Air Force

RESOURCE RECOVERY &
RECYCLING PROGRAM
GUIDE

May 1995
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Strategic Goal</td>
<td>1-1</td>
</tr>
<tr>
<td>1.2</td>
<td>Program Start-up</td>
<td>1-1</td>
</tr>
<tr>
<td>1.3</td>
<td>Program Measurement</td>
<td>1-4</td>
</tr>
<tr>
<td>2</td>
<td>Recycling Operations</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Planning the Program</td>
<td>2-1</td>
</tr>
<tr>
<td>2.2</td>
<td>Program Responsibility</td>
<td>2-1</td>
</tr>
<tr>
<td>2.3</td>
<td>Resources</td>
<td>2-1</td>
</tr>
<tr>
<td>2.4</td>
<td>Waste Stream Profile</td>
<td>2-2</td>
</tr>
<tr>
<td>2.5</td>
<td>Market Survey &amp; Identification</td>
<td>2-3</td>
</tr>
<tr>
<td>2.6</td>
<td>Facilities, Equipment, &amp; Vehicles</td>
<td>2-4</td>
</tr>
<tr>
<td>2.7</td>
<td>Collection &amp; Separation Strategies</td>
<td>2-6</td>
</tr>
<tr>
<td>2.8</td>
<td>Procedures for DRM O Material Sales</td>
<td>2-7</td>
</tr>
<tr>
<td>2.9</td>
<td>Direct Sale of Recyclable Materials</td>
<td>2-9</td>
</tr>
<tr>
<td>2.10</td>
<td>Distribution of Proceeds</td>
<td>2-12</td>
</tr>
<tr>
<td>2.11</td>
<td>Household Hazardous Materials</td>
<td>2-12</td>
</tr>
<tr>
<td>3</td>
<td>Composting Programs</td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Elements of an Effective Composting Program</td>
<td>3-1</td>
</tr>
<tr>
<td>3.2</td>
<td>Composting Facilities &amp; Operations</td>
<td>3-3</td>
</tr>
<tr>
<td>3.3</td>
<td>Material Collection</td>
<td>3-9</td>
</tr>
<tr>
<td>3.4</td>
<td>Quality Control</td>
<td>3-9</td>
</tr>
<tr>
<td>3.5</td>
<td>End Uses</td>
<td>3-10</td>
</tr>
<tr>
<td>3.6</td>
<td>Other Alternatives</td>
<td>3-11</td>
</tr>
<tr>
<td>3.7</td>
<td>Summary</td>
<td>3-11</td>
</tr>
<tr>
<td>4</td>
<td>Advocacy</td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Education</td>
<td>4-1</td>
</tr>
<tr>
<td>4.2</td>
<td>Innovation</td>
<td>4-1</td>
</tr>
<tr>
<td>4.3</td>
<td>Purchasing Environmentally Preferable Products</td>
<td>4-2</td>
</tr>
<tr>
<td>5</td>
<td>Information Sources</td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Legal Requirements</td>
<td>5-1</td>
</tr>
<tr>
<td>5.2</td>
<td>References</td>
<td>5-1</td>
</tr>
<tr>
<td>5.3</td>
<td>Recycling &amp; Composting Associations</td>
<td>5-3</td>
</tr>
<tr>
<td>5.4</td>
<td>Major Command Points of Contact</td>
<td>5-4</td>
</tr>
<tr>
<td>5.5</td>
<td>Abbreviations &amp; Acronyms</td>
<td>5-6</td>
</tr>
</tbody>
</table>
ACKNOWLEDGMENT

This Guide was compiled with the invaluable team effort of: Capt Dave Maharrey (USAF/ CEVP); Nancy Carper (HQ AFCEE/ EP); Bob Hailey (HQ ACC CES/ ESC); Mark Horstman (HQ AMC/ CEVC); Diana Dean (USAFA/ CEV); Johann Behnken (AFDTC/ EMC); Donald Kolnsberg (375 SPTG/ CEV); and Scott Ammon (509 CES/ CEV).
CHAPTER 1 - INTRODUCTION

This document describes the general elements found in successful resource recovery and recycling programs (RRRP) and provides guidance for implementing a program. The target audience for this guide is the RRRP manager (also called the qualified recycling program (QRP) manager). There are a number of ways to set up a RRRP and it is expected that installations will tailor this program to fit the specific conditions and goals of the installation. This guide supersedes the Air Force Recycling How-To-Guide, published June 1994. Additional copies of the RRRP guide may be obtained from the Air Force Center for Environmental Excellence, Environmental Quality Directorate (AFCEE/ EP) DSN 240-3371

1.1 Strategic Goal. The goal of the Air Force RRRP is solid waste reduction, pollution prevention, and conservation of natural resources. Objectives include:

- Minimize the amount of waste discarded in landfills;
- Increase the percentage of waste that is recycled;
- Stimulate market demand for environmentally preferable products by increasing both the type of products and the amount of products purchased;
- Expand the education program with a focus on public awareness and support of recycling and composting programs;
- Maximize proceeds both now and in the future; and
- Comply with Federal, State and local mandates.

1.2 Program Start-up. The most important part of the RRRP Manager’s job is resource advocacy; acquiring the manpower, equipment, vehicles, and funding necessary to create a program that reduces waste disposal at the least cost. This section focuses on the overall RRRP program and provides general guidance about program resources.
Later chapters concentrate on the specific program elements (e.g., recycling, composting) and provide detailed suggestions.

1.2.1 Selecting a RRRP Manager. Selecting a dedicated, enthusiastic, and creative program manager is critical to the success of any RRRP. It is strongly recommended that the RRRP manager have no other full-time responsibilities. The program manager must be able to dedicate 100 percent of his/her time to the RRRP.

The RRRP manager is responsible for consolidating information from all recycling activities, reporting on solid waste reduction and affirmative procurement activities, composting, environmental compliance of the program, and education.

The program manager should also develop a strategic five-year RRRP plan, program requirements in the Work Information Management System-Environmental Subsystem’s (WIMS-ES) A-106 and Pollution Prevention Modules, and advocate for funding. The RRRP manager is responsible for the functioning of the RRRP Subcommittee (See 1.2.3 Organization Participation).

1.2.2 Program Responsibility. The installation commander has overall responsibility for implementing a resource recovery and recycling program. The RRRP must comply with public law, Executive Orders, Department of Defense and Air Force policies and regulations, as well as applicable state or local requirements (See 5.1 Legal Requirements).

1.2.3 Organization Participation. Support from the installation’s senior leadership and other organizations is essential to the RRRP’s success. The most effective way to incorporate installation organizations into the RRRP is through the Environmental Protection Committee (EPC). The EPC should be used to report results, advance new ideas, describe problems, and identify solutions while ensuring that each organization knows its role for the program to succeed.

Increased installation emphasis can be obtained through the establishment of a RRRP Subcommittee which reports directly to the EPC. The RRRP Subcommittee allows installation-wide participation in this highly visible wing program. Committee members establish program objectives designed to maximize recycling of materials and minimizing solid waste disposal. The committee includes the RRRP manager and should be composed of representatives from a variety of base organizations, to include tenants. As a minimum, recommend representatives from the following organizations be members of the RRRP Subcommittee (installations may not have all these organizations):

- Aircraft Maintenance;
- Army and Air Force Exchange Service (AAFES);
Base Comptroller;
Civil Engineer Operations;
Contracting;
Defense Commissary Agency (DeCA);
Defense Reutilization and Marketing Organization (DRMO);
Environmental Management;
Legal;
Public Affairs;
Services;
Supply; and
Vehicle Maintenance.

The initial tasks facing the RRRP Subcommittee are to obtain a waste stream characterization, identify available resources, identify potential markets, determine method of program accomplishment, identify facility, equipment, and vehicle requirements, and promote education. On the basis of this data, the subcommittee will develop a program start-up strategy and obtain organizational support for the identified initiatives. The installation commander has ultimate ownership of the program and is responsible for ensuring the program meets or exceeds Air Force goals.

Once the RRRP is functioning, the RRRP Subcommittee should review and consider: (1) suggestions to improve and expand present operations; (2) audits and inspection reports; (3) the RRRP budget and execution; (4) proposed programs/projects for recycling revenue use; and (5) educational and promotional activities.

1.2.4 Economic Analysis. Another essential tool is an economic analysis of the waste stream, handling methods, and material markets. This analysis allows the RRRP manager to make intelligent choices in program start-up and employment of resources. The material markets section of the analysis should include not only how industry prefers the material packaged, but an examination of the total costs (manpower, equipment, transportation) necessary to meet this preference. The higher price obtained for material packaged in the preferred method may not be sufficient to justify the increased costs.

1.2.5 Funding. Knowledge and understanding of the funding process is necessary for program success. The funding process includes obtaining and managing start-up and recurring operating costs as well as distributing proceeds from recyclable material sales. These activities must be in accordance with AFI 32-7001, Environmental Budgeting, and AFI 32-7080, Pollution Prevention Program. Funding requirements must be budgeted and programmed through installation and MAJCOM Financial Plans and during the Program Objective Memorandum (POM) development process.

