that do not have staff to process and market recyclables can hire private vendors to market their goods.

While Chatham and Johnston counties are not urban counties, they are located close to urban areas and have the luxury of easy assess to recycling markets. Johnston county uses recycling processors in Raleigh.[69] Chatham uses several recyclers located in Durham and Winston-Salem.[70] For counties not close to recycling processors, other recycling avenues are needed.

Surry county uses "recycling days" to meet the recycling mandates.[71] One of the advantages of "recycling days" is volunteer labor can be used. In order to create a successful program counties must establish a date, time, and site where materials will be accepted. After these specifics are set then promotions and advertisements are initiated to inform the public. Surry county uses volunteers to staff the sites for the day.[72] To take "recycling days" one step further, if the county has not established markets, a waste management company can be hired to market the recyclables. Halifax county has received such bids from American Refuse Systems,

Inc. and Browning-Ferris Industries. For a fee, these firms will transport and process all recyclables collected.

Other successful recycling programs have banned corrugated cardboard, used diversion credits, and initiated composting programs. The banning of corrugated cardboard is an example of a recycling program rural counties can implement with minimal effort. Chatham, Alamance, Buncombe, and Rowan counties have all instituted corrugated cardboard container bans. Chatham county instituted its ban on March 2, 1992.[73] The ban only applies to commercial, industrial, and institutional sources. The hauler of the cardboard is the responsible party. Any load of waste having more than fifteen percent corrugated cardboard is considered a violation. Chatham county's goal is to "never issue a fine".[74] Nevertheless, a fine system has been established to penalize repeat offenders.

In order to make the ban as palatable as possible, the county passed the ban five months before it took effect and gave a grace period before beginning the fines. In the five month interim, the recycling staff educated businesses in the county regarding the ban.

Banning corrugated cardboard (OCC) can have a significant impact on the waste stream. In Buncombe county, which has banned cardboard, OCC represents thirteen percent of the MSW stream by weight.[75] Furthermore, cardboard constitutes a greater portion of the waste stream by volume

because the average density of municipal solid waste is three cubic yards per ton, and OCC is ten cubic yards per ton when compacted in a garbage truck.[76]

Catawba county, an urban county located in the western piedmont, has implemented a diversionary credit system[77] that appears to be easily duplicated in rural counties. This system along with other recycling programs has helped Catawba county reduce its tons per day disposed in the landfill from 495 in 1989-90 to 404 in 1991-92, an eighteen percent reduction without factoring in growth.[78]

The diversionary credit system gives cities and private haulers a one ton tipping fee credit for every ton of waste diverted from the landfill. The cities and private haulers benefit in two ways. One, they do not pay a tipping fee for each ton of waste diverted. Two, for each ton diverted, they are permitted to dump a ton of waste free.

At the end of the month, participating towns send to the county engineer the number of tons recycled to receive their credit. In order to insure accuracy, the county engineer has on-site audit privileges to check for compliance.

The county has also devised a credit system for rural residents. Rural residents use the county's convenience centers where they are charged $1.50 per garbage can disposed. The county gives a $0.75 credit for each grocery bag of recyclables. If a rural resident brings two bags of recyclables for each garbage can of waste, no disposal fee is

paid. In this way all residents of Catawba county have access to the diversion credit system.

Another program that can reap great rewards for reducing the waste stream in meeting the twenty-five and forty percent waste reduction goals is composting. It is estimated nationally that yard waste accounts for twenty percent of the waste stream by weight and ten percent by volume.[79] While rural counties in North Carolina may have five percent or less of their waste made up of yard waste,[80] composting can still assist counties in their efforts in meeting the waste reduction goals.

As of January 1, 1993, yard waste is banned from MSW landfills. Counties are required to have separate yard waste composting facilities. Composting facilities that produce more than 6,000 cubic yards per quarter must be permitted by the North Carolina Solid Waste Section. This includes any facility that receives more than 6,000 cubic yards for any one quarter in the year, i.e. spring or fall. Landfills receiving less than 6,000 cubic yards of yard waste per quarter need only notify the State annually of their composting operations.[81]

There are three major categories of compost. They are composting yard waste by itself, composting municipal solid waste, and sludge co-composting. Yard waste composting uses wastes such as leaves, grass clippings, bush and tree trimmings. Depending on the type of grinder or shredder, a

county may use larger material like trees and stumps as well in their composting process. Agriculture and silvaculture wastes may also be used in yard waste composting.

