



NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

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A COST-BENEFIT ANALYSIS
for REVISION and REIMPLEMENTATION
of the OFFICE PAPER RECYCLING PROGRAM
at the NAVAL POSTGRADUATE SCHOOL, MONTEREY

by

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Lieutenant, United States Navy

December 1992

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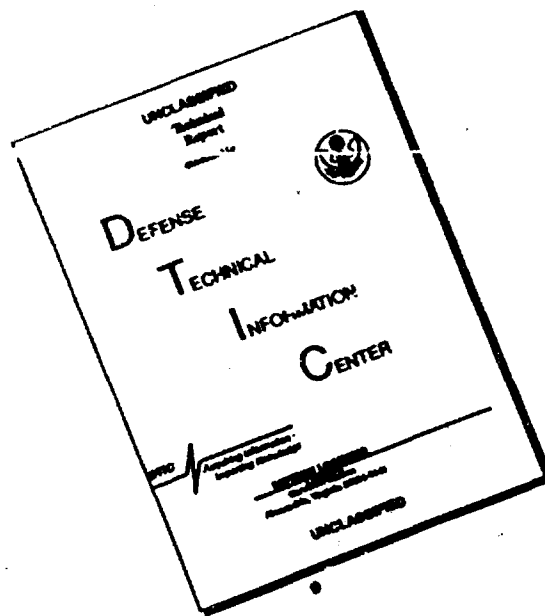
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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No 0704-0188	
1a REPORT SECURITY CLASSIFICATION Unclassified			1b RESTRICTIVE MARKINGS none		
2a SECURITY CLASSIFICATION AUTHORITY na			3 DISTRIBUTION AVAILABILITY OF REPORT Approved for public release ; distribution is unlimited.		
2b DECLASSIFICATION/DOWNGRADING SCHEDULE na					
4 PERFORMING ORGANIZATION REPORT NUMBER(S)			5 MONITORING ORGANIZATION REPORT NUMBER(S)		
6a NAME OF PERFORMING ORGANIZATION Naval Postgraduate School		6b OFFICE SYMBOL (if applicable)	7a NAME OF MONITORING ORGANIZATION		
6c ADDRESS (City, State, and ZIP Code) Monterey, CA 93943-5000			7b ADDRESS (City, State and ZIP Code)		
8a NAME OF FUNDING/SPONSORING ORGANIZATION na		8b OFFICE SYMBOL (if applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER na		
8c ADDRESS (City, State, and ZIP Code)			10 SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO	PROJECT NO	TASK NO
11 TITLE (Include Security Classification) A COST BENEFIT ANALYSIS for REVISION and REIMPLEMENTATION of the OFFICE PAPER RECYCLING PROGRAM at the NAVAL POSTGRADUATE SCHOOL, MONTEREY.					
12 PERSONAL AUTHOR(S) BROWN, EDWARD, WALTER					
13a TYPE OF REPORT final		13b TIME COVERED FROM _____ TO _____		14 DATE OF REPORT (Year, Month, Day) 1992 December	
15 PAGE COUNT 167					
16 SUPPLEMENTARY NOTATION The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Govt					
17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Recycling, Office paper, waste paper		
FIELD	GROUP	SUB-GROUP			
19 ABSTRACT (Continue on reverse if necessary and identify by block number) This thesis examines the current waste paper recycling program at the Naval Postgraduate School, Monterey. The thesis evaluates the costs and benefits of the existing recycling program and a new revised waste paper recycling program. The thesis shows that a new program can be implemented and increase the benefits to the school by \$6,000 per year. It shows inefficiencies in the current Solid Waste disposal practices. It also shows that the Public Works Department, Supply Department and Morale Welfare and Recreation Departments must work together to make recycling work. In addition to waste paper recycling, this thesis identifies a need for increased cardboard recycling, as well as source reduction.					
20 DISTRIBUTION AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS			21 ABSTRACT SECURITY CLASSIFICATION		
22a NAME OF RESPONSIBLE INDIVIDUAL William Gates			22b TELEPHONE (Include Area Code) 408 646-2754		22c OFFICE SYMBOL AS/Gt

DD Form 1473, JUN 86

Previous editions are obsolete

S/N 0102-LF-014-6603

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

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at the NAVAL POSTGRADUATE SCHOOL, MONTEREY

by

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

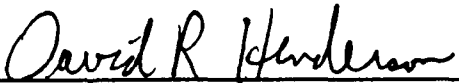
from the
NAVAL POSTGRADUATE SCHOOL
December 1992

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ABSTRACT

This thesis examines the current waste paper recycling program at the Naval Postgraduate School, Monterey. The thesis evaluates the costs and benefits of the existing recycling program and a new revised waste paper recycling program.

The thesis shows that a new program can be implemented and increase the benefits to the school by \$6,000 per year. It shows inefficiencies in the current Solid Waste disposal practices. It also shows that the Public Works Department, Supply Department and Morale Welfare and Recreation Departments must work together to make recycling work.

In addition to waste paper recycling, this thesis identifies a need for increased cardboard recycling, as well as source reduction.

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I. INTRODUCTION

"The Navy's ability to accomplish its mission requires operations in land, sea, and air environments. The Navy is committed to operating ships and shore facilities in a manner compatible with the environment..."

-OPNAVINST 5090.1A, Environmental and Natural Resource Program Manual, 2 Oct 1990.

"If we don't do it (Resource Conservation Recovery Act Rewrite-HR 3865) now, my feeling is you won't deal with it for five years, at which time the problem will be very acute." -Congressman Al Swift, (D)Washington.

In recent years the worsening problem of solid waste management has extracted a heavy toll on local communities and businesses. Increased tipping fees at landfills and expanding state regulation have made it vitally important to reduce and clean up wastes generated. On the average, each resident currently generates 4.5 pounds of trash per day. In 1988, over 70% of solid waste generated was buried in approximately 6,000 landfills, many of which are on the verge of closing [Ref.1]. Currently, waste-to-energy incinerators provide disposal for 11% of waste. However, incinerators produce other undesirable side effects and meet with staunch public opposition. Ash residue from incinerators contains heavy metals and is extremely hazardous. With current incineration capabilities and projected future capacity, it is estimated that

approximately 125 million tons of waste per year will still need to be landfilled. [Ref.2]

Congressman Swift echoed the urgency with which the mounting solid waste problem must be addressed. The EPA estimates that 80% of our landfills will be closed by the year 2008, either for environmental reasons or because they are full. [Ref.2] Historically, as landfills closed, new facilities were opened or other disposal methods used. Times have changed. Increased regulation and environmental awareness have made siting new disposal facilities much more difficult. Concurrently, there is continued growth of refuse generation rates as reflected in Figure 1.

The use of paper in the United States has grown at an average rate of 4% per year.[Ref.7] In 1960, gross discards amounted to 87.5 million tons while net discards (those actually disposed of after recycling) were 81.7 million tons. In 1986, gross discards grew by 80% to 158 million tons while net discards grew by 60% to 131.2 million tons. This equates to a nearly 20% savings due to increased recycling efforts.[Ref.8]

In 1989, 20.9 million tons of waste paper were recycled in the United States. This material alone saved landfills a 10 foot-deep layer covering over 6 square miles. [Ref.9] The Environmental Defense Fund estimates that trash from the

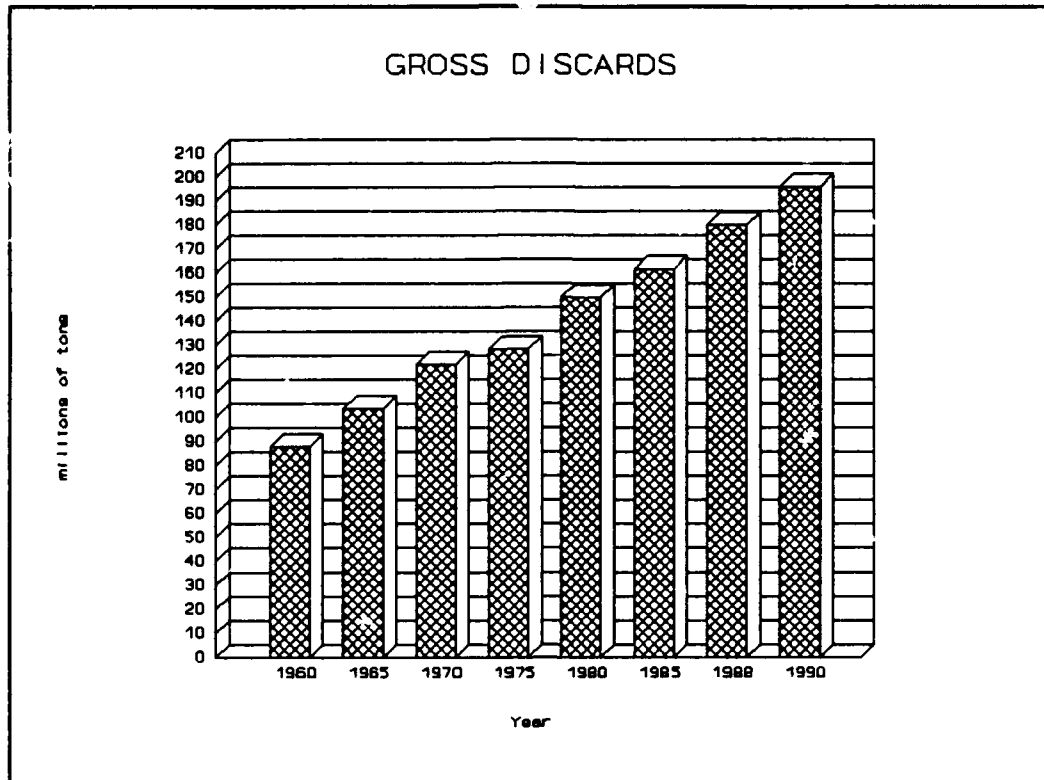


Figure 1 Source: US Environmental Protection Agency "Characteristics of Municipal Solid Waste in the US.: 1992 Update."

average paper-intensive business may consist of nearly 60% white paper.