1.2.6 Manpower. Acquiring the manpower to operate the RRRP is increasingly becoming the single most important factor affecting decisions concerning the start-up
and operation of recycling and composting programs. However, potential labor pools
do exist and include such resources as military, civilian, contract, federal and state
prisoners, and volunteers. The advantages and disadvantages of each pool are
discussed in both Chapter 2, Recycling Operations, and Chapter 3, Composting
Programs.

1.2.7 Equipment. The RRRP manager needs to determine the best balance between
costs and equipment efficiency. For example, if a large, inexpensive labor pool is
available, cheaper, more labor intensive equipment can be used. Conversely, in a tight
manpower situation, the purchase of more expensive, but labor saving equipment may
be a better option.

1.2.8 Vehicles. Transportation is essential for the success of the RRRP. Vehicles may
be obtained through appropriated fund resources, General Services Administration
(GSA) lease, or closure base residue. Requirements must be submitted to MAJCOM for
authorization and acquisition.

1.3 Program Measurement. Measuring program effectiveness is an important part of
the overall process. The following three metrics, in combination, provide the best
complete picture of program operations.

1.3.1 Solid Waste Disposal. This method measures solid wastes disposed of in
landfills and through incineration (not waste-to-energy) in tons. The annual numbers
are compared to previous years and the baseline year (currently calendar year 1992 for
the Air Force) to measure performance. The desired trend is reduction in annual
 tonnage disposed. Increases in disposal quantities should be examined to determine
whether they were due to ineffective programs, inaccurate baseline data, or other
factors, such as mission changes.

1.3.2 Solid Waste Generation. This metric measures the total waste generated on the
installation in tons. The total waste is the sum of the disposed amount and the
recycled/ reused amount (sum of recycled, composted, and waste-to-energy amounts).
The desired trend is reduction in annual tonnage generated. This metric allows an
installation to determine the effect of their source reduction efforts, the first level in the
pollution prevention hierarchy.

1.3.3 Recycling Percentage. This performance indicator measures recycled/ reused
amounts as a percentage of total waste generation. The recycled/ reused amount is
divided by the total waste generated. The desired trend is an increase in the annual
recycling percentage. This indicator judges the effectiveness of the recycling efforts, the
second level of the pollution prevention hierarchy.
While source reduction is the primary focus for pollution prevention efforts, few source reduction initiatives are available to installations. This is because most source reduction opportunities are present before the installation is affected. For example, product packaging is determined by the manufacturer. The installation must determine how to handle the waste from the product, not how to eliminate the waste. Therefore, recycling percentage is an important measure of the RRRP’s effectiveness.
CHAPTER 2 - RECYCLING OPERATIONS

2.1 Planning the Program. A comprehensive recycling program impacts all base organizations as they all generate solid waste. Therefore, it is imperative the recycling program receive support and commitment from all organizations on the installation.

Many areas have local or regional recycling programs. Joining existing or planned regional recycling programs is encouraged. When regional recycling programs are unavailable or unreasonably costly, the installation will need to develop its own recycling program.

Listed below are some of the planning tasks associated with implementing or improving a recycling program. The maturity of your recycling program will determine which task you begin with.

- Determine responsible/managing organization;
- Identify resources;
- Perform a waste stream profile;
- Identify potential markets;
- Determine method of operation (in-house or contract);
- Identify facilities, equipment, and vehicles;
- Determine collection and separation strategies;
- Educate base population; and
- Identify opportunities for expansion.

2.2 Program Responsibility. The installation commander has overall responsibility for implementing a recycling program. The program must comply with public law, Executive Orders, DoD and Air Force policies and regulations, as well as applicable state or local requirements (See 5.1 Legal Requirements).

2.3 Resources.

2.3.1 Program Funding. Funds to support the start-up and operation of a recycling program will be obtained in accordance with AFI 32-7001, Environmental Budgeting, and AFI 32-7080, Pollution Prevention Program. Several of the available funding sources are:

- Pollution Prevention (PP) Funding can be used to cover start-up costs (e.g., purchase equipment, bins), recurring service costs and recycling contracts.
Operations & Maintenance (O&M) Funding for refuse collection can be used when recycling requirements are integrated into the base solid waste management contract.

Military Family Housing (MFH) Funds must be used for recycling program requirements that encompass MFH. Examples are the purchase of recycling containers for MFH units and contract costs for curbside pick-up.

2.3.2 Manpower. Another major resource needed to successfully operate a recycling program is manpower. The Air Force Manpower Standard (AFMS) only identifies one man-year for solid waste management and recycling in the core manpower requirements. This shortage has challenged program managers to become innovative in sourcing manpower.

There are a number of ways to obtain manning for recycling operations. Potential personnel sources are military, civilian, contract, federal and state prisoners, and volunteers. The manager must weigh various factors when deciding which labor source to employ. Military and permanent civilian personnel are applied against the Unit Manning Document (UMD), but military manpower does not have to be reimbursed by program revenues. Contract labor does not count toward the UMD, but is generally more expensive. Prison labor is inexpensive, but not always available and may require escorts. Volunteers, while usually enthusiastic, are not always consistent.

2.4 Waste Stream Profile. To establish an effective recycling program, an installation must first determine the types and volumes of recyclable materials generated on the installation. As a start, review your baseline study and the profile percentages provided in the Performance Work Statement software handbook from AFCESA (For more information, contact Mr. Gary Jacks, AFCESA/ CESM, DSN 523-6190). Concentrate on the materials requiring recycling in accordance with AFI 32-7080. These items are paper, plastics, metals, glass, used oil, lead acid batteries, and tires. Some of these categories can be subcategorized further, for example:

- Paper (computer, office, newspaper, colored)
- Metals
  - Ferrous (steel and iron)
  - Nonferrous (brass, aluminum, copper)
  - Used beverage containers

This list is neither all inclusive nor meant to limit materials considered for recycling. A creative and enthusiastic program manager may identify additional materials available for recycling based upon local conditions or markets. Examples of other materials being recycled are wood, food waste, Christmas trees, toner cartridges, etc.
Where a baseline survey has been completed, information from this survey can be used to estimate the volume of material potentially available for recycling. If a detailed baseline survey is not available, other avenues will have to be used to estimate material types and volumes. These avenues may include visiting various facilities and visually inspecting trash receptacles, interviewing personnel, or using some standard estimates available from a variety of sources including the EPA. Universities and colleges can be an excellent source of baseline information, or may assist in performing a baseline survey.

2.5 Market Survey & Identification. The servicing DRMO is responsible for performing market research for all appropriated resourced material defined as recyclable. Program managers should contact DRMO to obtain current market value and market stability information. If no local markets can be determined, the DRMO’s are required to seek assistance from the respective Defense Property Disposal Region in identifying other potential markets.

If an installation believes it can obtain better market prices than those provided by current DRMO contracts, they may wish to proceed with their own market identification. If the installation's survey indicates better prices can be obtained, provide this information to DRMO and request they upgrade contracts or, if all else fails, to terminate contracts for “convenience to the government.” Another option is to obtain a waiver to direct sale appropriated material (See 2.9 Direct Sale of Recyclable Materials).

When market analyses are unavailable from DRMO, an installation must use its own resources to identify available markets for recyclable materials. Information on potential markets can be obtained from:

- The EPA;
- State Environmental Agency;
- Recycling organizations;
- Yellow pages under recycling or waste paper;
- Local newspapers;
- Municipal solid waste managers;
- Other base recycling managers;
- Local paper, aluminum, or cardboard manufacturers;
- Periodicals; and
- Other recyclers/generators in the area.

Potential buyers of recycled material should be queried regarding quantity requirements, acceptable levels of contamination, average price, delivery requirements, pickup availability, and equipment availability (e.g., will they provide a storage bin or trailer for hauling the material). This information is necessary to establish equipment,
facility, vehicle, and material processing requirements. Examples of how these factors can affect the recycling program are:

- If a contractor wants glass delivered in original state, a crusher or condenser may not be needed.
- When a larger quantity of material is needed before sale (i.e., glass), you may opt for a crusher to minimize storage requirements.
- Will the contractor pick-up the materials or will you need to transport as part of the sale? Do you or the contractor pay the freight costs?
- Your equipment and storage requirements will in-turn drive your facility square footage requirements.

2.6 Facilities, Equipment, & Vehicles. The recycling program selected by the installation is impacted by available facilities, equipment, and vehicles. For example, if the Facility Utilization Board determines square footage is unavailable to support recycling requirements, the program manager should program for a new facility or consider contract options. Equipment needs and storage space are the primary drivers for facility size.