During interviews with four rural counties (Chatham, Burke, Lee, and Davie) none was found to be using high-technology in its yard waste composting process. Examples of high composting technology are in-vessel composting and aerated static piles. Mike Shore of Chatham County Recycling Department states, "High capital costs associated with aerated static piles and in-vessel systems are too expensive for rural counties."[82]

Chatham county contracts to have yard waste ground up in a tub grinder. The mulch is set into windrows and turned once a month with landfill equipment. The county has plans to purchase a tub grinder but will stay low-tech as long as possible. In order to meet state rules for composting, compost only has to be turned one a month.[83] Chatham county estimates it has diverted five to ten percent of the waste stream by composting.[84]

Burke county uses a different approach. Because of a lack of space the county does not compost. Instead it shreds all yard waste, wood pallets, other wood products, and tree limbs up to six inches into mulch. The mulch is sold for six dollars a truck load. The mulch is easy to sell. Ten to eleven percent of the waste stream was diverted last year.[85]

A second type of composting, known as MSW composting,

uses the organic portion of the waste stream. Municipal solid waste compost ingredients include yard waste, wood waste, paper, cardboard, food waste, sludges, and other selected commercial and industrial wastes that are biodegradable. This can amount to forty percent of the waste stream.[86]

Buncombe county has a pilot program composting municipal solid waste. The program appears to be easily duplicated in rural settings. Dr. James Shelton, a soil scientist with North Carolina State University is in charge of the pilot program.

Buncombe County's MSW composting program is a low-tech facility.[87] The only piece of specialized equipment is a windrow-turner. Prison labor is used to sort the solid waste into recyclable, non-compostable, and compostable materials. The compostable material is then put in windrows 100 feet long, ten feet wide, and four feet high. The windrow-turner mixes and shreds the material. The MSW is turned five times. Nitrogen is added in the form of urea fertilizer. A temperature of at least 131 degrees Fahrenheit must be sustained for fifteen days to ensure the breakdown of pathogens.[88] The compost is then sifted through a one-half inch screen and cured for an additional seven to nine weeks.

Dr. Shelton has been testing the compost for heavy metals content and in crop production. From June 1992 to January 1993, 300 tons of MSW has been composted. According

to Dr. Shelton, "Test crops of tomatoes, trees, and fescue grass in media mixed with compost have shown improved growth rates."[89] In testing for heavy metal content, Dr. Shelton has only found higher levels of lead and cadmium in compost. He attributes this to the use of metallic based inks in magazines, which the industry is phasing out.[90]

Co-composting mixes wastewater treatment sludge with a bulking agent like leaves, wood chips, and sawdust. The pathogens associated with wastewater treatment sludge are destroyed provided the mixture reaches a temperature of at least 126 degrees Fahrenheit and is maintained at that level for three days.[91] Co-composting still has the potential of carrying heavy metals and other potential contaminates in sludge. This sometimes creates difficulty in marketing co-composted materials.[92]

Franklin county is conducting a pilot program to compost yard and wood waste with chicken and hog waste. The county estimates twenty percent of the waste stream is yard and wood waste.[93] After the yard and wood material are put through a tub grinder, it is windrowed and mixed with manure. Temperatures in the sixty foot windrows are checked hourly, as the temperatures decrease the piles are turned and water is added. In six to eight weeks compost is produced.

Financial Arrangements

With the promulgation of Subtitle D and S.B. 111 regulations, solid waste costs have increased dramatically.

Counties are building high-tech landfills at approximately $350,000 per acre.[94] Convenience centers used for rural waste collection are being constructed. Many counties are staffing these centers. Johnston county has twelve manned centers. The collecting, processing, and marketing of recyclables are an additional cost. As with recycling programs, each county it seems finances solid waste a little differently. Below are some examples:

In Halifax county, all cities, towns, and private waste haulers pay nine dollars per ton for solid waste disposal as calculated at the county's scales. All are billed monthly. The charge for demolition and construction waste is five dollars per ton. Tipping fees are designated for operating and capital costs associated with waste disposal in the landfill.

The solid waste budget divides all the department's activities into disposal and collection. The county, as of yet, is not operating a high-tech landfill and approximately $2.40 per ton is donated from the county's general fund to cover disposal costs.[95] During the next several years the general fund donation will be phased out. The tipping fee will be raised so that the disposal budget is self-supporting.

While the tipping fee captures all residences and businesses within towns, all businesses under contract with private haulers, and all businesses in the county who haul

their own garbage, a gap existed for county residents that live outside towns. The household solid waste fee is designed to cover a county resident's share of disposal costs and for financing the entire cost of the collection system.

The county solid waste department estimated twenty-four percent of the waste stream, or 12,800 tons, comes from rural residences. There are 9,600 households outside the towns; Thus, each household disposes an average of one and a third tons of waste into the landfill per year. Disposal costs per rural household are twelve dollars per year, based on the waste tonages and current tipping fees.