As mentioned earlier, landfilling is the primary way of dealing with solid waste disposal. However, Figure 2 demonstrates the changing trend of preferred disposal methods.

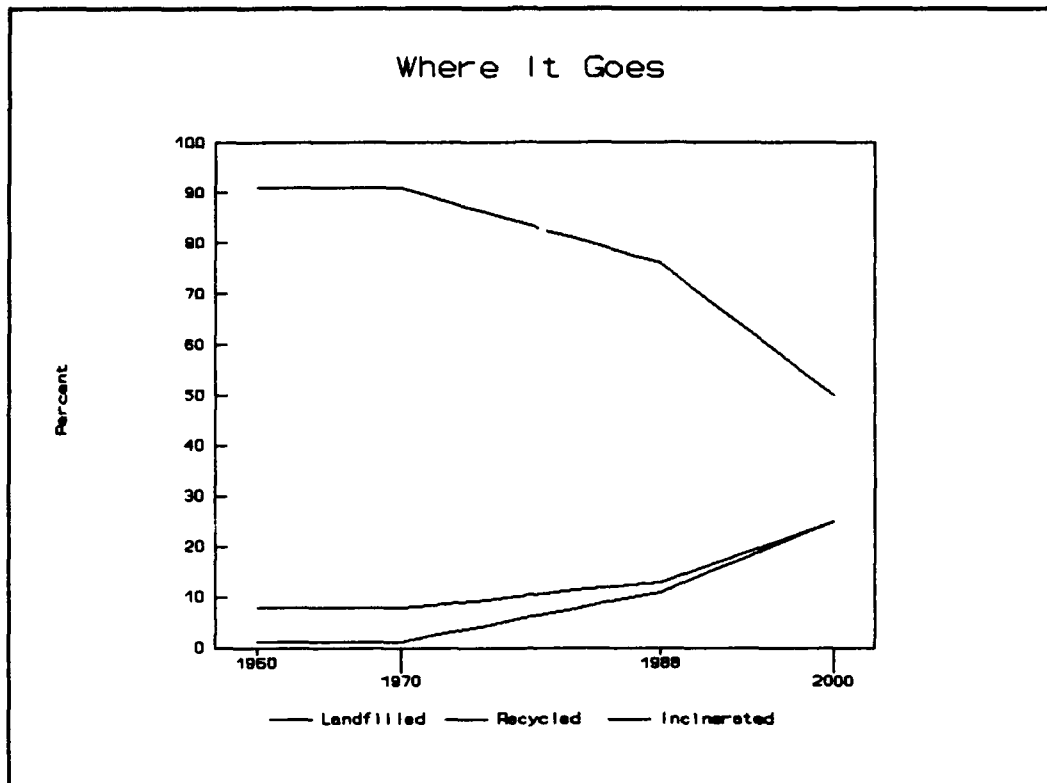


Figure 2 SOURCE: Environmental Protection Agency

Source reduction/recycling requires changing our lifestyles. Items such as disposable razors, disposable diapers and excess packaging must be reduced. According to the EPA, each year Americans generate waste containing over 16 billion disposable diapers, 2 billion disposable razors and mountains of tires. In addition, nearly 1/3 of the waste generated is excess packaging.[Ref.4] America must change its tendency to be a throw-away society.

Historians speculate that our "toss-it-out" lifestyle can be traced to our frontier society. Land has historically been plentiful and cheap. When it is ruined, we simply move on to

the next area. High recycling rates in densely populated countries such as Japan support this theory. Here the recycling rate nears 50%. Landfills have historically been built on land which was inexpensive and unwanted, abandoned rock quarries and swampy areas unfit for habitation. Why should Americans recycle material at a cost of \$100/ton when they could dispose of it for \$5/ton? Residents of Monterey currently pay \$14.00/ton for waste disposal, which still should not encourage recycling. But even though recycling is often not efficient, the government has mandated recycling through legislation.

A. U.S. NAVY

Figure 3 depicts the characteristics of the 4.5 million tons of waste generated by the Navy in FY90.

Paper accounts for 39.98% of the waste, yard and green waste 17.59% and metals 8.52%. [Ref.6] Figure 4 depicts the percent of materials recycled in the same year.

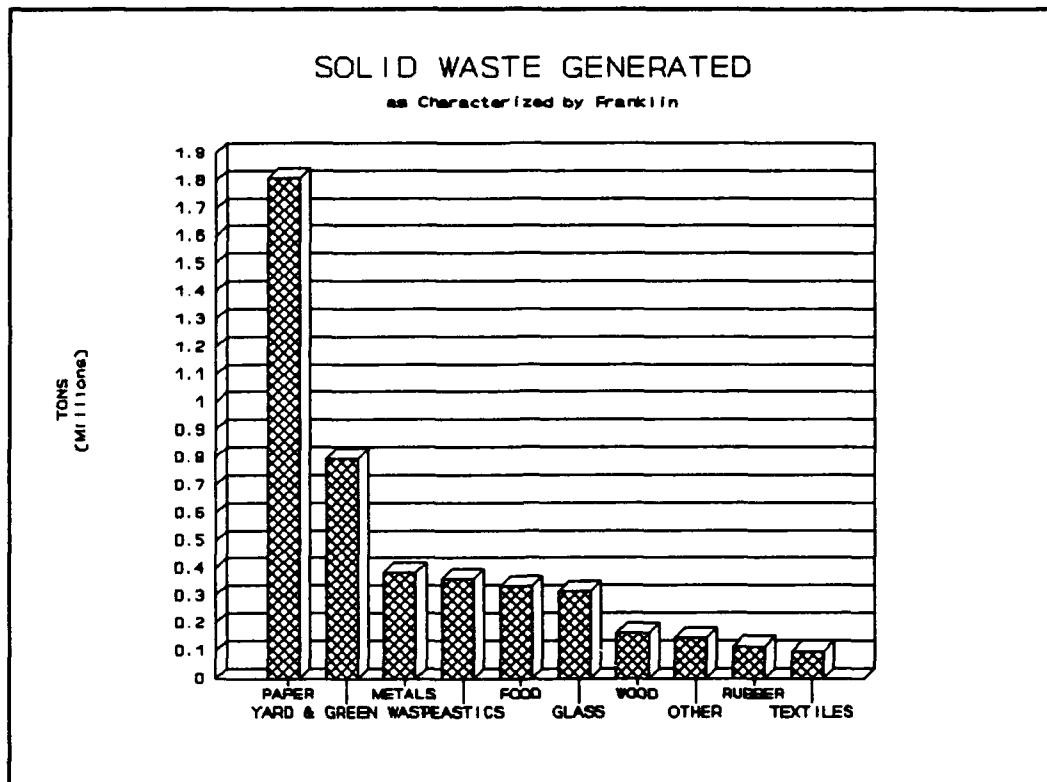


Figure 3 Solid Waste Annual Report FY90 - Based on EPA Municipal Average, 1988

Note that 75% of metals are recovered, while less than 1% of paper is reclaimed. Reasons for this trend are that scrap metal is valuable and cheap to recover. Metal recovery programs have been going on for a long time. When work on a project is essentially complete, scrap is deposited into labeled containers and sold to scrap dealers through the Defense Reutilization Marketing Office (DRMO). The same is true for paper; however, more personnel are involved in paper collection. Metals frequently involve fewer than 20 participants whereas every employee and visitor to a facility must be involved with paper separation. Also, a ton of metal

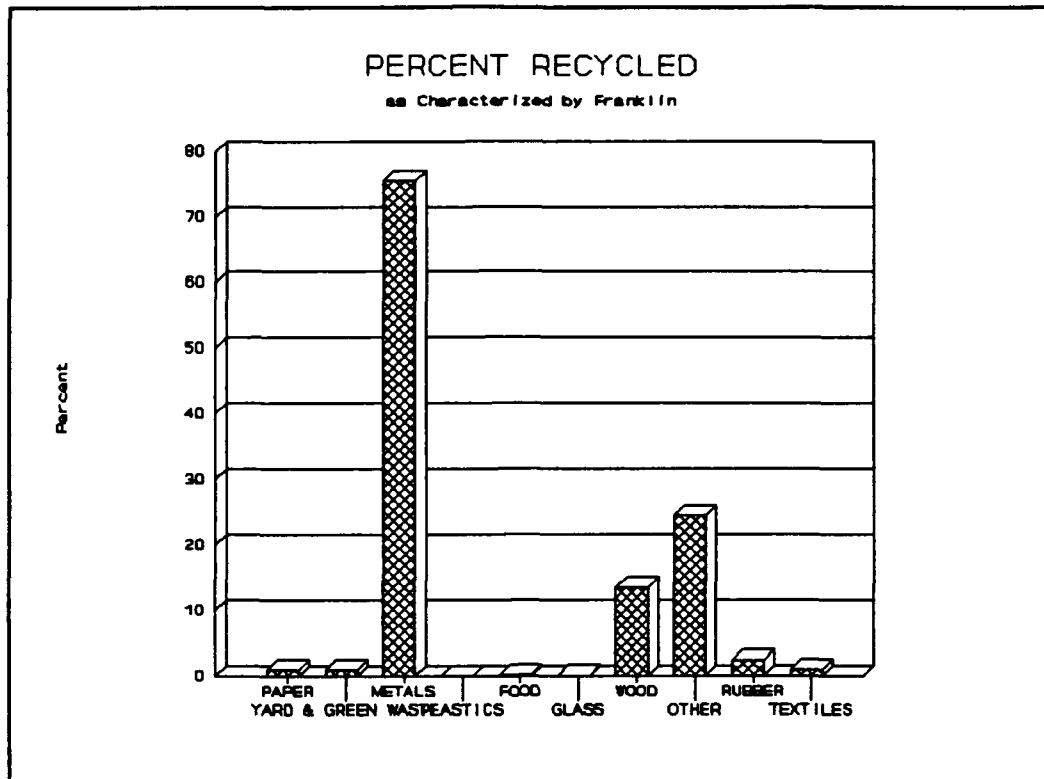


Figure 4 Solid Waste Annual Report FY90 - Based on EPA Municipal Average, 1988

is much easier to handle than a ton of paper.