2.6.1 Facilities. Facilities for a recycling center need not be complex. Typically the area consists of a material recovery facility (MRF), otherwise known as a recycling center, with a small office area. The MRF should be large enough to house the material processing equipment (magnetic separator, metal can “condenser”, paper balers, etc.) and allow for material handling equipment maneuverability. The MRF may also provide some storage capability for materials that are subject to weather damage. MRFs of 4,000 to 6,000 square feet are typically required for programs in the first stage. As the recycling program grows, more space and more efficient material processing equipment may be acquired.

Adjacent to the MRF should be a paved marshaling yard surrounded by a privacy fence. The marshaling yard provides an area for loading equipment and trucks to operate and should include a ramp where forklifts can load commercial transport trailers. Thirty cubic yard transport trailers are also being used by some installations to provide additional storage space and to minimize the movement of processed materials once they have been prepared for shipment. Buyers may be willing to preposition road ready licensed trailers at the recycling facility for high volume items. In addition to the MRF, additional covered storage space may be required to prevent weather damage to materials waiting for shipment.

2.6.2 Equipment. The types, models, capabilities, and purposes of available recycling equipment are numerous. Equipment is available to accomplish or assist in collecting, compacting, baling, shredding, sorting and other tasks associated with
processing material for recycling. Ease of use, simplicity, cost, and effectiveness of the equipment are important traits. When searching the market for equipment items that best fit your requirements, contact the manufacturer to obtain, names of companies, municipalities or other agencies now using the equipment item. Contact these entities and get their candid evaluation of the equipment, to include operating costs. Also, contact other base program managers and ask for their input. Established GSA contracts should be your initial source for equipment, but don’t limit yourself to these contracts.

After equipment requirements are established, authorizations must be obtained and added to the shop TA (Table of Allowance). Changes to TAs are coordinated through the base logistics transportation office and approved by the MAJCOM. After TAs for equipment are approved, leasing is an option to acquire short term use of equipment.

2.6.2.1 Collection Containers. Containers are chosen based on the material to be collected, expected volume, collection strategy, and cost.

- MFH curbside collection containers can be a simple plastic bin (normally provided by the contractor for contract operated programs).
- Desk-top paper collection containers are typically small cardboard bins, located on the desk, or the plastic desk-side containers. A container should be located at all desks, copiers, fax machines, and printers.
- Drop-off collection containers are generally some type of dumpster (e.g., Dempsey dumpster) or compartmentalized trailer. There are a variety of styles and sizes. Some types are self-dumping containers which may help minimize processing time.

2.6.2.2 Balers. Balers are normally required to package cardboard and paper into more manageable bundles. Compacted items are less bulky and often command higher prices. Consider versatility of the make and model of the unit purchased. Balers can be either horizontal (self-load) or vertical stroke. The horizontal baler will cost more (total cost approximately $60-90,000), but is less labor intensive. An option for this model is a “fluffer” that is used to improve the compaction of paper. The vertical downstroke unit will cost less (total cost approximately $20,000) but is labor intensive. This unit can be considered for bailing of plastics and as a back-up in the event the horizontal baler is down for maintenance.

2.6.2.3 Crushers/Condensers. Crushers and condensers are typically used for aluminum and steel cans. Condensers, often referred to as a “cuber”, compresses cans into a high density, low volume cube. Crushers simply crush individual cans. The model selected should be based upon the market preference and transportation costs. Crushers are also used for glass.

2.6.2.4 Shredders/Sorters. Shredders reduce the bulk of many materials (e.g., cans, paper, and plastic). A paper shredder may be warranted if your installation processes large quantities of “Privacy Act” or “For Official Use Only” paper (check with your
installation Information Management section to determine the appropriate level of protection and methods of destruction in accordance with AFIs 37-131 and 37-132). Before purchasing a paper shredder, check with Information Management for possible resources already on base. Sorters are used to separate metals. A simple magnetic sorter separates metal, such as steel and aluminum cans. When obtaining these pieces of equipment, self-loading or conveyer type units should be considered since they are less labor intensive.

2.6.2.5 Conveyors. Conveyors come in an assortment of sizes and can be used in conjunction with other equipment items, such as a horizontal baler, or they can be used individually for material sorting. These items can range in price from a couple of thousand dollars for a simple conveyor to upwards of $65,000 for a material sorting conveyor.

2.6.2.6 Material Handling Equipment. Equipment to load and handle the recyclables is required. Types of equipment may include: front-end loaders (e.g. Bobcat loader with forklift, grapple hook, and bucket attachment), fork lifts, pallet jacks, and trailers, etc.

2.6.2.7 Other Equipment. Based on waste stream analysis and market demand, other equipment items may be considered; for example, drum crushers, oil filter crushers, aerosol can puncturers, perforators, etc.

2.6.3 Vehicles. Vehicle needs will be determined by the level of the recycling operation. Small operations can usually be supported using existing base vehicles while most intermediate level operations require substantial vehicle support. When base assets are not available to support recycling activities, the recycling program may require dedicated vehicles and equipment. Vehicle needs, depending on the level of operation, can include a front-end loader, flatbed truck, etc.

After vehicle requirements are established, authorizations must be obtained and added to the shop TA. Changes to TAs are coordinated through the base logistics transportation office and approved by the MAJCOM. After TAs for vehicles are approved, leasing is an option to acquire short term use of vehicles.

2.7 Collection & Separation Strategies.

2.7.1 Collection Strategies. The choice of collection strategies has considerable impact on both level of participation and program costs. The easier it is for the customer to participate in the program, the greater the level of participation.
2.7.1.1 Drop-off. The drop-off collection method typically consists of placing multiple collection bins in a centralized location, often the recycling center, where participants bring their recyclables. Participation can be increased by placing additional bins in strategic locations throughout the base (e.g., a newspaper collection bin near the commissary). Participants should be required to sort their material and place it in appropriate bins. A less desirable and more labor intensive option is allow participants to bring their material to the recycling center for sorting.

- **Advantages:** This collection method is usually the least expensive collection option. Equipment and manpower costs are minimized. Persons that voluntarily drop off recyclables tend to properly sort items. Drop off collection can be used alone or in conjunction with other collection methods. This is an excellent startup method.

- **Disadvantages:** Participation levels are usually lower since participants bear the burden of collecting and delivering recyclables to the collection center. Recyclables may be commingled or mixed with trash if bins are unattended. If participation is mandatory, recyclables are unlikely to be properly sorted. The area may also become untidy if bin overflow is allowed.

2.7.1.2 Facility Pick-up. In-house or contract personnel, on a scheduled basis, will collect recyclable materials from base facilities. Typically, this pick-up encompasses the centrally located containers where individual facility occupants have transferred the materials. Materials often include paper, cardboard, toner cartridges, aluminum cans, and computer paper.

- **Advantages:** There will be greater participation and greater quantity and types of materials collected. This method is also more customer friendly.

- **Disadvantages:** Increased manpower and container requirements result in increased cost.

2.7.1.3 MFH Curbside Pick-up. Similar to trash collection, recyclables are picked up at MFH units. Participants set recyclables out on collection days. Recyclables can be collected together and sorted at the recycling center, or participants may be required to separate their materials prior to curbside pick-up. Bins should be provided to the participants to facilitate uniformity and ensure ease of pickup. Curbside pick-up can be used in conjunction with drop off collection to achieve maximum collection rates. Recyclables should be picked-up the same day as the refuse. This action provides greater customer convenience and participation. Also, same day pick-up of refuse and recyclables may ease the surveillance requirements from the additional Quality Assurance Evaluation (QAE) tasking.

- **Advantages:** This collection method typically has the highest rate of participation since it requires only minimum effort on the participant's part. MFH resident's only set recyclables out as they would their trash.

- **Disadvantages:** Collection costs are increased.
2.7.1.4 **Contractor.** Using a contractor for collection of recyclables is similar to using a contractor for refuse collection. It may be possible to modify your existing refuse collection contract to include recycling requirements. You may also want to include in the contract the operation of the MRF if there is a shortage of in-house manpower. The contract can provide incentives, such as the contractor keeping the material sales proceeds, for the contractor to minimize costs and maximize collection.

**Advantages:** Use of contract recycling can minimize start-up, manpower, and facility costs (less capital investment). The program can be tailored to meet the specific needs of the base. The base may continue to receive recycling proceeds.

**Disadvantages:** There will be an additional contract management responsibility. This method is typically more expensive which results in less recycling proceeds to the installations.

2.7.1.5 **Combination.** It is common practice to use a combination of the above collection strategies to maximize participation and material collection with the most efficient operation.

2.7.2 **Separation Methods.** Material separation can occur at the generating source, at the drop-off containers, or at the material recovery facility. Choosing where to separate the materials will have an effect on the program strategy and costs. Separation is done manually or mechanically by ferrous/ non-ferrous separators.

2.8 **Procedures for DRMO Material Sales.** Once the recyclable materials are sorted and prepared for market, it is time to process the necessary paperwork for a sale. DRMO is responsible for selling all appropriated resourced recyclable materials. It is their responsibility to process the material for sale and obtain current market prices.