The second part of the household solid waste fee is for the collection system. The collection system, which includes six convenience sites with plans for building four more and numerous green-box sites, is designed for rural residential use only. At this time none of the convenience centers is staffed. The household solid waste fee includes the entire cost of operating the convenience centers and green-box collection system. The cost of the collection system comes to thirty dollars per household. The total charge for the household solid waste fee is thus forty-two dollars per year.

Rural residents are billed along with their tax notices. This fee can be collected and levied as a tax. The county selected the annual fee system because there was no county-wide monthly billing system in place.

Any dwelling unit valued at less than $1,000 is exempted

from the fee. Also, in the case of residents who contract for garbage pickup with a private hauler, a release can be obtained, signed, and certified, and the household will be exempted from the fee that year. The county still captures the rural residents share of disposal costs because the hauler is charged nine dollars per ton at the scales.

Commercial and industrial collection outside of towns is thirty-five dollars per month per green-box, thirty dollars of which goes to collection and five dollars goes to disposal.

Future plans for Halifax county include implementing a recycling program for residents outside towns. Recycling costs will be added to the household solid waste fee. The tipping fees will be increased in order to discontinue subsidizing the disposal section from the general fund. The green-box charge to commercial businesses will be increased to reflect the actual costs for garbage pickup. As S.B. 111 and Subtitle D regulations become effective, all fees will increase accordingly.

Franklin county charges a special district tax on all property outside the corporate limits of any town. Currently, this tax is $0.063 per $100 of property evaluation. This tax brings in just over $500,000 in revenue annually.[96] The tax pays for the operation and maintenance of ten convenience sites throughout the county. Four sites are manned and six are unmanned. The four staffed sites are

located in the vicinity of Wake county in order to prevent illegal use by Wake county residents. The county contracts with Waste Industries, Inc., to haul the waste from the convenience sites to the landfill at cost of about $242,000 per year.

The $0.063/$100 tax also pays for county residents share of disposal costs. Forty-five percent, or 12,000 tons, of the county's waste is generated by residents living outside towns.[97] Waste Industries, Inc., is charged eighteen dollars per ton to dump in the landfill. They in turn pass the tipping fee costs back to the county in the amount of $216,000.

The landfill disposal costs amounted to $480,000 fiscal year 1991-92, which includes the tipping fees charges to Waste Industries, Inc., as well as the eighteen dollar per ton tipping fees charged to the towns.[98] Towns are billed on a monthly basis according to the weight of the town's garbage. The towns, at their discretion, pass costs on to their residents by assessing fees or absorbing costs through the town's general fund.

Franklin county has started a solid waste reserve account to assist in paying for the new landfill which will be needed shortly. Presently, there is $50,000 in the fund.[99] Special Obligation Bonds (SOB) will likely be used to finance the project. SOBs finance big capital purchases without pledging property taxes.[100]

Unlike Franklin and Halifax counties, Johnston county chose to fund the collection portion of the solid waste department out of the its general fund. This amounts to $400,000 annually.[101] The county's reasoning is that convenience sites are available to all citizens, inside and outside cities; thus, all should share in the costs. Johnston county has twelve staffed collection sites. The cost of recycling at the collection sites is paid for out of the disposal portion of the budget because anything recycled does not go into the landfill.

In order to use the convenience sites, vehicles must have a decal that costs thirty-five dollars annually.[102] The county budgeted $175,000 in decal revenue.[103] All this revenue is credited to landfill fees for disposal. The Johnston county tipping fees are twenty-seven dollars per ton[104] which is charged to all cities and all private haulers. Costs to operate the landfill are sixteen dollars per ton. The additional eleven dollars per ton revenue is earmarked in a reserve account for future landfill costs.[105]

Collection Systems

In rural counties there are three basic systems for waste collection. These systems are green-boxes, convenience sites, and door-to-door collection.

While many counties are phasing out green-boxes (eight cubic yard containers) other counties still use them. In Halifax county there are over seventy such receptacles. One

drawback to green-boxes is that they can be unsightly. Also, many times counties will place boxes at a cross road with little regard to safe ingress and egress. Further, because of their small size, they are easily filled to over capacity, and they are prone to vandalism, like being set on fire. Another drawback of green-boxes is there is no way to prevent illegal disposal of banned materials into them.

Even with the drawbacks, eliminating green-boxes can be difficult. The biggest reason is convenience. Green-box sites are easy to establish. In some cases, a property owner's approval over the phone is all that is necessary. They also can be easily removed should complaints arise.

With the passage of S.B. 111, numerous items are now banned from landfills. Subtitle D regulations require counties establish a program to detect hazardous wastes before they are disposed into the landfill. In response to these requirements, many counties are building convenience sites. Convenience sites represent a more controlled environment for waste disposal.