The data presented shows a vastly under used Navy resource. This thesis focuses on the untapped resource of waste paper.

B. GOVERNMENT INITIATIVES

In 1965, Congress enacted the Solid Waste Disposal Act (PL89-222). It was the first federal legislation to deal with the disposal of solid waste. This law was amended in 1970 by the Resource Recovery Act (PL91-512) which recognized potential economic benefits of recycling.

The Resource Conservation Recovery Act (RCRA) (PL98-216) was last amended on 14 Feb 1984. It expired on 30 Sep 1988. A 138-page draft bill is currently being considered in the Senate (S-926). It calls for 50% of all municipal garbage to be recycled by the year 2000. A companion bill (HR-383) is being considered in the House of Representatives. These bills have been considered in the past several Congresses but have died in committee. The controversial content of the legislation, resistance by the Bush Administration, and fighting between the Eastern and Western States delays passage of the current legislation.

As mentioned earlier, the current legislation addresses recycling goals. The bill mandates higher recycling levels. It gives industry several options to reach the goal of 50% by 31 Dec 2000. Packagers can either make their product from recycled materials, recycle materials themselves, or make packages that can be reused up to 5 times.[Ref.5]

Regulation of hazardous waste is also included in this legislation. One of the main sticking points to its passage seems to be the battle between the haves and the have nots. The bill contains provisions regarding the regulation of interstate waste. States that export much of their refuse, such as New York and New Jersey, want to keep interstate transit of waste open. They want to have this legislation restrict the refusal of their waste. Many residents of Pennsylvania and of some western states want to allow their

state governments to decide whether they will accept out-of-state waste. Residents of these states complain that they are becoming a dumping ground. Without legislation, these states can do little to stop the dumping. The constitution prohibits states from passing any laws that interfere with interstate commerce. Political bickering has continued to stall the passage of this legislation.

OPNAVINST¹ 5090.1A clearly states the Navy's policy for solid waste management. We are fully committed to complying with local, state and federal laws which preserve the environment.

Several states have taken independent action to relieve the solid waste disposal crisis. In 1988, Californians alone disposed of over 38 million tons of solid waste [Ref.3]. At this time, over 90% of California's wastes were landfilled. On September 30, 1989, the California Assembly passed Assembly Bill AB939, California Solid Waste Management Act. It requires communities to reduce their waste generation 25% by 1995 and 50% by 2001. These reductions are based on quantities as of January 1, 1990. To comply with this requirement, communities have set up source reduction and recycling programs.

The Solid Waste Disposal Act (SWDA) of 1965 as amended by RCRA required all federal facilities to comply with federal, state, interstate and local requirements concerning the

¹ Appendix A lists all applicable acronyms used in this research.

disposal and management of solid wastes [Ref.10]. The California Solid Waste Management Act requires source separation and recycling. Numerous DOD and Navy instructions and regulations exist for managing and implementing recycling efforts. Significant references include: PL97-214, (10 U.S.C. 2577) Military Construction Codification Act, 1982, which provides installation commanders with an incentive to recycle by allowing up to 100% of the proceeds from recycling to go to MWR; Title 42 USC 6902, which promotes a national research and development program for improved solid waste management; DOD Directive 4165.60, Solid Waste Management - Collection, Disposal, Resource Recovery and Recycling Program, Deputy Secretary of Defense Memorandum, 28 January 1983, which provides guidance for establishing a Qualified Recycling Program.

DOD Directive 4165.60 mandates that all facilities with over 100 workers separate high-grade paper at the source [Ref.11]. Also, at those places with fewer than 100 workers, programs are encouraged but the costs for removal should be less than the cost of normal disposal.

The issue of paper reduction and solid waste management, is also described in the following instructions;

- DOD Directive 4165.60, 1976-Solid Waste Management Resource Recover and Recycle Program
- OPNAVINST 7020.6, 1974-Trash and Waste Material Recycling

- NAVCOMINST 7020.18, 1974-Trash and Waste Material Recycling
- Bupers INST 1710.11A, Nov 85-Navy Recreation Operational Policies
- NAVFACINST 5600.14-Use of Paper, Reduction of
- NAVFACINST 5090.1- Environmental Protection\Engineering Program Ashore; Engineering Field Division (EFD) Responsibilities for

OPNAVINST 5090.1A, 2 Oct 1990, requires recycling programs to be established to avoid costs, to reduce the volume of materials landfilled, and to obtain proceeds from recycling.[Ref.10: p.10-6] Increasing attention is being given to this problem. In 1991, President Bush issued Executive Order 12780, the Federal Recycling and Procurement Policy, which requires that federal agencies increase recycling efforts. This Executive Order also calls on the federal government to encourage market demand by increasing usage of goods made from recycled materials.

In Fiscal Year (FY) 1990, the Navy disposed of 4,524,590 tons of solid waste and recycled nearly 379,350 tons. But as depicted by figures 2 and 3, a plethora of materials is yet to be recovered.

In recent years Americans have realized that landfills were rapidly filling up and are becoming increasingly difficult to replace. They have also noticed the side effects caused by improperly constructed landfills and poorly designed incinerators. Pollution of groundwater, pest proliferation,

and air pollution are but a few of these nuisances. These problems have prompted a call for increased regulation. The stated strategy of groups such as Citizens Clearinghouse is to oppose construction of landfills, forcing American consumers to conserve. [Ref.12]

C. AREA OF RESEARCH AND RESEARCH QUESTION

This thesis will evaluate the feasibility of modifying the existing office paper recycling program at the Naval Postgraduate School, Monterey. It reviews the existing paper recycling program and identifies whether deficiencies exist. It also develops a new system/model and evaluates additional costs and benefits of this program and its impact on the operation of the facility. While this study is specifically tailored to the Naval Postgraduate School, its concepts are universal and can be applied at any Navy facility or university.

The specific question addressed is as follows: "Is it economically efficient to replace the existing office paper recycling program at the Naval Postgraduate School?" In answering this question, research must respond to the following: What percent of waste reduction is currently occurring under the existing program? Does this program meet the waste reduction needs of the Navy? Is there a better program available to further reduce solid waste? What are the implementation and upkeep costs of this revised program? How

and by whom should the program be managed? What amount and grade of recyclable paper can be expected from this program? What benefits can be delivered by this program?

D. SCOPE AND METHODOLOGY

This research examines whether the price received for paper collected in the existing program is the highest possible price. It also examines whether an optimum percentage of solid waste is being recovered.

A model recycling plan has been developed. The costs and additional benefits are calculated and a comparison is performed.

The methodology used is a cost-benefit analysis of two alternatives. The first alternative is to do what we are currently doing. The second is the implementation of a revised paper program. Data has been collected from Public Works, Supply, Morale, Welfare and Recreation (MWR) and the Naval Energy Environmental Support Activity (NEESA). Analysis of current contracts, historical prices and trends is incorporated in this thesis. A study of actual paper quantities in the waste stream has been prepared to show whether industry estimates hold true at this facility.

E. BENEFITS OF THIS RESEARCH

The purpose of this study is to highlight issues and concerns regarding paper recycling that specifically apply to

the Naval Postgraduate School at Monterey. These same issues must be concerns of all managers of federal agencies and DOD facilities. The study analyzes current solid waste management. It asks if we as managers of tax dollars are getting the best available value.

The results presented herein can be modified and applied to other DOD and educational institutions.

Important topics brought to the forefront by this study include cost avoidance and the valuation of a clean environment. This study is a step for the Navy toward taking the lead in environmental understanding and at the same time saving money. It will show the true costs and benefits of a qualified office paper recycling program.

F. DEFINITIONS

Appendix B offers a list of definitions of technical terms.

II. THEORETICAL FRAMEWORK

Is it economically efficient to replace the existing office paper recycling program at the Naval Postgraduate School?

A. INTRODUCTION

This chapter addresses the basis for establishing a cost-benefit analysis. It addresses the relationship between the U.S. Navy and the local community, and current contractual relationships, which include refuse removal and janitorial services. Proposed changes and/or modifications to these contracts are suggested. The chapter details the current recycling effort being performed. It briefly describes Naval Postgraduate School Instruction 4165.1A, which identifies recycling. Chapter 3 provides recycling and source reduction regulations and directives.

The chapter examines the current and proposed recycling programs. When discussing the current recycling program it examines the responsibilities of the four main characters.² The analysis of this new proposed recycling program examines

²For purposes of this research the four main characters are: Morale, Welfare & Recreation (MWR), Supply Department, Public Works Department, Participants.

research on how to increase participation in recycling programs. Techniques include physical, emotional or educational incentives. Recycling programs at other collegiate institutions are discussed to show potential recyclability and comparability. This Chapter details steps to institute the new recycling program. Many of these steps modify the existing recycling program. Similarities or no-cost modifications are discussed where relevant.

To address the research question stated at the beginning of this chapter the thesis asks whether the existing recycling program operates in an optimal fashion. It proposes that optimization can be proved or disproved by designing the best alternative program available and comparing cost-benefit results. This alternative program takes into consideration the best parts of the existing program, then adds modifications developed through research and analysis. The proposal also accounts for limitations imposed by Congress, the Department of Defense, and the U.S. Navy on naval facilities, and by the Naval Postgraduate School. Limits include competition in contracting rules, restrictions on disposal of materials purchased with appropriated funds, etc.