2.8.1 **Turn-in and Accountability Procedures.** To ensure funds from sales managed by DRMO are received, the installation must provide DRMO with properly completed DD Form 1348-1, turn-in documents. If the DD Form 1348-1 is inaccurately completed or lacks information, proceeds generated by the sale will generally be deposited to the general account of the US Treasury. Reversals/ recovery of funds deposited to the general account are unlikely. The critical information needed on the DD Form 1348-1 with respect to the installation recycling fund cite consists of four parts:

- A two digit service identification code (SIC) -- 57 for AF;
- Recycling Budget Clearing Account Code (BCAN) -- obtained from Accounting and Finance;
- Appropriation Limitation identifier -- 8900 for AF; and
Fiscal station number -- installation specific identifier, obtained from Accounting and Finance.

Also, the recycling manager, or his designated representative, must include on the DD Form 1348-1 the following statement of certification accompanied with his/her signature:

“I certify that this material meets all applicable qualifications of the DoD RRRP and that no munitions list/strategic items requiring demil are present. The following is a valid RRRP fund site: (installation RRRP account fund site)”

To ensure the installation receives the correct amount of funds from the sale of recyclables, the recycling program manager must track the delivery and sale of recyclables. **NOTE:** Sale information is available from DRMS Form 1427 and DRMO's computerized tracking system. As a minimum, document the following for each transaction:

- Date of turn-in;
- Item description (including weight);
- DD Form 1348-1;
- Date and price of sale;
- Date and amount of distribution received by installation; and
- Total proceeds.

### 2.9 Direct Sale of Recyclable Materials

If requested by the appropriate organization, the recycling manager can direct sell all recyclable materials not acquired with appropriated funds. These materials include items collected from organizations such as the Commissary, Base Exchange, or the base Services Squadron. The recycling manager has unilateral authority to direct sell those recyclables collected from MFH. When direct selling any of these items, the recycling manager must keep accurate accountability of all materials, to include types, weights, proceeds received, and where the materials were generated (e.g., AAFES, DeCA). If appropriated funded resources collected, processed, or handled these materials, these proceeds must be used to cover appropriated fund costs (See 2.10 Distribution of Proceeds).

Direct sale of recyclable material should be handled similar to other installation sales, such as firewood and Christmas trees. Sales should be coordinated with, and supported by, the installation contracting office.

Other situations may arise where the recycling manager may direct sell appropriated resourced recyclable materials. However, to do so, a waiver must be obtained from Defense Reutilization and Marketing Service (DRMS).
2.9.1 **Direct Sale Waiver.** If an installation believes current DRMO contract prices are not competitive with current market prices or the proceed return time does not support program expenses, the installation may opt to request a waiver to direct sell appropriated resourced materials. This waiver could result in quicker return of proceeds and allow the RRRP manager to meet program expenses.

**NOTE:** If an installation chooses to execute its recycling program by using a contractor, and as part of the contract the contractor returns the proceeds from the sale of the recyclables to the installation (i.e., “funds change hands”), it is considered a direct sale of appropriated resource materials and a waiver from DRMS is needed. A waiver is not needed if the contractor keeps the proceeds to offset the total contract cost as negotiated at contract award.

The established DRMS procedures (sent to MAJCOM/ CEVs 16 Mar 95) for submitting a waiver request to direct sell appropriated resourced materials is as follows (clarifying remarks/suggestions are italicized):

(1) Submit the request to your MAJCOM who will in-turn endorse it with a recommendation for approval/disapproval. The MAJCOM will return the endorsed request to the installation for their submittal to the servicing DRMO. The request must contain the following information:

I. The past year’s quantities generated, by requested commodity, at DRMO obtained prices. (Include the distance to the DRMO, the time between delivery and actual payment [*time is money*], and any other relevant costs.)

II. The past year’s quantities generated, by requested commodity, at complete market value (net of overhead and transportation).

III. Written acknowledgment of the requirements and provisions of the Deputy Under Secretary of Defense (Environmental Security) Memorandum of 28 Sep 93, subject: Policy for DoD Recycling. The installation must note in particular the following:

   A. The requirement that sales of recyclable materials be in accordance with Section 203 of the Federal Property and Administration Act of 1949;

   B. The requirement for installations selling directly to maintain operational records for fiscal year reporting requirements, review and program evaluation purposes. This is to include, but is not limited to, quantities generated and sold, prices obtained, copies of successful contracts, potential buyer mailing list; and

   C. The definition of eligible recyclable materials and applicable exclusions. (From DUSD (ES) Memo, 28 Sep 93: **Recyclable materials.** Includes materials diverted from the solid waste stream and the beneficial use of such materials. Recycling is further defined as the result of a series of activities by which materials that would become or otherwise remain waste, are diverted from the solid waste...
stream by collection, separation and processing and are used as raw materials in the manufacture of goods sold or distributed in commerce or the reuse of such materials as substitutes for goods made of virgin materials. The term also includes, for purposes of this policy document, scrap, (including ferrous and nonferrous scrap) and, specifically, firing range expended brass and mixed metals gleaned from firing range cleanup which do not require demilitarization.)

IV. Written acknowledgment that any approval granted is subject to change or termination if the Office of the Secretary of Defense’s direct sale policy is changed or terminated.

V. Failure to comply with the above requirements is justification to withhold the granting of requested direct sales waivers or the cancellation of existing waivers.

(2) DRMOs will confirm the validity of commodities, quantities generated, prices, or any relevant changes as reflected on DRMO records and forward request to the DRMS (Attn: DRMS-MD). DRMOs will also include a recommendation as to the granting of the requested direct sales waiver.

(3) DRMS will review the request and approve or disapprove as appropriate. DRMS will then notify the requesting installation, the MAJCOM, and the effected DRMO, with an information copy to HQ DLA (Attn: MMSC). When there subsequently is a dispute between the DRMS recommendation and the MAJCOM’s position, the request will be forwarded to HQ DLA for assistance.

(4) Approvals will be granted for a maximum period of six months. As part of the consideration of any waiver renewal, the installation will submit to the DRMS (Attn: DRMS-MD) the following data:

I. Commodities generated and successfully sold;
II. Time period involved;
III. Relevant proceeds obtained; and
IV. Types of sales contracts utilized.

(5) Direct sales waiver renewals will be granted only when it can be clearly demonstrated that the applicable DRMO and DRMS sales activities can not duplicate or exceed the same efficiency and cost effectiveness as that of the generating activity.

As noted above, accurate and complete accountability is a must.

2.10 Distribution of Proceeds. Recycling proceeds returned to the installation from the DRMS and from direct sales of appropriated funded material must first be used to recover appropriated fund costs incurred managing and operating the qualified recycling program to include but not limited to: manpower, equipment, utility, and real property costs. After appropriated costs are reimbursed and there remains revenues from that fiscal years sales, then the installation commander may use up to 50 percent of the remaining sale proceeds for pollution abatement, energy conservation, and occupational safety and health activities. These activities may be funded up to 50
percent of the cost of a minor construction project. Any remaining proceeds may be transferred to the Morale, Welfare, and Recreation Fund to be used for morale, welfare, and recreation activities.

2.11 Household Hazardous Materials. Hazardous materials such as pesticides, cleaners, and similar products are common in most households. Unfortunately, many of these materials end up in the household trash when they are no longer needed. Even though household hazardous waste is specifically exempt from federal regulations, the local landfill is not the best disposal method. Household hazardous waste is of particular concern on a military installation due to the constant movement of personnel and their families. As a result, large quantities of unused, potentially hazardous materials are tossed in with the household trash. A much better alternative is a “drop and swap” program for unused materials. A central location is established where departing personnel can drop off their unwanted materials, and incoming personnel can pick-up items they need. In essence, unwanted hazardous materials are recycled back to the consumer for use. It is up to the installation to determine where the “drop and swap” is located and the hours of operation. Accept only those materials in their original containers and having legible labels. The base should be prepared to deal with materials that cannot be redistributed and must be disposed of as waste. It is important that all state and local regulations be considered before initiating a program of this sort.
CHAPTER 3 - COMPOSTING PROGRAMS

Yard waste, by weight, may constitute up to 20 percent of the solid waste stream at an Air Force installation. Many states already ban landfilling of yard and other organic wastes. Composting is a well-known technology for processing organic materials that can help installations meet solid waste reduction goals, produce a beneficial end-product, and minimize environmental pollution from organic solid waste.

3.1 Elements of an Effective Composting Program. Many factors must be considered in deciding whether an on-site composting program is feasible at an installation. Some of these factors are waste stream composition, regulatory requirements, siting issues, funding availability, manpower and equipment requirements, and the availability of existing municipal composting programs in the area.

3.1.1 Waste Stream Investigation. Identifying and quantifying the components of the solid waste stream are an integral part of preliminary planning for a composting operation. Excellent sources for this information are the initial installation Solid Waste Baseline Survey and annual solid waste stream evaluations. Other sources include federal, state, and local environmental agencies.