Halifax county has found that as convenience sites are constructed and green boxes are removed, the public complains. In order to combat this, the county picks up the green-boxes closest to the convenience sites first. Over time, the receptacles further away from the convenience site are removed.

Convenience sites are generally fenced in areas, with

paved or gravel driveways. Each may have several green-boxes or forty cubic yard roll-off boxes. They can be easily staffed. The services offered at convenience sites vary. For instance, a county may provide receptacles for recyclables and separate containers for banned materials and yard waste. The services offer by a county at a convenience site are largely a function of whether or not the site is manned.

Some counties in the state continue to have unmanned convenience sites. Halifax is one of these counties. The biggest reason for not manning its sites at this time is cost. In August of 1992, a county solid waste task force estimated staffing ten convenience sites would cost the county $250,000 annually.[106] This equates to an additional twenty-five dollars per household solid waste fee. The county's position at this time is to wait until the last four convenience sites are built, which should take two more years. In the meantime, the county will explore other programs that could prevent banned and hazardous materials from entering the landfill.

Craven county, a coastal county with a 1990 population of 81,613 has implemented a program where household garbage is collected door-to-door. The collection system also picks up recyclables curbside and is a volume based user fee system. Every household outside a municipality receives a monthly bill of eight dollars. For their monthly fee

residents receive four stickers and a recycling bin. If a sticker is placed on a garbage bag, county crews will pick up trash at the curb. Bags without stickers do not get picked up. Recyclables are also picked up once a week. The recycling program collects glass, aluminum, plastics, and newspaper.[107]

The eight dollar monthly fee is broken down into a three dollar general charge and $1.25 fee per sticker. Additional stickers can be bought at governmental buildings and retail stores. This volume based user fee system provides an incentive to residents to reduce their waste. The fewer number of bags disposed the lower the charge. Rob Bracken, waste management agent for the Craven County Cooperative Extension Service, "People that bag up ten bags of lawn clippings will be paying through the nose."[108] The county expects most households will use more than the four stickers per month. If actual costs are between ten and eleven dollars per household, the garbage collection and recycling program costs will be covered by fees.[109]

Disposal

The costs of constructing and operating high-tech landfills are high. The city of Waynesboro, Virginia, recently built a landfill with double liners, leachate collection system, methane gas and water monitoring systems, as well as closure and thirty year post-closure care. The costs were $350,000 per acre.[110] Counties in North Carolina are

using a number of options in order to lower or defer disposal costs associated with Subtitle D and S.B. 111.

In North Carolina's hierarchy of waste disposal methods incineration is a more accepted form than landfilling. Several factors make incineration unattractive to rural counties. Capital costs for constructing incinerators are high. Rural counties cannot capture the economies of scale of more populated counties. A regional facility may improve economies of scale, but transportation costs become an issue if waste has to be carried far. Also, land in many rural counties is an abundant commodity. Therefore, this section focuses on landfilling options.

Of the 120 municipal solid waste landfills in North Carolina, seventy-two have amended their landfill permits for vertical expansions.[111] Vertical expansions provide several benefits to counties. One of those benefits is that a vertical expansion creates better conditions in which to close down a landfill, by reducing waste settlement.[112]

Second, additional disposal capacity is created permitting counties more time to design high-tech landfills. Third, according to Jim Coffee, North Carolina Solid Waste Section, supervisor, the state is not requiring bottom liners and leachate collection systems in vertically expanding landfills until January 1, 1998.[113] Landfills expanding vertically must still meet all other Subtitle D regulations of closure, post-closure, locations restrictions, operating

criteria, ground-water monitoring, and financial assurances.[114]

In March of 1992, Watauga County opened its baling facility. The County constructed a 24,000 square foot building for $1.55 million which can process thirty-five tons per hour.[115] Baling provides several disposal advantages to counties.

Baled solid waste on average can increase landfill capacity by thirty percent because of the higher compaction rate of waste.[116] Baled waste saves space because less cover dirt is used in the cell. Conventional landfilling uses one part cover dirt to three parts solid waste. Baled waste uses one part cover to twenty-four parts waste.[117]

In a baling operation garbage is dumped on a tipping floor before it is bulldozed onto a conveyer. This procedure enables hazardous and other regulated wastes to be inspected and removed before landfilling.

Baled material has no loose garbage that is blown around the disposal cell. Birds, rodents, and other disease carrying vectors are minimized.

Because baling compacts waste to a high density, moisture infiltration is reduced producing less leachate and creating less settling.

A regional solid waste facility is under construction at the coast. Craven, Pamlico, and Carteret counties have formed the Coastal Regional Solid Waste Management Authority.