By evaluating the costs and benefits obtained from the new waste paper recycling program, a decision can be made whether this program is superior or inferior to the existing design. If superior, recycling resources are not being efficiently employed and strong evidence then supports adoption of a new

recycling program. Data collected is the subject of Chapter V.

B. CURRENT RELATIONSHIPS

The Solid Waste Annual Report FY90, as prepared by NEESA, paints a picture of cooperation between the Navy and the public in its actions concerning environmental responsibility. [Ref.13] In its directives, regulations and actions, the Navy endorses the solid waste policies of federal, state, and local Governments. Programs that reduce plastics at sea and improve handling of hazardous and infectious wastes are a result of exhaustive study and policy changes. These programs arose from a combination of public outrage over existing procedures and direction from higher authority.

Solid waste recycling practices have been the focus of review. As with other programs, requirements for recycling efforts emerged from higher authority by way of Solid Waste Disposal Laws, the Military Construction Codification Act and Executive Orders. Recycling departs from other programs because other factors have developed that require reduction of waste.

As of FY 1990, there were 31 bases operating landfills out of 131 reported facilities [Ref.13]. Forty-five percent of total waste generated by the reporting facilities was disposed of in these landfills, which are swiftly filling. Contrast this with ocean dumping of waste. In ocean dumping, there is

practically no limit on dumping. However, this practice causes side effects that the public opposes. If not for regulations, ships could better secure wastes and still dispose of them in manners acceptable 20 years ago. On the other hand, land-based facilities can no longer operate the way they did 20 years ago. Landfill space is scarce but more significantly the costs for disposal are increasing.

During FY 1990, 58 of 131 Navy and Marine Corps facilities reported paper recycling, 44 reported recycling cardboard and 22 recycle newspapers. [Ref.13] The Naval Postgraduate School has programs for recycling aluminum, copper, residential bottles and cans, newspapers, toner cartridges, tires, steel and paper. These programs diverted 329 tons of waste from the landfill and had revenues of \$1,243. Total solid waste generated by this facility in FY 1990 was 3,144 tons, with a disposal cost of \$151,647.

C. LOCAL SOLID WASTE REMOVAL METHODS

An Engineering Field Division contract with the City of Monterey provides for solid waste disposal from this facility. This contract identifies refuse removal as a utility service. Two contracts actually exist. One provides service for the Main School Facility and the other serves the Naval Annex. Contract numbers assigned to these documents are N62474-68-C-0263 and N62474-70-C-0157, respectively. The original agreement on which these contracts are based is a nine-page

document issued on 02 January 1963 for an estimated \$12,055 per year. The rates for disposal were based on fees effective 01 July 1953.

The situation has changed significantly since initial contract award. Disposal costs have risen profoundly. A cost increase to contract N62474-68-C-0263 became effective 01 January 1992 and increased costs by \$31,149.24 per year. The current estimated yearly cost for refuse removal exceeds \$212,000 [Ref. 14 & 15]. This is a 1,758 percent increase over the original contract value.

The City of Monterey subcontracts its refuse removal to a sole source hauler, Monterey City Disposal Services, Inc. The City Council of Monterey sets refuse removal fees. To be more aggressive in contracting for these services, the Public Works Department recently requested that the existing contract be canceled in accordance with applicable contract clauses, and refuse removal services be reprocured by competitive bid. This is similar to methods used by other facilities. The local office contends that the existing contract is unworkable in its current format. It provides no incentive for conservation or cost reduction. The local office presumes that refuse removal is a service rather than a utility.³

³ Arguments may be presented that since refuse removal is dictated by the local government, it is a mandatory service that should qualify it as utility. This is similar to paying for cable television services as a utility.

The Engineering Field Division (EFD) denied the request for cancellation of the contract. The Local Contract Manager, Mr. Coesart, believes the reason for the denial is, "if it ain't broke, don't fix it." Cutbacks at the EFD and increased procurement regulation in recent years could lead the local administrators to this belief. Mr. Coesart identified repetitive cases where responses were late or when EFD personnel appeared to take the easy way out.

Since the denial of their request, the Facilities Support Contracts Division of Public Works has requested that the existing contract be modified to base payment on two line items. The first would be for refuse removal services and the second for tipping fees. This would provide an incentive for the school to reduce the tonnage of waste discarded. As landfill fees increase, a growing trend in the Navy is this type of cost separation.

D. COLLECTION

Janitorial services are provided at the Naval Postgraduate School by means of a service contract. This contract, numbered N62474-91-D-0711, was awarded 03 January 1992 for \$573,000. The contract requires refuse removal from assorted receptacles to containers located outside the buildings. This requirement is found in Section C.5.2.1.30 of the contract. [Ref. 16] The cost of cleaning the facilities includes the cost of this service. Once refuse is removed to dumpsters

outside the buildings, Monterey City Disposal Service, Inc. transports it to the landfill.

E. PUBLIC RELATIONS

A successful source reduction/recycling program is a public relations treasure. A significant component of any source reduction or recycling campaign is advertising what you are doing and what the community can do to help. This lets the local community know that the Navy is part of the community and is concerned about the community's well being. Source reduction programs, such as reducing paper coffee cups or mandating two-sided copying, not only save money but are perceived by the population as a job well done.

F. CURRENT RECYCLING PROGRAM

NAVPGSCOL Instruction 4500.1A, Disposal of Excess Property, Scrap Metal, and Recyclable Paper, dated 24 Nov 1986, last change 16 Dec 1986, implements the current waste paper recycling program at the Naval Postgraduate School. This Instruction identifies recyclable paper and describes how to dispose of it. No instructions or concrete procedures identify how paper shall be collected to encourage maximum participation.

Several methods of paper collection can be observed at the Naval Postgraduate School. These methods range from organized collection in computer rooms to ad hoc collection in office

spaces. The effectiveness of these programs varies. Typical collections consist of a cardboard box in a central location where personnel are supposed to dispose of paper. One drawback to this method of collection is that without organization, anything and everything will be disposed of in this container. Another is that without leadership not all employees even know waste paper recycling exists. According to John Bolster, Supervisor Excess Property Program, Supply Department, the high rate of contamination is historically the reason that low prices have been paid for paper from the Naval Postgraduate School. Contaminants include paper clips, and more critically, phonebooks.

Many organizations⁴ collecting paper have a "designated" representative who contacts Mr. Bolster and prepares a turn-in document.⁵ On the second and fourth Tuesdays of the month, Mr. Bolster and two sailors collect paper and all other recyclable or excess property from the facility. The paper is delivered to a warehouse and palletized. It is then shrink-wrapped and delivered to DRMO, Fort Ord.⁶ Recycling, as a

⁴ Organizations is used as opposed to facilities because in some buildings only some people participate. For example, the computer lab in Ingersoll conscientiously collects paper, yet the office spaces have limited participation.

⁵ Sample turn-in document illustrated in Appendix D, document number 1.

⁶ Shrink-wrapping is a method of securing goods for transport. An elastic material encases the goods which adds stability and prevents separation.

mandatory requirement at the Naval Postgraduate School, is not enforced yet participation appears to be relatively constant.

Significant personnel involved with most successful recycling programs include Public Works, the Supply Department and Morale, Welfare and Recreation. Their participation in the existing program at Naval Postgraduate School, Monterey is defined below.

1. Public Works

This department has the possibility of significant gains through recycling, yet has no responsibilities in the effort. The Facilities Support Contracts Manager, Mr. M. Coesart, and the Environmental Specialist, Mr. F. Vogl, have classified the Public Works Department as a customer of the recycling program. They sort waste paper for collection just like any other department.

2. Morale, Welfare and Recreation (MWR)

This department receives the profits from paper recycling. No evident action is taken by MWR to manage or organize the program. This department under the current program makes profits whether they exert any effort for recycling or not. To keep costs down they do very little under the existing waste paper recycling program.

3. Supply Department

The Supply Department is probably the most involved department at the Naval Postgraduate School concerning

recycling. This department provides all of the effort for none of the benefit. There is little wonder that the program is not fully implemented. The Supply Department, Excess Property Management Branch, organizes, collects, prepares and transports waste paper. Mr. Bolster, Supervisor Excess Property Program, schedules collection trips and provides a vehicle for collection of material. The military command at the Naval Postgraduate School provides Mr. Bolster with two personnel for collection. He collects the material, prepares necessary documentation and transports both to DRMO, Fort Ord. DOD Instruction 4165.6 and OPNAV Instruction 5090.1A require reimbursement for the costs of running a recyclable materials sales program. The Supply Department receives no reimbursement for the work accomplished.

This section has briefly examined the existing recycling program. The responsibilities are described as accurately as can be determined. Uncertainties do exist as to responsibilities for the recycling program. These uncertainties may be a problem with the program and arise from an apparent lack of ownership. The school has an ample supply of waste paper and many employees wish to recycle it. This is evident from discussions with employees. However, a lack of organization introduces an attitude of indifference into the

program. Thus the program apparently suffers from low prices⁷ and less than exemplary participation.⁸

While it is difficult to compare recycling rates among different military bases because of their operational tasking, it might be more appropriate to compare recycling at the Naval Postgraduate School with other colleges and universities.

⁷Low prices based' on historical market rates. These prices partially arise from the expectation by the buyer that the paper will be contaminated with phone books, magazines and non-paper products.

⁸Justification for calling participation less than exemplary evolves from a tour of offices and work spaces performed by the researcher. While paper recycling boxes were prevalent in computer rooms and copy rooms, many office trash cans were observed to contain paper. A study completed as part of this research will determine the percentage of paper still remaining in trash. The results of this study are presented in Chapter V.