3.1.2 Regulatory Requirements. Regulations governing the location and operation of composting facilities vary from state to state; some areas have strict guidelines, while others have minimal requirements. Generally, stricter regulations apply for the composting of sewage sludge, food waste, and municipal solid waste. State and local regulatory requirements can include permitting requirements, groundwater monitoring requirements, runoff control, operator certification, and other operating and record keeping requirements. Before establishing an on-site composting program, coordinate with your local and state environmental regulators.

3.1.3 Siting Issues. The location and size of a composting facility must comply with any existing regulatory requirements and the installation’s Base Comprehensive Plan. Federal Aviation Administration (FAA) guidelines recommend against siting any type of solid waste facility, other than yard waste composting facilities, within 10,000 feet of a runway. This requirement is to prevent birds, which could be attracted to the site by potential food sources, from interfering with aircraft. Potentially suitable locations for these facilities are areas adjacent to buffer areas of existing or closed landfills or wastewater treatment plants. Other factors to consider in facility siting include convenient location to minimize hauling distances, suitable site topography and soil characteristics, sufficient land areas for the volume and type of materials to be processed, and adequate distance from public areas to minimize odor concerns.
3.1.4 Funding. Composting operations can vary from very low-end, low-cost programs to high-technology industrial operations. Sound financial planning is a crucial step in successfully developing a composting program. To determine funding requirements, complete an economic-benefit analysis. This analysis should consider organic waste volumes, availability of existing equipment, manpower requirements, most suitable technology, facility and equipment requirements, contract costs, and recurring costs. Funding to support start-up and recurring operation costs for composting programs shall be in accordance with AFI 32-7001, Environmental Budgeting. Funding requests must be budgeted through installation and MAJCOM Financial Plans and programmed in the POM development process.

A number of potential funding sources may be used. Choice of funding sources will vary depending on the policies of the installation's MAJCOM. Several of the available sources are:

- **Pollution Prevention Funds** can be used to cover composting program start-up and recurring operating costs. Funding needs are identified through the WIMS-ES A-106 and Pollution Prevention Modules. Pollution prevention funding requests should be coordinated through the base environmental engineering flight or office;

- **Military Family Housing Funds** can be used for costs associated with curbside collection in military family housing areas. MFH funding requests must also be included in Financial Plans and in the POM. Funding requests are coordinated through the civil engineering resources flight;

- **Installation O&M Funds** may be used for start-up and operation of composting programs, at the discretion of the Installation Commander; and

- **Federal, state, local or private grants** may be available to assist in set-up or operation of installation composting programs. For information on grant availability, contact the regional EPA or the state environmental department.

3.1.5 Manpower. Another major resource needed to successfully operate a composting program is manpower. The Air Force Manpower Standard (AFMS) only identifies one man-year for solid waste management and recycling in the core manpower requirements. This shortage has challenged program managers to become innovative in sourcing manpower.

There are a number of ways to obtain manning for composting operations. Potential personnel sources are military, civilian, contract, federal and state prisoners, and volunteers. The manager must weigh various factors when deciding which labor source to employ. Military and permanent civilian personnel are applied against the Unit Manning Document (UMD), but military manpower does not have to be reimbursed by program revenues. Contract labor does not count toward the UMD, but
is generally more expensive. Prison labor is inexpensive, but not always available and may require escorts. Volunteers, while usually enthusiastic, are not always consistent.

3.1.6 Facility Requirements. Most small to medium scale composting operations do not require building facilities; however, minimum facility requirements include a fenced site and a composting pad surface. To operate efficiently, a composting facility must have sufficient space for the preprocessing, processing, and post-processing stages of the composting cycle. The composting pad surface does not have to be paved, but it must be designed to prevent ponding and to control erosion and runoff. Soil permeability should also be considered. Regulatory and permitting requirements, if applicable, will provide the basis for facility design and must be thoroughly researched. In addition to facility requirements, the type and amount of traffic into and out of the facility should be considered in the design process.

Site access must be controlled at all times to avoid compromise of the composting process and ensure a safe operation.

3.1.7 Vehicles & Equipment. Vehicle and equipment needs will be determined by the level of composting operation to be implemented. Small, low-technology operations such as static pile composting can usually be operated using existing base vehicles and equipment while most intermediate-technology operations, including windrow operations, require substantial, dedicated, vehicle and equipment support. Vehicle and equipment needs, depending on the level of technology used, can include a front-end loader, windrow turner attachments, grinders or shredders, screening equipment, portable storage bins, aeration equipment, odor control equipment, in-vessel equipment, etc.

After vehicle and equipment requirements are established, authorizations must be obtained and added to the shop TA (Table of Allowance). Changes to TAs should be coordinated through the base logistics transportation office and approved by the MAJCOM. After TAs for vehicles and equipment are approved, leasing is an option to acquire short term use of vehicles and equipment.

3.1.8 Existing Municipal & Community Programs. Many cities and communities operate successful composting operations. When these programs are available, installations should consider participating in these existing composting programs in lieu of implementing in-house composting.

3.1.9 Air Force Installation Programs. Composting managers can network with installations that already have or plan to start yard waste composting operations. To obtain a copy of Air Force current and planned yard waste composting programs, contact Mr. Wayne Fordham, AFCESA/ CESM, DSN 523-6465.

3.2 Composting Facilities & Operations. The composting process occurs in two major stages. In the first phase, microorganisms decompose the organic material
through metabolic activity and the size of the composting pile is reduced. During the second stage, the compost is "cured" or finished and further microbial decomposition will occur very slowly. Because microorganisms are essential to composting, environmental conditions that maximize microbial activity will maximize the rate of composting. Microbial activity is influenced by oxygen levels, particle sizes of the feedstock material, nutrient levels (indicated by the carbon-to-nitrogen ratio), moisture content, temperature, and pH.

### 3.2.1 Composting Methods

The most commonly used processing methods are static piles, turned windrows, aerated static piles, and in-vessel composting systems. The level of technology selected will depend on the type of feedstock materials, requirements for odor and leachate control, quality requirements for the finished material, funding availability, and space availability. Brief discussions of each of these methods follow:

#### 3.2.1.1 Static Pile Composting

Static Pile Composting is low technology composting. Static or passive piles are piles of composting material that are turned infrequently, as little as once per year. This method requires only minimal labor and cost and is especially suited for backyard composting in military family housing areas and for small volumes of ground maintenance wastes. Before promoting backyard composting programs on an installation, the support of the base Environmental Protection Committee (EPC) and Installation Commander are required. Composting under these conditions is very slow and odor problems can result if food waste materials are incorporated or when large quantities of green materials are added to the piles.

With all composting methods, regular monitoring of temperature and moisture conditions is recommended. For static piles, the moisture content of internal and external layers should be occasionally checked. When moisture conditions are too low, the piles can be watered with hoses or sprinklers. Temperature and oxygen levels can be controlled by forming piles of the appropriate size for the region. Larger piles have greater insulation and can sustain higher temperatures. However, passive piles should not be constructed so large as to overheat. At temperatures greater than 140°F, microorganisms may die off and anaerobic conditions can develop.

The disadvantages to static pile composting are long composting times (often longer than one year to produce finished compost) and the possibility of anaerobic conditions and accompanying odor problems. Despite these disadvantages, static pile composting can be a simple and effective method for some programs.

#### 3.2.1.2 Turned Windrow Composting

This process is a more efficient method to static pile composting. Turned windrow is the most widely used intermediate-technology composting method. Windrows are long composting piles that are mechanically turned at regular intervals to enhance environmental conditions for
microbial decomposition. As windrows are turned, cooler outer layers are moved to the center of the pile where there are higher temperatures and intensive microbial activity. The turned windrow method produces compost material in two to six months.

Optimum size for windrows are 8 to 12 feet at the base and 5 to 8 feet high. Windrow cross-sections should be rounded, concave or trapezoidal to allow proper insulation. Progressive decomposition of the composting material reduces the size of the windrows and two decomposing windrows can be combined to create space for new windrows or for stockpiling.

Turning frequency is generally once or twice per week. The turning equipment used will determine the size, shape, and space between the windrows. Front-end loaders are commonly used, however specialized windrow turning equipment is recommended to compost large volumes of material. Windrow turning attachments are available that hook up to most front-end loaders. Monitoring for moisture content, oxygen content, and temperature should be done frequently, generally daily, and operating logs should be maintained. This operating data is evaluated to optimize windrow turning frequency, windrow composition, and watering frequency.

3.2.1.3 Aerated Static Piles. These are a higher technology application than turned windrows. In this method, piles or windrows are placed on top of a grid of perforated pipes and air is forced through the piles or windrows using fans or blowers. This action maintains aeration in the composting process and minimizes, or eliminates the need for turning. Air can be supplied through a suction system or a positive pressure system. In a suction system, air is drawn into and through the pile and then vented through a pile of finished compost or a filter to control odor. With a positive pressure aeration system a blower pushes air into the compost pile and the air is vented over its entire surface. Because of the way air is vented, odor treatment does not occur in a positive pressure system.