This Authority under state law is a separate municipality. It can issue bonds and set fees; however, the Authority has no tax levying ability.[118]

In 1991, the Authority issued twenty-seven million dollars worth of revenue bonds.[119] The bonds were used to buy 130 acres of land in Craven County, where a twenty-two acre high-tech landfill cell is under construction.[120] The landfill cell will meet all Subtitle D regulations. A composting facility will also be on this site. In addition, the revenue bonds are paying for the construction of transfer stations in Pamlico and Carteret counties.

While all three counties are currently operating their own landfills, each will close down before October 9, 1993.[121] The Authority expects the new landfill to open before October 9, 1993. If the new landfill is not operational by the deadline, the three existing county landfills will still be closed, and waste will be long-hauled to a private landfill.[122]

The Solid Waste Authority is still investigating long-term solutions. The twenty-two acre cell will last an estimated four to five years.[123] If additional cells are constructed, more land must purchased. According to Jack Guinan, Executive Director, the Authority is examining waste-to-energy incineration. Preliminary figures indicate the volume of waste generated in the three counties makes this option marginal.[124]

The capital and operating costs of the landfill facility

are shared on a pro-rata basis. Pamlico and Carteret are required to pay their own costs of the transfer sites because Craven county was unwilling to help bear their transportation costs; thus, tipping fees are thirty-seven dollars per ton for Craven and forty-five dollars per ton for Pamlico and Carteret.[125]

One area of concern for the Authority is while it is charged with complying with the requirements of Subtitle D and S.B. 111, it has no control over recycling. The municipalities fought hard to retain control over the recyclables in their waste stream. Recycling remains a city and county responsibility, and the Authority operates solid waste disposal.

Montgomery county is no longer in the waste disposal business. Addington Environmental of Ashland, Kentucky, operates the county landfill under a franchise agreement with the county.[126] Addington will operate the existing landfill which just received a vertical expansion permit, until the high-tech landfill is constructed.

The State Solid Waste Permitting Section is in the process of reviewing engineered plans for the new high-tech landfill. After State approval construction on the new landfill will take eighteen to twenty-four months. Under the franchise agreement Addington will build a five million dollar recycling center and will spend four million to construct and operate a high-tech landfill.[127] In a subsequent

phase, a composting facility will be added.

The contract permits Addington to accept up to 1,000 tons of waste per day, within a seventy-five mile radius. However, no garbage is allowed from out of North Carolina. The facility has 120 acres of land and a life expectancy of twenty years, expandable to forty years.[128]

Addington has guaranteed to meet or exceed all Subtitle D and S.B. 111 requirements. Montgomery County pays $29.50 per ton of MSW and $19.50 per ton demolition waste.[129] Tipping fees are locked in at this price for seven years.[130] After which time, an escalation clause tied to the Consumer Price Index becomes the basis for future increases. Any other counties that may in the future use the landfill in Montgomery County will pay the county a one dollar per ton host fee.[131]

The county has not had any negative publicity concerning the privatization of their landfill. One reason in part may be the County Environmental Affairs Board had early and complete access to the process.

V. Conclusion

New legislation at both the State and Federal levels is having a significant impact on how counties operate their solid waste systems. In response to these regulations local governments have initiated a variety of programs to comply with these laws.

The North Carolina Solid Waste Management Act is regarded as some of the State's most comprehensive environmental legislation. The "Act" established waste reduction goals, provided guidelines for recycling and composting, set timetables for banning certain wastes, and initiated other planning and reporting requirements for local governments. While all aspects of the law are important, the waste reduction goals have received the most attention from cities and counties.

The Federal Subtitle D Regulations are part of the Resource Conservation and Recovery Act of 1976. Subtitle D has six parts including location, operation, design, ground-water monitoring, closure and post-closure, and financial assurances. Each of the six parts becomes effective at different times. Dates range from October 9, 1991, for closure requirements to October 9, 1996, for certain ground-water monitoring systems. Subtitle D permits flexibility for states with approved programs. However, by

January 1, 1998, all landfills in North Carolina will meet all six criteria. The disposal costs for complying with S.B. 111 and Subtitle D are estimated at $350,000 per acre.

In response to the new laws local governments have started a number of programs. Counties and cities that have implemented programs to recycle glass, plastics, aluminum, and newspaper are getting only marginal results. Two waste reduction options all rural counties should consider are banning corrugated cardboard and composting. Both can be implemented with relatively little expense and can have a significant impact on reducing the waste stream.

The financial arrangements rural counties use to fund solid waste vary. Tipping fees are charged in sixty-seven North Carolina counties.[132] Besides tipping fees, some counties have started charging household solid waste fees or setting a special district tax for residents outside towns. Other counties still fund parts of their collection and disposal systems out of the general fund.