UNIVERSITY	MATERIALS	EST. ANNUAL lbs/student
BIRMINGHAM-SOUTHERN COLLEGE	Office Paper, Aluminum Cans, Newspaper, Glass	36.667
UNIVERSITY OF CHICAGO	Office Paper, Stl Cans, Al. Cans, Glass, Newspaper, Corrugated	106.667
UNIVERSITY OF COLORADO	Office Paper, Oil, PET, HDPE, Newspaper, Al. Cans, Corrugated, Ferrous Metal, Phone Books, Organics, Glass, Vehicle Batteries, Textbooks, Reusables,	58.333
DARTMOUTH COLLEGE	Office Paper, Newspaper, Glass, Aluminum Cans, Corrugated, Scrap Metal	330.000
NORTH CAROLINA STATE UNIVERSITY	Office Paper, Newspaper, Scrap Metal, Textiles, Glass, Aluminum Cans, Oil, Yard Waste, Construction Debris	107.692
RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY	Mixed Paper, Newspaper, Office Paper, Corrugated, Al. Cans, Yard & Food Waste, Plastic Containers, Oil, Glass	162.500
SAN FRANCISCO STATE UNIVERSITY	Mixed Paper, Newspaper, Phone, Books, Office Paper, Al. Cans, Glass	8.143
NAVAL POSTGRADUATE SCHOOL, MONTEREY*	Aluminum, Copper, Curbside Paper & Cans, Paper, Steel, Toner Cartridges, Tires	365.556

*Data extracted from NEESA Solid Waste Annual Report FY
1990

Source: Resource Recycling, 1990.

Comparing the recycling program at the Naval Postgraduate School with the other universities makes NPS look rather impressive. However, when the curbside bottles and cans program tonnages are removed, the volume/student of recyclable material drops from 365.55 lbs./year to 45.55.⁹ This rate seems more in line with other universities.

G. RECYCLING PROGRAM - A PROPOSAL

Design Parameters

It has been estimated that academic and administrative buildings produce up to 60% high-grade paper. [Ref.24] In dormitory facilities, up to 30% of the waste is newspaper. However, at the end of classes students discard large quantities of high-grade paper in the form of syllabi and class notes. Some schools have special end-of-semester collection programs. In the Spring of 1991, the University of Wisconsin in Madison collected two tons of high-grade paper during their "special" collection.

The design of the revised recycling program at the Naval Postgraduate School will be fashioned around administrative and academic buildings. Consideration is also given to using periodic end-of-quarter clean-outs. A key design parameter,

⁹Household collection rates were excluded because universities do not generally lodge families. Some portion of this amount might be considered based on higher dormitory use rates on some campuses. It is assumed for purposes of this study that the Unmarried Personnel Housing occupancy equates to standard dormitory occupancy.

evident in all the literature, is a desire to keep recycling programs simple. This was constantly in the forefront during design of this revised program.

Basic design parameters for recycling programs to be considered include: [Ref. 17 & 18]

1. Participation - Mandatory or Voluntary.

Should the recycling program have uniform rules or should each building or organization be allowed to develop its own? Is there benefit in uniformity?

2. Choice of Materials - Separate and recycle all paper or only high-grade.

This choice depends on the goals of the program. If the goal is to reduce waste, then all waste should be recycled. If the goal is seeking the highest "revenue," then the markets must be analyzed when determining recyclable materials.

3. Area Served

Density and building mission controls collection measures and other design parameters. Container size, type, color and any special restrictions are identified here.

4. Separation Procedures - Will material be commingled or source separated?

When determining these procedures, care shall be given to minimizing disruption of work. Labor relations issues must also be addressed.¹⁰

5. Drop Off Collection or Office Collection - How much should participants do to recycle?

When selecting the proper collection measures there are several factors to be addressed. First, is fire safety going to be affected? Next, from what areas must collection receptacles be restricted? (e.g. stairways, hallways, utility rooms.) Is space limited?

6. Sale Procedure

Should recyclable material be disposed of by DRMO sale, by donation to local charity group or by turning it over to a disposal company?

7. Program Operator

Which Administrative body has responsibility for the operation of the program?

¹⁰ Typical labor relations issues involve disputes with employees about whether they are required by their contract to separate paper.

8. Community Relations

Will the program affect community relations in any way?

The remaining sections of this chapter address each of these design parameters. The sections deal with decisions made and set out steps for adaptation.

1. Methods of Increasing Participation

This thesis examines beliefs and motivation behind recycling. Research was reviewed in several areas, most heavily in the area of municipal collection programs. Available research has been reviewed to examine how consumers are motivated to recycle. The research involved analyzing participation as a result of the severity of threat and the effect of incentives on recycling participation. Reward programs as well as commitment programs were analyzed.¹¹ During the research several trends became apparent. These trends or ideas can be divided into three main areas. These factors include emotional factors, physical incentives and education.¹²

¹¹Commitment programs involve having the subject sign a document which requires participation in the effort. In these programs people essentially, "give their word" that they will recycle.

¹² This was not a complete search of all documentation as numerous psychological studies have been performed. These studies are considered beyond the scope of this thesis.

a. Emotional Factors

Beliefs that recyclers are different or hold different beliefs from non-recyclers are false, according to Raymond DeYoung, University of Michigan, Ann Arbor. [Ref.19] Mr. DeYoung's study addressed attitudes about recycling, the degree to which people derive personal satisfaction from "frugal" actions, their assessment of whether recycling ought to be extrinsically motivated and the degree to which these people view recycling as a trivial activity. Attitudes motivating behavior are a function of a person's beliefs about the behavior. [Ref.20] These beliefs are known as "behavioral" beliefs and will drive a person's participation level in an activity. This study found that there were no fundamental differences between the beliefs of recyclers and non-recyclers.

b. Physical Incentives

Incentive-based recycling systems are present in many local communities and military installations. At Fort Meade, for example, battalions that contributed the largest amount of recyclable materials were provided a \$5,000 special project as a reward [Ref.21]. This program encouraged recycling through competition. Further, organizers were able to maximize high value items by assigning higher point values to these items.

However, these programs normally tend to be ineffective. Studies have found that extrinsic incentives promote only modest increases in participation. Moreover, when the incentives are removed participation levels fall to pre-incentive level [Ref.20]. These programs routinely fail to produce long-term, enduring changes in behavior [Ref.22]. Incentive-based systems tend to undermine the impact of other techniques [Ref.23]. The effectiveness of behavior changes diminishes as incentives become more significant [Ref.22]. Therefore, the proposed recycling program offers no incentives for recycling.

Another area involves threats for non-performance. Many recycling programs involve penalties or disincentives for non-performance. Research has found that behavioral change is inhibited as the threat for non-performance grows [Ref.22]. When the threat diminishes, performance levels return to pre-threat levels.

c. Education and Convenience

Two keys for changing beliefs and behavior are education and convenience. In general, people are more likely to recycle when they have convenient recycling opportunities and greater knowledge about recycling [Ref.20]. Programs for recycling should concentrate on educating participants on how to recycle. This education subsequently affects their beliefs. By modifying the belief structure, the revised

recycling program hopes to fundamentally adjust behavior so that other techniques, such as incentives or rewards, will be unnecessary.

People will generally select convenient and familiar methods for reducing solid waste. They adopt behaviors that are well accepted and for which external support exists [Ref.24]. People frequently know why to recycle, they need to be told how. Education modifies a persons behavior and therefore is a central part of any recycling program.

Several program elements echo in the research literature. They are best summed by combining components from the NEESA 5.0-010A, Qualified Recycling Program Development Guide and the Report on the Implementation of Resource Recovery Guidelines at FT. Meade [Ref.21]. The following items are adopted for the proposed recycling program at the Naval Postgraduate School, Monterey.

- Promote awareness or an interest and understanding of the recycling program by installation personnel at a meaningful level.
- Motivate through education. Educate during employee orientation and frequent reminders (monthly-computer bulletin boards or memorandums) during start-up and bi-monthly thereafter.
- Frequent publicity of recycling programs to achieve an air of success and adoption of "normal" or "accepted" behavior. This occurs in the base newspaper and through bulletin board notices. Press releases should be made whenever significant goals are reached. Increased

performance and outstanding achievement must be recognized by the Command.

- Publicity always includes: why recycling is important, who to call with questions and how to recycle. Appendix D, Document 3 contains a sample advertising handout.
- Run a contest to design a recycling logo. Have the Print Shop print stickers with this logo. Use it on all further educational material.
- Require the Classmate and The Quarterdeck to be printed on recycled paper if cost effective.
- Re-issue the Recycling Instruction and provide explicit directions. Make recycling mandatory.¹³

Conspicuously absent from this design are references to incentives or punishments, which is consistent with the responses to a Florida survey of recycling coordinators. Ninety-seven percent agreed that citizens are encouraged to participate in recycling by appeals to their environmental conscience. Only seven percent believed that monetary incentives were effective. [Ref.25] The revised program minimizes costs by not using rewards, and maximizes continued commitment by influencing behavioral changes. The program requires infrequent additional cost and scattered oversight.

2. Choice of Materials

As mentioned earlier, the decision on the choice of materials for a recycling program depends on the overall goals

¹³ Make it mandatory but do not include penalties for not recycling.

for the program. If the goal is solid waste reduction, all material possible should be reduced. If the objective is profitability, then only the materials with cost-benefit ratios less than 1.0 should be accepted.¹⁴

This thesis centers around waste paper recycling. Should this program separate high-grade paper from other paper waste or leave it combined? The question of whether this is a profit-making operation must similarly be addressed.

Assume the motivation behind recycling paper is a requirement by high authority.¹⁵ The motivation for program enhancement should be strengthened if larger profits are possible. In addition, with significant constraints on operating budgets, cost savings or cost reductions play a stronger role in the decision-making process. Termination threatens a recycling program which costs more than the benefits received.