To ensure proper decomposition, temperature and oxygen levels must be closely monitored. Aeration is controlled by running blowers continuously or intermittently. In general, aerated static piles are best suited for granular and relatively dry feedstock materials with a relatively uniform article size.

3.2.1.4 In-vessel Composting. These systems are high technology methods in which composting is conducted within a fully enclosed system. All critical environmental conditions are generally controlled through fully automated built-in systems. In-vessel composting systems are generally expensive; however, they may be justified where space is limited and careful odor and leachate control is required.

There are two general types of in-vessel composting technologies: rotating drum systems and tank systems. Rotating drum systems use a tumbling action to continuously mix the materials. The rotating drums are long cylinders, typically nine feet in diameter, that rotate slowly. Oxygen is forced in from exterior air pumping systems, while the tumbling action allows temperature to be maintained at high,
uniform levels. In general, complete stabilization of the composting material is complete within one to three months. Tank in-vessel systems use long, rectangular vessels and external pumps which force air through a perforated bottom. Materials are mixed within the tank by a moving belt, paddle wheel or other device to break down clumps. The composting process can be completed within 30 days, but often the materials must be cured in windrows for an additional 30 to 60 days.

3.2.2 Curing Stage. After materials have been composted using one of the methods described above, curing should be allowed until the materials are stabilized. During the curing stage, compost is stabilized as the remaining nutrients are metabolized by any microorganisms that are still present. Since curing piles undergo slow decomposition, care should be taken to ensure anaerobic conditions do not develop. The curing process generally takes approximately one month and requires much less space than the actual composting process. Materials can be placed in small piles during the curing stage.

Once the curing process is complete, the finished compost should have an earthy odor. In addition to relying on odor to determine when the compost is sufficiently stabilized, temperature checks and oxygen and carbon dioxide testing can also provide evidence of compost maturity.

3.2.3 Odor Control. Odor production can lead to installations, or communities, wanting to close the composting site. Odors are often properly controlled by adjusting the composting process to provide ideal environments for aerobic bacteria. Serious odor problems may require covering the active composting area, incorporating biofilters, or adjusting facility operations to decrease odor production.

3.2.4 Composting Operations Plans. A clear, detailed composting operations plan should be developed prior to beginning a composting operation. These plans should be annually revised or verified. A composting operations plan may also be required by state and local environmental regulations. The operations plan should include operating procedures, safety and emergency procedures, operational checklists, and process troubleshooting. Along with the composting operations plan, facility monitoring logs should be developed to record operational parameters (turning frequency, temperature readings, watering frequency, windrow/pile composition, etc.).

3.2.5 Watering. Maintaining a moisture content of 40 to 60 percent can significantly enhance the composting process. Before composting begins, the moisture content of the feedstock materials should be determined. The "squeeze test" is a simple way to estimate moisture content. If just a few drops of water are released when a handful of feedstock material is squeezed, the moisture content is generally acceptable. For more definitive moisture content determinations, a sample of material can be weighed wet
and weighed after oven drying. Moisture content is then established using the following formula:

\[
\text{moisture content} = \frac{\text{wet weight} - \text{dry weight}}{\text{wet weight}}
\]

Depending on climate conditions, composting technology used, and operational factors, a water supply may be required on-site to meet compost watering requirements. Water requirements should be incorporated into the facility design. Storm runoff retention ponds can provide a source for meeting watering needs.

3.2.6 Operator Training. Operator and compost facility worker training is an essential element of a successful and safe composting program. The level of training required will vary with the type and level of composting technology used, and with state and local requirements. Currently, there are no specific composting training programs offered through Air Force or DoD schools. Best sources for training include university-offered courses, community-sponsored training programs, and private firms that offer on-site training services.

3.2.7 Feedstock Materials. Virtually any organic material can potentially be composted and composting programs can be designed to handle yard trimmings (leaves, grass, tree prunings), food wastes, sawdust, wood, scrap paper products, sewage biosolids, and animal manure. More recently, composting has been used to bioremediate petroleum-contaminated soils. In deciding which organic wastes to incorporate into a composting operation, several factors (e.g., cost, site size, amount of waste, environmental regulations) must be considered. Generally, more stringent environmental regulations will apply when composting sewage sludge and animal manure. In addition to environmental requirements, the type of composting method employed (low tech or high tech) will also determine which materials should be composted.

Once an initial decision is made on the materials to be used for feedstock, each facility should experiment to establish proper feedstock blend ratios. For composting to proceed efficiently, microorganisms require specific nutrients in an available form, adequate concentration, and proper ratio. The essential macronutrients needed by microorganisms in relatively large amounts include carbon (C), nitrogen (N), phosphorus (P), and potassium (K). Microorganisms require carbon for an energy source and they need carbon and nitrogen to synthesize proteins and reproduce. Potassium and phosphorus are essential to cell reproduction and metabolism. Composting organisms also need trace elements to foster proper assimilation of all nutrients. However, in a composting system, carbon and nitrogen are usually the limiting factors for efficient decomposition.

The carbon to nitrogen ratio, commonly known as the C:N ratio, is a common measure of the availability of nutrients for microbial use. For proper decomposition the nutrients in the compost pile or windrow should be in the right C:N proportions. The table below shows C:N ratios for common composting feedstock materials. High C:N

<table>
<thead>
<tr>
<th>Feedstock Material</th>
<th>C:N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yard trimmings</td>
<td>10-20</td>
</tr>
<tr>
<td>Food wastes</td>
<td>10-40</td>
</tr>
<tr>
<td>Sawdust</td>
<td>10-20</td>
</tr>
<tr>
<td>Wood</td>
<td>10-20</td>
</tr>
<tr>
<td>Scrap paper products</td>
<td>10-20</td>
</tr>
<tr>
<td>Sewage biosolids</td>
<td>10-20</td>
</tr>
<tr>
<td>Animal manure</td>
<td>10-20</td>
</tr>
</tbody>
</table>

The table shows typical C:N ratios for various feedstock materials commonly used in composting operations.
ratios (high C to low N) inhibit the growth of microorganisms that degrade compost feedstock. Low C:N ratios (low C to high N) initially accelerate microbial growth and decomposition. However, with this acceleration, available oxygen is rapidly depleted and anaerobic conditions can develop if operating conditions are not carefully controlled. Excess nitrogen is released as ammonia gas and extreme amounts can form enough ammonia to kill microbes and inhibit the composting process. Excess nitrogen may also be released in the leachate.

Table 1
C:N Ratios of Common Composting Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>C:N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves and Weeds</td>
<td>90:1</td>
</tr>
<tr>
<td>Sawdust</td>
<td>500:1</td>
</tr>
<tr>
<td>Paper</td>
<td>170:1</td>
</tr>
<tr>
<td>Wood</td>
<td>700:1</td>
</tr>
<tr>
<td>Horse Manure</td>
<td>25:1</td>
</tr>
<tr>
<td>Grass</td>
<td>12-20:1</td>
</tr>
<tr>
<td>Food Scrap</td>
<td>15:1</td>
</tr>
<tr>
<td>Sludge</td>
<td>11:1</td>
</tr>
</tbody>
</table>

Optimum composting occurs when the C:N ratio of the composting material is from 25:1 to 35:1. At C:N ratios greater than 35:1, the composting process slows down while at C:N ratios lower than 25:1, anaerobic conditions often develop. Generally, the C:N ratio for yard trimmings can be approximated by examining the nature of the feedstock; green vegetation is high in nitrogen and brown vegetation is high in carbon. More precise C:N ratios are determined by laboratory analysis. Feedstock materials with different C:N ratios must be mixed in proper proportions to obtain optimal C:N levels.

Acidity and alkalinity (pH) should also be monitored. At a neutral pH of 7, the composting process is more efficient. Different materials have different pH values and care must again be exercised in mixing them. Because pH levels are largely self-regulating, actions are rarely necessary to bring pH to optimum levels; however in instances where pH levels are significantly low, buffering agents such as lime can be added.

The final aspect to consider in compost pile and windrow composition is mixing or blending of feedstock materials. For example, bulking agents such as wood chips are often added to grass piles to increase particle size. Bulking agents are dry materials with high carbon content. They should be incorporated to maintain adequate porosity and aerobic conditions in compost piles. Mixing should be conducted after feedstock sorting and size reduction and before processing begins.

3.3 Material Collection. Separating yard wastes from other waste is easiest when accomplished at the source. Materials must be brought to the composting site in an
economically feasible manner and with minimum contamination. To increase military family housing participation, frequent and convenient collection is needed. Programs can be designed to collect just yard trimmings, or yard trimmings and recyclables. Collection can occur at curbside or through drop-off sites. For collection of base grounds maintenance wastes and other organic materials, it is generally best to set up delivery to the composting facility.