The most common types of collection systems are green-boxes, convenience sites, and door-to-door collection. Counties in general are phasing out green-boxes and moving toward a more controlled system of collection. The staffing of convenience centers and door-to-door collection can be expensive.

Waste disposal is another aspect of solid waste management rural counties must change, particularly in light

of the expense associated with a high-tech landfill. One of the options available to local governments is a regional disposal facility. Another option is a baling operation which can increase a landfill's life by thirty percent. Many counties have applied for and received permits to expand vertically. Other counties have gotten out of the waste disposal business entirely and now contract with a private enterprise to dispose their waste.

FOOTNOTES

1. George W. Nester, "Sky Rocketing Landfill Costs: Waynesboro Bales Out," Virginia Review Waste and Resource Management, (September/October): 32.

2. North Carolina, "Solid Waste Management Act of 1989," Statutes, (1989, c. 784, s.2.) 177.

3. Ibid., 177.

4. North Carolina Department of Environment, Health, and Community Development, North Carolina Recycling and Solid Waste Management Plan, vol. 1, Assessment of Local and Regional Infrastructure and Resources, by Roy F. Weston, Inc. and Hazen and Sawyer, P.C. (February 1992), 3-21.

5. Ed Regan, "The Solid Waste Management Law Revisited, Questions on Law Linger," County Lines, 17 (9 October 1991): 2.

6. North Carolina Recycling Association, "Realistic Waste Reduction and Recycling Goals for North Carolina (Draft)," (27 March 1991), 2, photocopied.

7. Regan, "Law Revisited," 2.

8. North Carolina, "Solid Waste Management Act of 1989," Revised Statutes, Annotated, (1991) 60.

9. N.C. Recycling Association, "Realistic Goals," 2.

10. North Carolina, Statutes, 183.

11. N.C. Recycling Association, "Realistic Goals," 5.

12. North Carolina, Revised Statutes, Annotated, 66.

13. Ibid., 68.

14. NCDEHNR, State Solid Waste Plan, vol. 1, 5-13.

15. North Carolina Department of Economic and Community Development, Energy Division, Technical and Market Development Analysis for Compost Materials in North Carolina, by UNC Institute for Transportation, Research and Education and E and A Environmental Consultants, Inc. (1 April 1991), 12.

16. NCDEHNR, State Solid Waste Plan, vol. 1, 5-9.

17. Ibid.

18. Ibid., 5-3.

19. Ibid.

20. Ibid.

21. North Carolina, Revised Statutes, Annotated, 68.

22. North Carolina Department of Economic and Community Development, Energy Division, Assessment of the Recyclable Materials Markets and Market System in North Carolina, by UNC Institute for Transportation, Research and Education, Hazen and Sawyer, P.C., and Mt. Auburn Associates (1 April 1991), 3-41.

23. North Carolina Department of Environment, Health, and Natural Resources, Division of Solid Waste Management, "Summary of Major Solid Waste Management Legislation from the 1991 Session of the General Assembly."

24. North Carolina, Revised Statutes, Annotated, 65.

25. North Carolina, Statutes, 181.

26. Ibid., 197.

27. United States Environmental Protection Agency, Solid Waste Disposal Facility Criteria; Final Rule, Federal Register (9 October 1991) vol.56, no.196, 50978-51119.

28. Jim Coffee, solid waste section permitting supervisor State of North Carolina, telephone interview by author, 18 December 1992.

29. Cutler and Stanfield, P.A., A Guide to Understanding the New EPA Regulations on Municipal Solid Waste Landfills, (November 1991).

30. EPA, Final Rule, 51022.

31. Ibid., 51017.

32. Ibid., 51018.

33. Ibid.

34. Ibid., 51020.

35. Ibid., 51019.

36. Ibid.

37. Ibid.

38. Ibid.

39. Ibid., 51021.

40. Ibid., 51022.

41. Ibid., 51021.

42. Ibid.

43. Joyce Engineering, Inc., "At Long Last: EPA Issues Final Subtitle D Regulations," Waste Management Update, 5 (Winter 1992): 4.

44. EPA, Final Rule, 51021.

45. Ibid., 51020.

46. Ibid., 51021.

47. Ibid., 51024.

48. Ibid., 51023.

49. Ibid., 51032.

50. Ibid.

51. Ibid., 51024.

52. Ibid.

53. Ibid., 51033.

54. Ibid., 51026.

55. Ibid.

56. Ibid., 51027.

57. Ibid., 51028.

58. Ibid.

59. Ibid.

60. Joyce Engineering, Waste Management Update, 8.

61. EPA, Final Rule, 51029.

62. Ibid.

63. Ibid., 51030.

64. Ibid.

65. Ibid.

66. North Carolina Department of Environment, Health, and Natural Resources, "Chatham County Award Application," Governor's Take Pride in America Recycling Award Program, (16 April 1992).