For the purposes of this program, recyclable paper consists of three separate grades, high-grade, low-grade office paper and clean computer paper. Procedures generally will be the same for collection of both high-grade and low-grade office paper. These recycling programs can be initiated

¹⁴Defined for purposes of this writing as costs/benefits.

¹⁵The contrary argument that the Government wants to protect the environment can be given. However, if this were true, many more successful recycling programs should exist. At a facility such as Naval Base, Norfolk, which recycles 14 items for over 13,839 ton per year, the environmental argument may be more appropriate.

without delay because a recycling program already exists at the Naval Postgraduate School.

3. Area Served

Area Density Evaluation is perhaps the most difficult part of designing the new program. There are several specific location types: office spaces (both individual and multi-user), copy rooms, computer rooms, student study spaces, classrooms, living quarters and miscellaneous facilities.

In individual and large central offices, desk-top collection containers will be used. These containers are similar to file folders. Two folders will be located on each desk. As employees discard paper they will place it in the appropriate location. Some employees may voluntarily opt to use cardboard boxes to accumulate materials. While acceptable, this is not encouraged as part of the organized program. Mr. R. Ching, Rutgers University Recycling Coordinator, has found that "the folders do not allow for paper cups and non-recyclable materials to contaminate the material." It is easier to accidentally throw an unacceptable item in a box and cover it up than put it in a folder on your desk. These folders will have recycling instructions, points of contact and the facility recycling logo printed on them. This reflects the objective of increased education and simplicity.

Copy rooms will have large containers located adjacent to each copy machine for high-grade paper. Since these rooms often serve as mail rooms, one container will also be positioned in these rooms for miscellaneous paper products. If necessary, employees will be able to use these containers to unload their paper holders. These containers will be purchased with specially designed tops preventing unacceptable material collection. To prevent excessive weight, these containers shall be no larger than 22.5 gallons. Wheels would be required at a large extra cost if containers were too large.

Computer rooms will be encouraged to continue existing procedures. They will reuse original delivery boxes. Since all paper is high-grade and relatively uniform in size, this is a clean and organized operation. Signs will be made identifying the locations of these containers. This paper will be collected, stored and sold separately. If clean, the value of this paper nears 300% the price of recyclable high-grade white office paper. This price difference is due to the homogeneous nature of the product and its lack of contaminants.

Student study spaces and the library will be assigned large containers similar to the copy rooms. These containers will be conspicuously marked to identify acceptable materials. Signs shall be posted at entrances and exits identifying that a recycling program is in effect.

An end of quarter program, similar to the University of Wisconsin's, will be enacted. To accept properly sorted recyclable paper, this program establishes a central disposal facility at excess property. The facility operates during exam week. Advertising in the Classmate, The Quarterdeck and on CATV Channel 4 in housing is critical. In this way, the Command and faculty encourage students to participate.

Miscellaneous spaces, including Maintenance Shops and MWR facilities, will each receive two central disposal containers. One for high-grade and one for low-grade paper. This design accounts for the relatively small quantities of paper generated by these facilities. Some facilities will not receive any containers. This is due to their low generation rate and proximity to other facilities. Containers will not be larger than 12 gallons for areas without copy machines.

4. Separation Procedures

Will employees be required to separate paper or will special recycling employees be hired to perform the separation? This program requires separation at the source because it is relatively easy for most employees to keep two folders on their desk as opposed to one. This thesis anticipates no employee labor relations problems. Similarly, it expects no additional work disruption.

The selected method enhances awareness for all personnel. By thinking about which container or folder to use, they have to think about recycling.

5. Drop-Off or Office Collection

This asks the question, how much should be required of participants in recycling? Part of the answer involves simplicity. 40 CFR 246.200-5 recommends the efficient use of janitorial and refuse collection services. This program modifies the existing janitorial contract. The existing contract requires trash in many buildings to be emptied daily. The modification requires trash to be emptied two to three times a week. High-grade paper will be picked up once a week, as will colored paper. This way, only modest increases in cost may be expected. These increases can be offset by service reductions elsewhere. After collection, the janitors leave the paper at a convenient location (building entrance). MWR personnel remove the paper the following day.

To promote safety and manageability, the janitors will use clear plastic bags to accumulate the paper and will be required not to overload these bags. The clear bags allow for inspection of contents. Leaving the paper for morning collection provides free publicity. Employees can see their success.

Twice a week, MWR personnel will be required to collect all paper, once for mixed paper, once for high-grade.

Collection includes all paper at building entrances and containers in copy rooms and miscellaneous spaces.¹⁶ Collected material will be transported to the Excess Property warehouse. When economically efficient quantities of waste paper are accumulated, they will be transported to Fort Ord.

Additional personnel create program start-up costs. These costs will not be recovered for at least the first year of the program, due to the delays in the DRMO sales process. However, these delays are minimized by the closure of Fort Ord. Due to this closure, the DRMO facility is moving to a smaller location. This means more frequent sales and faster inventory turnover.

Alternative storage methods include rented or Government- excess trailers. When full, trailers can be relocated to Fort Ord.

6. Sale Procedure

It seems apparent that sale through DRMO would be the best method. The revised program plans on using this method. However, if sufficient contract reductions result, the

¹⁶Once a week may not be sufficient for some copy rooms, yet may be too frequent for others. Employees shall be directed to contact MWR Recycling Center\Coordinator when containers in common areas are full. Modified schedules can then be made. Expect average pickup periods to be once a week. Larger containers may also be necessary. In the initial purchases, 5% of the containers should be oversized. This way heavy use facilities will have adequate storage capabilities. It is very important that containers are not overfull. This encourages contamination and tarnishes the professionalism of the program.

Government may investigate allowing Monterey City Disposal Services, Inc. to bring in their own waste paper recycling program. The disadvantage to this is no payback to MWR programs. Reduction in base operating expenses is the advantage. This study gives this issue no further consideration.

7. Program Operator

"Crowning a king" gives participants a central point of focus. This person is critical and should be devoted to the task [Ref.17]. MWR will be the administering body in this revised paper recycling program. They are the most likely organizer because they receive the most benefits. In addition, they have more flexibility for assigning personnel for paper collection.

Public Works provides contractual support and Supply will take control of the paper once it is delivered to Excess Property. This requires virtually no reimbursement of program operating costs. It also falls in line with other Navy recycling programs and the aluminum can collection program at the Naval Postgraduate School.

8. Community Relations

This thesis anticipates no direct negative impacts on the local community due to the revised recycling program. The program should elicit good will from the local community. It should show the Naval Postgraduate School as a leader in

environmental protection. Large scale programs like this are not routine in this area. However, a key ingredient in the program is revision of the current refuse collection contract to account for tonnage and collection fees. If successful, tonnage costs and frequencies of service will decrease. This yields less profit to the contractor and may have minor negative impacts on the City of Monterey.

H. NEXT CHAPTER

The following chapter deals with regulations and legislation concerning recycling. It further expands on information contained in Chapter I.

III. REGULATIONS

This chapter proposes to identify the requirements for recycling in the Navy. It defines responsible parties and addresses what the government is accomplishing in this area. The chapter identifies proposed legislation and government initiatives. Regulations and directives are used to define national guidelines, research and development, and other requirements. Funding sources for implementing a recycling program or modifying existing programs are examined as are procedures for recovering funds from the sale of recycled materials. The chapter delineates responsibilities for implementing a recyclable materials recovery programs.

This chapter describes local regulations. It highlights California codes as they apply to this thesis. Specific local waste handling measures, the local landfill situation and actions taken to extend its life are addressed in this chapter.

A. PROPOSED LEGISLATION

As discussed in Chapter I, modern society uses more and more paper and paper products. The use of paper has been growing at a 4% average annual rate [Ref.1]. On the national level, it is predicted that the average American uses more

than 19 tons of paper in his/her lifetime. Over a 70 year lifespan, this equates to nearly 550 pounds of paper per year. [Ref.20] While industry sources predict a sharp rise in the demand for recycled fibers, statistics show a large rise in supply. This depresses the price of raw materials. This, coupled with increasing raw materials from tree farming, has severely reduced the price of scrap paper and also makes recycling less economical. Currently tree farms plant three trees for every one they cut. These trees are healthier and faster growing than those previously planted. [Ref. 9] This supply/demand effect is shown in figure 5.

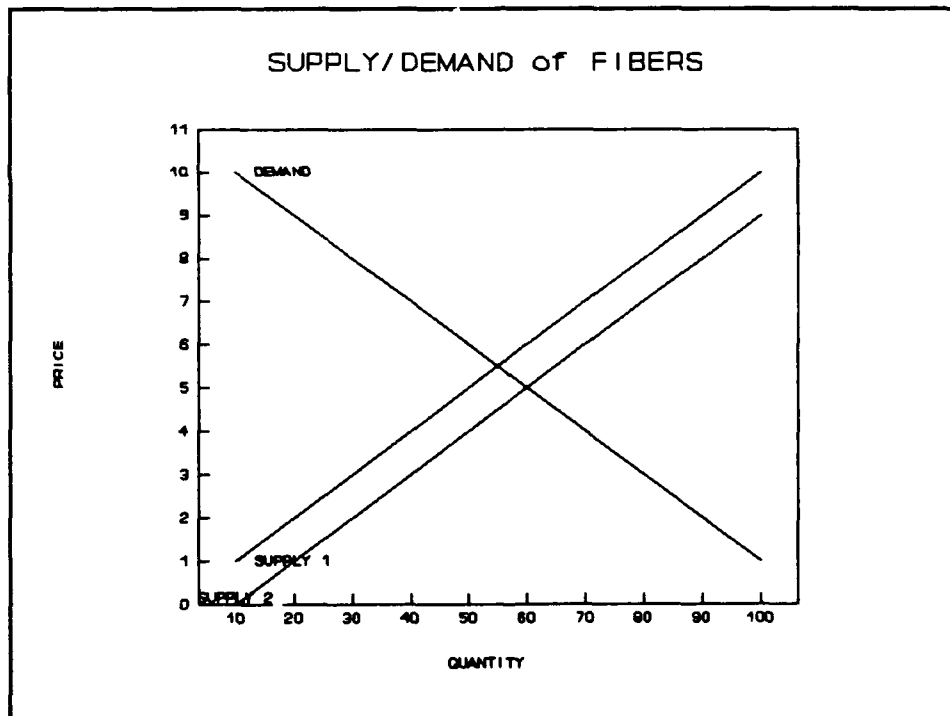


Figure 5. Shift due to Increased supply

The increased supply of recycled fibers is caused by mandatory recycling programs legislated by local governments. These programs have been enacted without giving attention to increasing demand.