There are several alternatives that can be established to accomplish collection of yard wastes and other organic materials. Curbside collection for family housing areas can be integrated into existing refuse or recycling collection contracts and funded using MFH funds. Base grounds maintenance contracts can be modified to include delivery of landscaping wastes to the composting facility.

3.4 Quality Control. After the initial processing and curing of the compost material is complete, quality control procedures are needed to refine the compost product to meet end-use specifications. Certain end uses of compost require the production of a high-quality product that does not pose threats to plant growth or the food chain. Other uses, such as for berming or landfill cover, have less rigorous requirements. Compost derived from yard trimmings contains fewer nutrients than compost produced from sludge composting; however, it contains fewer hazardous constituents and other contaminants. During post-processing, compost can be screened and analyzed to ensure that stabilization is complete.

3.4.1 Testing. Compost should be tested for chemical and pathogen contamination and to determine nutrient levels. Compost stability can be assessed by seed germination tests or by analyzing factors that indicate compost maturity, such as oxygen consumption, carbon dioxide production, C:N ratios, and cation exchange capacity. Several state and local requirements specify compost quality requirements; therefore, laboratory analysis may be required to ensure these requirements are met. In particular, when composting biosolids (sewage sludge and manure), concerns about the presence of heavy metals (lead, cadmium, copper, mercury, chromium, and nickel) should be incorporated into compost testing requirements. Finally, sampling for pesticides and herbicides may also be warranted.

Testing for contaminant and nutrient levels is important if end uses require specific nutrient ranges. Nutrient and contaminant information can be used to establish suggested uses for the compost, appropriate application rates, and restrictions on compost use.

To ensure product quality, the compost product should be laboratory tested frequently. A composite sample, composed of many small samples from different locations in piles and windrows, and/or individual samples can be taken. Field tests can also be conducted to demonstrate product utility. Finally, testing data should be recorded in a computerized spreadsheet to provide a basis for comparing changes in compost quality or characteristics.
3.4.2 Compost Screening & Sorting. Sorting and screening is conducted to remove unwanted material and larger particles that lower compost quality. Screening can be performed to generate compost of uniform size for end uses where uniformity is important, such as in horticultural applications.

3.4.3 Quality Characteristics. Product quality depends upon the biological, chemical, and physical characteristics of the compost material. Following is a list of desirable characteristics in finished compost:

- Compost maturity after proper curing and stabilization;
- High organic matter content;
- Absence of weeds, seeds, pathogens, and contaminants;
- Neutral pH;
- Balanced nutrient levels (nitrogen, phosphorus, etc.);
- Low concentrations of soluble salts;
- Uniform particle size (less than 0.5 inch);
- Dark color with an earthy bouquet;
- Moisture content below 50 percent; and
- Absence of heavy metals (lead, chromium, copper, etc.);

The final compost product should meet applicable regulatory standards and exhibit quality characteristics suitable to the expected end use(s) of the product.

3.5 End Uses. Finished compost is a valuable soil amendment that can be used in a variety of applications, from agriculture to landscaping to reforestation projects to residential gardening. Compost can benefit the biological, chemical, and physical properties of soil, including soil porosity, water retention, resistance to wind and water erosion, and crusting. Compost regulates the storage and release of nutrients, enhances the development of beneficial microorganisms, builds up plant resistance to parasites and diseases, and promotes faster root development. Plants grown using good quality compost can produce higher yields and show less weed growth.

3.5.1 Potential Uses at Air Force Installations. End uses for compost will depend on compost product quality, size, and local conditions. Proven applications include use of compost as a soil amendment, fertilizer supplement, top dressing, mulch, landscape planting material, potting mix component, peat substitute, landfill cover material, topsoil for road and construction work, soil erosion prevention, water quality applications, and bioremediation of contaminated soils. Compost can be provided to installation housing residents through housing self-help stores.
Although compost quality will largely determine potential end uses, both high- and low-quality compost can be used at installations. Generally, high-quality compost should be used in locations where people or animals come in direct contact with the compost or in the upgrade of public lands. Lower quality compost can be used for purposes such as land reclamation, landfill cover, berming, and to maintain road shoulders. Compost is valuable for land reclamation areas because of its high water retention capacity. A coarse compost with low water retention may be preferred for areas where weed control is necessary.

Compost used on Air Force installations must comply with both state and federal standards for land application. Beyond these standards, quality criteria for compost is discussed in the Quality Control section of this guide.

3.6 Other Alternatives. There are other alternatives available for yard waste instead of a centralized composting program or disposal. Grasscycling and backyard composting are two methods implemented at some Air Force installations.

3.6.1 Grasscycling. Grasscycling encourages leaving grass clippings on mowed lawns. A thin layer of grass clippings and leaves can improve soil moisture retention abilities and can act as a natural fertilizer, reducing the need for commercial fertilizers. Grasscycling ideas also include promoting the use of mulching mowers, advocating higher grass height standards, encouraging more frequent mowing, and instituting water-wise policies.

3.6.2 Backyard Composting. Backyard composting programs can be an integral part of a comprehensive solid waste management program. To encourage backyard composting programs, composting bins can be provided free of charge to military family housing residents, or provided on loan through MFH self-help stores. Brochures or information papers on backyard composting techniques can be provided to residents through the housing self-help store and during awareness fairs and events. Technical assistance courses can be provided to residents who are interested in pursuing backyard composting. Programs to promote interest in backyard composting can be initiated in base schools.

3.7 Summary. Compost is the natural recycling of organic wastes into one of nature's best mulches and soil amendments. Composting programs can offer an efficient, cost-effective method of reducing operating costs while complying with Air Force and DoD pollution prevention policies and achieving solid waste reduction goals.
CHAPTER 4 - ADVOCACY

4.1 Education. Without education, the best designed, equipped recycling and composting programs will not succeed. By making the base populace aware of the programs and educating them on their part, program effectiveness will be greatly increased. The RRRP manager must stress the benefits of source reduction, recycling, and purchasing environmentally preferable products throughout the educational program.

The education program should focus on raising the awareness of how the RRRP benefits the environment. This awareness must show installation personnel how their participation makes a difference. Base newspapers and community cable channels are prime media avenues to the installation population. Many basic media messages have already been produced by recycling and composting trade associations (See 5.3 Recycling & Composting Associations). These messages can be supplemented by installation specific messages listing the materials recycled, recycling center operating hours, composting program information, RRRP manager phone number, and similar information. Another important message for these media outlets is RRRP progress reports listing the amounts recycled/composted, the savings generated, and the amount of products containing recycled material purchased. By including this information, base personnel see the progress being made and feel that their efforts are going toward a tangible goal.

Another important element of education is community outreach. This includes increasing awareness by: speaking at Commander’s Calls and “town meetings” to soliciting comments and suggestions for improvements; visiting local schools to educate the children; incorporating the RRRP into the installation’s newcomer orientation program; and hosting Earth Day activities. Distribution of information, particularly materials and brochures furnished by recycling and composting associations, provides a reminder to these people at a later date. The education process should always have a positive focus.

4.2 Innovation. Each installation should establish an “I Team” (“I” stands for innovation) with the goal of pursuing new, innovative opportunities for waste reduction and pollution prevention. The team’s charter is to examine all imaginative ideas, logistically feasible or not, with the thought that nothing is impossible. Team members should pursue opportunities using their own expertise as well as pulling in knowledge from “field experts” who deal directly with the issues. The I Team should meet regularly to present new ideas and provide updates to previous ideas. Publishing a newsletter highlighting team success will feed the imagination and innovation of other installation personnel.
Another great source of information on innovative processes and successful installation programs is **PRO-ACT**. To assist Air Force personnel in meeting environmental guidelines and pollution prevention goals, the Air Force Center for Environmental Excellence (AFCEE) sponsors **PRO-ACT**, an environmental clearinghouse and research service. **PRO-ACT** researchers draw on the resources of management and operating contractors at various Air Force locations, other Federal and DoD Agencies, the EPA, state agencies, national research and development laboratories and industry.

**PRO-ACT** offers a broad range of services free of charge to all Air Force personnel. These services include up to 40 hours of research on environmental issues, regulatory alerts and updates, fact sheets on topics of general interest, bibliographic assistance, database and literature searches and crossfeed information packages containing research summaries, new technology information and lessons-learned documentation.

Currently, **PRO-ACT** is staff from 7 a.m. to 6 p.m., Central Time. **PRO-ACT** can be reached in a variety of ways to include:

- ☎️ 1-800-233-HELO (233-4356) or DSN 240-4214 or Commercial 210-536-4214
- ☎️ FAX DSN 240-4254 or 210-536-4254
- ☎️ WANG e-mail to PRO-ACT
- ☎️ Internet e-mail to proact@osiris.cso.uiuc.edu
- ☎️ DENIX e-mail to proact

### 4.3 Purchasing Environmentally Preferable Products

The purchase of products containing recycled material is a necessary part of closing the reuse/recycling loop. While the RRRP manager is the chief advocate, the Environmental Protection Committee and the RRRP Sub-committee are important supporters. The effectiveness and success of this program requires senior level interest to motivate users and procurers.