67. Michael Shore, recycling coordinator in Chatham county, telephone interview by author, 16 December 1992.

68. Michael Shore, "The Basics of Banning OCC in Chatham County," The R-Word, 4 (Fall 1992): 10.

69. Haywood Phthisic, utilities director in Johnston County, telephone interview by author, 9 November 1992.

70. NCDEHNR, "Chatham County Award."

71. North Carolina Department of Environment, Health, and Natural Resources, "Surry County Award Application," Governor's Take Pride in America Recycling Award Program, (16 April 1992).

72. Ibid.

73. Michael Shores, "Banning OCC," 10.

74. Ibid.

75. Steve Heiselman, "Recycling Diversifies and Expands in the Mountain Counties," The R-Word, 1 (Spring 1989): 6.

76. Ibid.

77. Dick Wyatt, county engineer of Catawba County, telephone interview by author, 3 December 1992.

78. Ibid.

79. NCDEHNR, State Solid Waste Plan, vol. 1, 5-13.

80. North Carolina Department of Environment, Health, and Natural Resources, Division of Solid Waste Management,

Yard Waste Composting, by J. Gordon Layton, (11 July 1990): 1.

81. Ibid.

82. Michael Shore, Telephone interview.

83. Ibid.

84. Ibid.

85. Tom Rhodes, recycling coordinator in Burke County, telephone interview by author, 16 December 1992.

86. North Carolina State University Cooperative Extension Service, "Scientist Sees Treasure in Composting," Roanoke Rapids Daily Herald, 9 December 1992. 10B.

87. Dr. James Shelton, North Carolina State University Soil Scientist, telephone interview by author, 5 January 1993.

88. Ibid.

89. Ibid.

90. Ibid.

91. North Carolina Department of Environment, Health, and Natural Resources, North Carolina Recycling and Solid Waste Management Plan, vol.3, Local Government Guidance and Technical Assistance, by Roy F. Weston, Inc. and Hazen and Sawyer, P.C. (February 1992): 4-26.

92. Thomas Couling, "The Pros and Cons of Composting," American City and County, (December 1990): 60.

93. County Lines, "Franklin County's Mouw cooks a mess of compost," (10 July 1991): 4.

94. George W. Nester, Virginia Review, 32.

95. John Kelly and Hazen Blodgett, "Halifax County Solid Waste Financing Proposal," 28 December 1990.

96. Mike Sumner, finance director in Franklin County, telephone interview by author, 9 November 1992.

97. Ibid.

98. Ibid.

99. Ibid.

100. Ibid.

101. Haywood Phthisic, interview.

102. Ibid.

103. Ibid.

104. Ibid.

105. Ibid.

106. Halifax County, Report to the Halifax County Commissioners on the Collection and Disposal of Solid Waste, by John Kelly, Chairman (October 1992).

107. County Lines, Craven County introduces county-wide trash Collection," (25 September 1991): 1,5.

108. Ibid.

109. Ibid.

110. George W. Nester, Virginia Review, 32.

111. North Carolina Department of Environment, Health, Annual Report, (1992): 27.

112. Ibid., 21.

113. Jim Coffee, telephone interview.

114. Ibid.

115. Mark Combs, solid waste director in Watauga County, telephone interview by author, 22 January 1993.

116. County Lines, "Baling offers a new option in solid waste management," (13 May 1992): 7.

117. George W. Nester, Virginia Review, 32.

118. Jack Guinan, executive director of Coastal Regional Solid Waste Management Authority, telephone interview conducted by author, 14 January 1993.

119. Ibid.

120. Ibid.

121. Ibid.

122. Ibid.

123. Ibid.

124. Ibid.

125. Ibid.

126. County Lines, "Montgomery, Richmond counties to get regional recycling center, landfill," (9 January 1991): 1.

127. Ibid.

128. Ibid., 3.

129. Gary McCaskill, county manager of Montgomery County, telephone interview by author, 14 January 1993.

130. Ibid.

131. Ibid.

132. Lee Clyburn, "Survey studies waste methods," County Lines, 17 (25 September 1992): 1,12.

SELECTED BIBLIOGRAPHY

Government Documents:

Halifax County. Report to the Halifax County Commissioners on the Collection and Disposal of Solid Waste, by John Kelly, Chairman. October 1992.

North Carolina. "Solid Waste Management Act of 1989." Statutes. (1989, c. 784, s.2.)