Recent changes in the de-inking process have added to the cost of recycled fibers.¹⁷ New technologies and the spread of laser printers have created additional problems. The capacity of mills to process these dry ink papers have lagged behind the supply of available resources. This is contributing to the glut of paper. Mills have traditionally not been required to use post-consumer waste in their recycled paper. They have used millbroke and scraps from their own operation to meet recycled content specifications. Post-consumer waste paper is typically harder to handle, and thus more expensive, due to it's nonhomogeneous makeup. Nat Springer, President of Baldwin Paper, recalls that "Forty-five years ago recycled fiber was a much larger part of the product. The price of virgin pulp was high compared to de-inking." [Ref.9] The high cost and oversupply have combined to drive down the price of waste paper.

Although the prices are very low, a market exists for waste paper. Paper is the Port of New York/New Jersey's

¹⁷ De-inking is a process to remove inks and contaminants from existing paper. The traditional method of de-inking has involved the use of chlorine bleach. This process however produces dioxins which, in 1985, were reported to cause cancer in rats.

biggest export.[Ref.26] Markets are spawning new uses for recycled materials. The public is becoming more aggressive in its demand for the use of recycled fibers in paper products.

What actions is the federal government taking to aid the private sector in solving the solid waste disposal crisis? Specifically, what areas in the field of paper consumption and recovery are being influenced? In 1990 the federal government purchased over 489,000 tons of paper, or about 2.5% of all paper made in this country, according to Senator Wendell Ford (D-KY) [Ref.9].

Draft legislation on recycling and solid waste management is currently being considered by the 102nd Congress. These legislative efforts include House Resolution HR-3865, Resource Conservation and Recovery Act, and Senate Bill S-976, Resource Conservation and Recovery Act Re-authorization.¹⁸ These Bills attempt to reduce refuse generated and improve management of the refuse that is generated. These provisions require a 25% reduction in solid waste by the end of 1995 and 50% by Dec. 31, 2000.

Other items being addressed in these proposals include more stringent incineration regulation. Incinerators frequently obstruct paper recycling. When incinerators are

¹⁸ A bill concerning restrictions on disposal of interstate waste was approved by the Senate on 23 July 92, by a vote of 89 - 2. No similar bill exists in the House of Representatives. It is doubtful these issues will be addressed by the close of the 102nd Congress.

sited, contracts are signed with the local communities. These contracts require the community to provide a minimum tonnage. This guarantees that the company building the incinerator earns a minimum return on its investment. Communities have been known to take their recyclable paper to local incinerators and pay for disposal as refuse because they could not meet quantities promised to the incinerator. Other problems arise because recycling removes dry, hot burning items from the waste stream. Operators of incineration plants prefer that these items be left in the waste stream. This provides additional disincentives for recycling. Proposals being considered would ban burning certain wastes. This would be extremely difficult because these wastes would have to be separated at the point of incineration. Platforms for this separation are costly and would further drive up disposal costs.

B. GOVERNMENT INITIATIVES

Since the Federal Government is a large consumer of paper and paper products, it is taking steps to reduce waste and encourage recycling. In October 1991, President Bush signed Executive Order 12780, The Federal Recycling and Procurement Policy. This order requires federal agencies to increase recycling efforts and increase the market demand for recycled products. [Ref.1] This is accomplished by purchasing recycled

products, by cost-effective waste reduction, and by recycling of reusable materials in operations and facilities. The following actions have been implemented.

- Establishing a Federal Recycling Coordinator and a Council on Federal Recycling and Procurement Policy.
- Requiring each agency to designate an agency recycling coordinator.
- Providing guidelines on recycling.
- Establishing a Solid Waste Information Clearinghouse.
- Providing Recycling Market Assessments.
- Publishing educational material.
- Procuring more items made from recycled materials in accordance with the RCRA.

Other government agencies have launched recovery programs on their own. The General Service Administration (GSA) has become the lead agency in the Federal recycling effort. GSA has responded to an EPA study indicating that 90% of waste in a typical Federal office facility consists of paper products. [Ref.1] In 1990, GSA established a Federal Recycling Program. This program unified Federal agencies in the area of source reduction, collection and marketing. It also involved purchasing recycled goods such as recycled paper, retread tires, insulation and recharged toner cartridges.

The Postal Service initiated a National Recycling Program in 1991. Savings are estimated at over 600,000 pounds of waste materials and nearly \$40 million each year. [Ref.1] The

purchase of recycled goods and source reduction play critical roles in this program. All postal cards are printed on recycled paper and bulky materials are being replaced in express mail. Additional programs are being undertaken to reduce trips by employees, use more environmentally sensitive products and reduce bulk mail.

The Federal government has undertaken other programs to spur the recycling industry and reduce waste. 40 CFR 250 requires purchasing paper made from recycled materials. Federal agencies must purchase these materials to the maximum extent possible. Title 42 U.S.C. 6952 instructs agencies on developing specifications for secondary materials. Title 42 U.S.C. 6902 states that it is the National policy of the United States to:

"promote a National research and development program for improved solid waste management and resource conservation techniques, more effective organizational arrangements and new and improved methods of collection, separating and recovery, and recycling of solid waste..."

With environmental concerns increasing, a renewed interest in developing new technologies is taking root. Public pressure is causing the government and producers to change policies and practices. These technology changes produce new and unanticipated problems. High paper prices in the past have prompted a new breed of hearty, faster-growing trees. These trees produce such low cost raw fibers that recycling has become the more costly alternative. Proven technologies

must be developed and fully appraised prior to implementing new policies.

C. FUNDING

This section discusses funding for recycling programs in two parts. First operational funding conditions will be addressed, and then start up or reintroduction funding. DOD Directive 4165.6, Oct. 4, 1976, Section V, Subsection B, states:

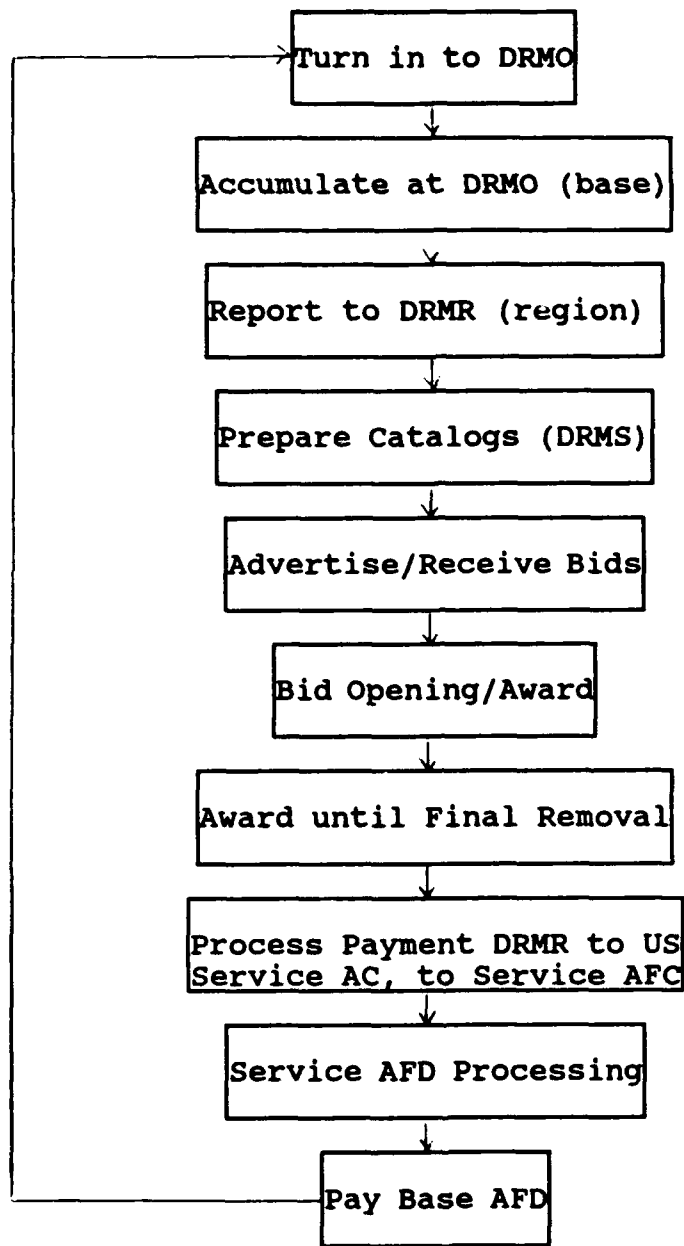
"all solid waste generated on a DOD installation shall be considered government property for purposes of disposal...except in those instances where military exchanges and commissary stores salvage and dispose of their recoverable resources."

This clarifies that DOD installations own and can sell recyclable materials. This also limits disposal options. It prevents individuals or "scavengers" from recovering waste. Frequently, these self-styled capitalists remove a great deal of waste paper. By identifying solid waste as government property, it restricts sale and recovery to the Defense Reutilization Marketing Office (DRMO). Exceptions include disposal of the material through a community run program or a charitable agency. For donating recyclable material to a charitable agency, separate restrictions apply.