The Resource Conservation and Recovery Act (RCRA) requires that EPA Guideline Items be used. The only exceptions to their use are: (1) not meeting performance specifications, (2) only available at an unreasonable price, and (3) not available within a reasonable time frame.

The following is a list of actions that installations may take to establish an aggressive program. Each item is followed by the office(s) typically responsible for the action.

- ☐️ Review and revise specifications to eliminate preferences for virgin material and encourage the use of EPA Guideline Items, as contained in Engineering Technical Letter 94-7, Dec 94, EPA Guideline Items in Construction and Other Civil Engineering Contracts (Civil Engineer);
Replace items in the base supply store with environmentally preferable products whenever possible and ensure the General Services Administration’s Environmental Products Guide is available for users (Supply);

Examine current maintenance operations and replace materials with EPA Guideline Items whenever possible (building insulation, concrete and cement containing fly ash: Civil Engineer; re-refined lubricating oil: Civil Engineer, and Transportation; re-tread vehicle tires: Transportation);

Require all writing, letterhead, and copier paper to meet Executive Order 12873 requirements (Contracting, Supply, Information Management);

Require all contract submittals, specifications, and change orders meet recycled content requirements and be printed double-sided (Contracting);

Require all base newspapers, news magazines, and base directories to contain recycled newsprint (Public Affairs);

Require all newly acquired/leased copy machines to automatically default to two-sided copies (Contracting, Information Management); and

Require the use of recycled toner cartridges in all copy machines and laser printers (Contracting, Information Management, Supply).
CHAPTER 5 - INFORMATION SOURCES

5.1 Legal Requirements.


Executive Order 12873, Federal Acquisition, Recycling, and Waste Prevention, October 20, 1993.

DoD Instruction 7310.1, Disposition of Proceeds from DoD Sales of Surplus Personal Property, July 10, 1989.


5.2 References.

The following publications are available at no charge from the EPA RCRA/ Superfund Hotline. Call 1-800-424-9346, Monday through Friday, 8:30 a.m. to 7:30 p.m., EST. In Washington, DC, call 703-412-9810.


Markets for Compost. EPA/ 530-SW-90-073b. 1993


Recycling Grass Clippings. EPA/ 530-F-92-012.

Residential Leaf Burning: An Unhealthy Solution to Leaf Disposal. EPA/ 452-F-92-007.


Yard Waste Composting. EPA/ 530-SW-91-009.
The following publication is available from the National Technical Information Service (NTIS). Call 1-800-553-6847, Monday through Friday, 8:30 a.m. to 5:30 p.m. In Washington, DC, call 703-487-4650.

Characterization of Municipal Solid Waste in the United States. PB95-147690 (94 Version); cost $27.

5.3 Recycling & Composting Associations.

Agriculture Composting Association, P. B. Box 608, Belchertown, MA 01007
413-323-4531

Air-Conditioning and Refrigeration Institute, 4301 North Fairfax Drive, Suite 425,
Arlington, VA  22203
703-524-8800   FAX 703-528-3816

Air and Waste Management Association, P. O. Box 2861, Pittsburgh, PA  15230
412-232-3444   FAX 412-232-3450

Aluminum Recycling Association, 1000 16th Street Northwest, Suite 400, Washington,
DC  20036
202-785-0951   FAX 202-785-0210

American Horticultural Society, 7931 East Blvd Drive, Alexandria, VA  22308
703-768-5700

American Reusable Textile Association, P. O. Box 1073, Largo, FL 34294-1073
813-531-6698

American Salvage Pool Association, P. O. Box 42450, Phoenix, AZ 85080-2450
602-581-2500   FAX 602-581-3844

Asphalt Recycling and Reclaiming Association, 3 Church Circle, Suite 250, Annapolis,
MD  21401
410-267-0023   FAX 410-267-7546

Automotive Recyclers Association, 3975 Fair Ridge Drive, Suite 20 North, Fairfax, VA
22033-2906
703-385-1001   FAX 703-385-1494

Bumper Recycling Association North America, 1730 North Lynn Street, Suite 502,
Arlington, VA  22209
5.4 Major Command Points of Contact.

**Air Combat Command**

HQ ACC CES/ ESC  
129 Andrews Street, Suite 102  
Langley AFB VA 23665-2769  
Mr. Robert Hailey  
DSN 574-4430; (804) 764  
FAX: Ext 8033

**Air Education & Training Command**

HQ AETC/ CEVP  
266 F Street West  
Randolph AFB TX 78150-4321  
Ms. Debra Snoha  
DSN 487-3422; (210) 652  
FAX: Ext 2542

**Air Force Materiel Command**

HQ AFMC/ CEVV  
4225 Logistics Avenue, Suite 8  
Wright-Patterson AFB OH 45433-5747  
Mr. Gopal Annamraju  
DSN 787-6312; (513) 257  
FAX: Ext 5875

**Air Force Reserve**

HQ AFRES/ CEVV  
155 Second Street  
Robins AFB GA 31098-1635  
Mr. Walter Volinsky  
DSN 497-1069; (912) 327  
FAX: Ext 0108

**Air Force Space Command**

HQ AFSPC/ CEVV  
150 Vandenberg Street, Suite 1105  
Peterson AFB CO 80914-4150  
Mr. Ralph Clark  
DSN 692-5028; (719) 554  
FAX: Ext 2562

**Air Force Special Operations Command**

HQ AFSOC/ CEV  
100 Bartley Street, Suite 218E  
Hurlburt Field, FL 32544-5273  
Mr. Mike Applegate  
DSN 579-4654; (904) 884  
FAX: Ext 5982

**Air Mobility Command**

HQ AMC/ CEVC  
507 A Street  
Scott AFB IL 62225-5022  
Mr. Mark Horstman  
DSN 576-5763; (618) 256  
FAX: Ext 2693
Resource Recovery & Recycling Program

United States Air Force Academy

HQ USAFA/ CEV
8120 Edgerton Drive, Suite 40
USAFA Academy CO 80840-2400
Ms. Diana Dean
DSN 259-2289; (719) 472
FAX: Ext 3753

Air National Guard

ANGRC/ CEVC
3500 Fetchet Avenue
Andrews AFB MD 20331-6008
Ms. Kerri Wildgruber
DSN 278-8197; (301) 836
FAX: Ext 8151

Pacific Air Forces

HQ PACAF/ CEVV
25 E Street, Suite D306
Hickam AFB HI 96853
Major George Herr
DSN 315-449-0704; (808) 449
FAX: Ext 0427

United States Air Forces in Europe

HQ USAFE/ CEVP
Unit 3050 Box 10
APO AE 09094 (Ramstein AFB)
LT Frank Titus, USN
DSN 314-480-6482, 011-49-63714
FAX: Ext 3368

Air Force Center for Environmental Excellence

HQ AFCEE/ EP
8106 Chenault Road
Brooks AFB TX 78235-5318
Ms. Nancy Carper
DSN 240-4964; (210) 536
FAX: Ext 4254

Air Force Civil Engineer Support Agency

HQ AFCESA/ CESM
139 Barnes Drive, Suite 1
Tyndall AFB FL 32403-5319
Mr. Wayne Fordham
DSN 523-6465; (904) 283
Mr. Gary Jacks
DSN 523-6190; (904) 283
FAX: Ext 6219

HQ United States Air Force

HQ USAF/ CEVV
1260 Air Force Pentagon
Washington DC 20330-1260
Captain Dave Maharrey
DSN 227-2797; (703) 69x
FAX: Ext 58943

5.5 Abbreviations & Acronyms.

AAFES - Army and Air Force Exchange System
AFCEE - Air Force Center for Environmental Excellence (Brooks AFB)
AFCESA - Air Force Civil Engineer Support Agency (Eglin AFB)
AFMS - Air Force Manpower Standard
BCAN - Budget Clearing Account Code
DeCA - Defense Commissary Agency
DLA - Defense Logistics Agency
DRMO - Defense Reutilization and Marketing Organization
DRMS - Defense Reutilization and Marketing Service
DUSD(ES) - Deputy Under Secretary of Defense (Environmental Security)
EPA - (US) Environmental Protection Agency
EPC - Environmental Protection Committee
FAA - Federal Aviation Administration
GSA - General Service Administration
MAJCOM - Major Command
MFH - Military Family Housing
MRF - Material Recovery Facility
O&M - Operations and Maintenance
POM - Program Objective Memorandum
PP - Pollution Prevention
QAE - Quality Assurance Evaluation
QRP - Qualified Recycling Program
RCRA - Resource Conservation and Recovery Act
RRRP - Resource, Recovery and Recycling Program
SIC - Service Identification Code
TA - Table of Allowance
UMD - Unit Manning Document
WIMS-ES - Work Information Management System - Environmental Subsystem