North Carolina. "Solid Waste Management Act of 1989." Revised Statutes, Annotated . (1991)

North Carolina Department of Economic and Community Development, Energy Division. Assessment of the Recyclable Materials Markets and Market System in North Carolina, by UNC Institute for Transportation, Research and Education, Hazen and Sawyer, P.C., and Mt. Auburn Associates. 1 April 1991.

_____. Technical and Market Development Analysis for Compost Materials in North Carolina, by UNC Institute for Transportation, Research, and Education and E and A Environmental Consultants, Inc. 1 April 1991.

North Carolina Department of Environment, Health, and Natural Resources. North Carolina Recycling and Solid Waste Management Plan vol.1, Assessment of Local and Regional Infrastructure and Resources, by Roy F. Weston, Inc. and Hazen and Sawyer, P.C. February 1992.

_____. North Carolina Recycling and Solid Waste Management Plan vol. 3, Local Government Guidance and Technical Assistance, by Roy F. Weston, Inc. and Hazen and Sawyer, P.C. February 1992.

_____. North Carolina Solid Waste Management Annual Report. 1992.

_____. "Chatham County Award Application." Governor's Take Pride in America Recycling Awards Program. 16 April 1992.

_____. "Surry County Award application." Governor's Take Pride in America Recycling Awards Program. 16 April 1992.

_____. Division of Solid Waste Management. "Summary of Major Solid Waste Management Legislation from the 1991 Session of the General Assembly."

_____. Division of Solid Waste Management. Yard Trash Composting, by J. Gordon Layton. 11 July 1990.

United States Environmental Protection Agency. Solid Waste Disposal Facility Criteria; Final Rule. Federal Register (9 October 1991) vol.56, no. 196, 50978-51119.

Publications:

Clyburn, Lee. "Survey studies waste methods." County Lines. 17 (25 September 1992): 1,12.

Couling, Thomas. "The Pros and Cons of Composting." American City and County. (December 1990): 56-62.

County Lines. "Baling offers a new option in solid waste management." (13 May 1992): 4,7.

County Lines. "Craven County introduces county-wide trash collection." (25 September 1991): 1,5.

County Lines. "Franklin County's Mouw cooks a mess of compost." (10 July 1991): 4.

County Lines. "Montgomery, Richmond counties to get regional recycling center, landfill." (9 January 1991): 1,3.

Cutler and Stanfield, P.A. A Guide to Understanding the New EPA Regulations on Municipal Solid Waste Landfills. (November 1991).

Heiselman, Steve. "Recycling Diversifies and Expands in the Mountain Counties." The R-Word. 1 (Spring 1989): 6.

Joyce Engineering, Inc. "At Long Last: EPA Issues Final Subtitle D Regulations." Waste Management Update. 5 (Winter 1992): 1-12.

Nester, George W. "Sky Rocketing Landfill Costs: Waynesboro Bales Out." Virginia Review Waste and Resource Management. (September/October 1992): 31-33.

North Carolina State University Cooperative Extension Service. "Scientist sees treasure in composting." Roanoke Rapids Daily Herald, 9 December 1992, 10B.

Regan, Ed. "The Solid Waste Management Law Revisited, Questions on Law Linger." County Lines. 17 (9 October 1991): 1-3.

Shore, Michael. "The Basics of Banning OCC in Chatham County." The R-Word. 4 (Fall 1992): 10.

Unpublished Documents:

Kelly, John and Hazen Blodgett. "Halifax County Solid Waste Financing Proposal." 28 December 90. Photocopied.

North Carolina Recycling Association. "Realistic Waste Reduction and Recycling Goals for North Carolina (Draft)." 27 March 1991. Photocopied.

Interviews:

Coffee, Jim, solid waste section permitting supervisor State of North Carolina. Telephone interview by author. 5 January 1993.

Combs, Mark, solid waste director Watauga County. Telephone interview by author. 22 January 1993.

Guinan, Jack, executive director of Coastal Regional Solid Waste Management Authority. Telephone interview by author. 14 January 1993.

McCaskill, Gary, county manager of Montgomery County. Telephone interview by author. 14 January 1993.

Phthisic, Haywood, utility director of Johnston County. Telephone by author. 9 November 1992.

Rhodes, Tom, recycling coordinator in Burke County. Telephone interview by author. 16 December 1992.

Shelton, Dr. James, soil scientist for North Carolina State University. Telephone interview by author. 5 January 1993.

Shore, Michael, recycling coordinator of Chatham County. Telephone interview by author. 16 December 1992.

Sumner, Mike, finance director in Franklin County. Telephone interview by author. 9 November 1992.

Wyatt, Dick, county engineer of Catawba County. Telephone interview by author. 3 December 1992.