Assistant Secretary of the Navy message R151854Z clarified the procedures for selling recyclable materials. All materials purchased with appropriated funds must be sold through DRMO.

The Military Construction Codification Act (P.L.97-214), effective 01 October 1982, served to expand the Department of Defense recycling program. If an installation has a Qualified Recycling Program, it may receive 100% of the proceeds from selling these materials. Previously, DRMO took 20% of sales for their effort. The money received from the sale must be used to cover operations, maintenance and overhead costs incurred in the recycling operation. Up to 50% of the remaining balance may be used for pollution abatement, energy conservation and occupational safety and health projects. However, no more than 50% of costs of these projects can be paid from proceeds from recyclable material sales. Any remaining balance shall be used by MWR activities as defined by other Department of the Navy Regulations. This is permitted per P.L.8-2577. At the end of any fiscal year, if the balance in the recycling material sales account exceeds \$2,000,000, the excess amount must be transferred to the U.S. Treasury. Additional instructions on funding of MWR programs can be found in SECNAVINST 7000.23A, Funding of MWR Programs.

One of the drawbacks of this process is the long leadtime between removal/generation and DRMO's receipt of revenues. Figure 6 graphically depicts the DRMO Funding Cycle.



AVERAGE TIME TO COMPLETE 1 FULL CYCLE - 200 DAYS

Figure 6: Source NEESA 5-010A Qualified Recycling Program (QRP) Development Guide

There are five ways to get funds to start up a Qualified Recycling Program.

1. Operating Funds

Base operating funds can be used until sales revenues are returned to the installation. These funds are needed if proceeds from recycling do not cover the costs of the program. It should be pointed out, however, that operating funds will be recouped as the recycling program reduces landfill and disposal costs. Costs may also be reduced by savings in collection costs. For some services, daily pickup may be reduced to 2 or 3 times per week.

2. Pollution Control Report (PCR) Funds

If the state requires solid waste recycling, as does California, PCR Funds may be available. These funds can be obtained by submitting a PCR project through the Engineering Field Division to Naval Facilities Engineering Command (NAVFAC) or the major claimant. These funds may be used for studies and surveys, to purchase bailers and other recycling equipment, and to prepare recycling plans.

3. Supplemental Funds

Supplemental funds may be available from internal sources. Central Base Funds, Service Headquarter Funds or other non-appropriated funds can be received as a loan or direct allocation. They may be used as "seed" money for program start up.

4. Productivity Investment Funds Program

Money can be obtained through DOD's Productivity Investment (PIF) Program. The funding procedure is defined in DOD Instruction 5010.36.

a. Productivity Investment Funds (PIF)-

PIF funds are used for long-term projects costing more than \$150,000.

b. Component Sponsored Investment Program (CSIP) Fund-

These funds are the same as PIF funds but are more flexible. Limits and availability vary depending on budget allocation.

c. Fast Payback Capital Investment (FASCAP) Funds-

These funds are used for projects between \$3K and \$150K with a 2-year payback period. This is probably the most applicable funding source for a recycling program.

5. Non-Appropriated Fund Return-on-Investment Loans

These loans may be available from COMNAVMILPERSCOM/N-65 for recycling programs. These funds are available for up to \$50,000.

It must be emphasized that while the above programs exist, the current funding climate limits their use. Loan repayment reduces the revenues of recycling projects and lengthens the period of time for such programs to become

profitable. As budgets tighten, unattached money is quickly taken for budget cutting or other uses.

False starts must be minimized when initiating a recycling program. They will be interpreted by the public as a lack of commitment by leaders regarding recycling. Therefore, recycling programs must be undertaken only when planning on using operational funds or after confirming funding from other sources.

D. REQUIREMENTS FOR RECYCLING

1. General

According to OPNAVINST 5090.1A, Chapter I, "The Navy's ability to accomplish its mission requires daily operations in land, sea and air environments. The Navy is committed to operating ships and shore facilities in a manner compatible with the environment...".

This stands as the backdrop for defining the rules and regulations that require recycling. The Solid Waste Disposal Act of 1965, as amended by the RCRA, requires that federal facilities comply with state and local regulations concerning solid waste management. This Act encourages recycling. This was further emphasized in Executive Order 12780, as discussed in Chapter I.

2. Objectives

Recycling objectives are illuminated in DOD Instruction 4165.9, Solid Waste Management-Collection, Disposal, Resource Recovery and Recycling Program. These objectives are listed below.

- The preservation and protection of the environment.
- The Conservation of natural resources through:
 1. Judicious collecting and disposal of solid waste.
 2. Source reduction
 3. Recovering and recycling materials.

The purposes for an activity recycling program are described in OPNAVINST 5090.1A. They include obtaining proceeds from selling recyclable material; avoiding disposal costs; and reducing the volume of waste buried in landfills.

3. When to Recycle

Rules for implementing recycling are detailed in DOD Instruction 4165.6. Specific directives that mandate paper recycling are contained in Section V, Subsections L and M.

- L. High-grade paper generated in office buildings of over 100 workers shall be separated at the source of generation and collected for the purpose of recycling.

M. At facilities where resource recovery is not mandatory....optional programs are encouraged...

Part M goes on to discuss the costs at which optional programs should be undertaken.

Another relevant directive is 40 CFR 246 - Source Separation for Materials Recovery Guidelines. This regulation defines high-grade paper and gives guidelines for implementing a desktop recovery program. This served as an outline for the program developed in Chapter II.

4. Naval Postgraduate School, Monterey

Naval Postgraduate School Instruction 4500.1A directs the recovery of recyclable paper at this facility. This instruction notes that all types of paper and paper products are recyclable. It states that material should be clean and free from unacceptable "non paper" material.¹⁹ Paper should be accumulated in cardboard boxes and picked up by Supply Department Shipping personnel. Proper documentation is required for removal. Appendix D provides a sample copy of a turn-in document.

¹⁹ Non paper material includes binderclips, paper fasteners, etc.

The instruction further identifies that there are 4 categories of acceptable paper.

- Tabulating cards
- Computer paper (ledger)
- Computer paper (ledger) shredded (placed in plastic bags)
- Mixed paper (all other types, no carbon)

5. Responsibilities

Responsibility for managing a recycling program is assigned in a myriad of instructions. Management generally is assigned to MWR. Directives that address this issue include:

- DOD Directive 4165.6 ,Solid Waste Management-Collection, Disposal, Resource Recovery and Recycling Program
- SECNAVINST 6240.6E, Assignment of responsibility for Department of the Navy Environmental Protection and Natural Resources Management Program
- OPNAV 5090.1A, Environmental and Natural Resources Program Manual
- OCNR 5090.1, Assignment of Responsibility for Environmental Protection and Enhancement Program
- NAVFACINST 5090.1, Engineering Field Division Responsibility for Environmental Protection/Engineering program ashore

Specifically, OPNAVINST 5090.1A appoints NAVFAC as the technical focal point for solid waste issues. COMNAVFACENGCOM must assist Commanding Officers in developing resource recovery programs. Major Claimants must ensure that activities under their commands comply with federal, state,

inter-state and local solid waste management requirements. COMNAVSUPSYSCOM develops specifications for purchasing recyclable materials and identifies techniques to reduce packaging.

At the local level, Commanding Officers must develop solid waste management plans. The Defense Reutilization Marketing Office provides market analysis when requested. These analyses are needed because no further action is required if no market is present. The market analysis should provide:

- Market price
- Forecast of future price
- Pick-up point charges²⁰
- Description of preparation required

Public Works (as an extension of NAVFACENGCOM), Supply and MWR provide additional assistance to the Commanding Officer in preparing solid waste management plans. These commands have a vested interest in the success of the recycling program. The Supply Department's interest involves material handling, Public Works is concerned with refuse removal and MWR receives the profit from this type of program.

²⁰ Pick-up point charges include charges required to process material for removal and for additional handling.

E. LOCAL AREA CONDITIONS

1. State Regulations - California Code

Recycling was mandated in California in 1989 by the California Integrated Waste Management Act. This legislation is located in the Public Resources Code, Division 30 entitled Waste Management. In this act the legislature of California noted that its purpose is to "reduce, recycle and reuse solid waste generated in the state to the maximum extent feasible..."

The mandate enacted by this legislation requires each city or county to divert 25 percent of all solid waste from landfills or incinerators by January 1, 1995, and 50 percent of all solid waste by January 1, 2000. This is supposed to be accomplished through source reduction, recycling and composting activities.

Under some conditions, these goals can be modified. These conditions are fairly specific. First, the locale must be small or the amount of refuse generated by the community must be modest. This accommodates farm areas with low densities where diversion of 50 percent of solid waste would create a tremendous hardship. The second exemption concerns incinerator contracts where the reduction in waste would cause "substantial impairment of the obligations of the contract".

[Ref. 3 section 41786]

The baseline for the solid waste reduction goals is the waste disposed at the permitted disposal facility as of January 1, 1990. This does not include materials which were previously recycled, such as agricultural wastes, inert solids, scrap metals, and white-coated major appliances.²¹ It also excludes sludge or any other waste product that would not normally be landfilled or incinerated. If not previously recycled, these products are included in waste calculations. Design quantities are adjusted for changes in population and in government, industrial or commercial operations in the area.

Funding for recycling projects and management of solid waste is discussed in Division 30, Chapter 2, Article 1, of the Public Resources Code. The Solid Waste Management Fund was established by imposing a per ton fee on operators of landfills and incinerators. Initially the fee was set at \$.50 per ton. It is not to exceed \$1.00 per ton. This fee is set by the California Integrated Waste Management Board to generate sufficient revenues for the approved budget for the fiscal year, including a prudent reserve [Ref. 3]. By using 1988 figures, this would provide an estimated operating budget of over \$19 million.

²¹ White-coated appliances are all refrigerators, washing machines, dryers, dishwashers, et al., not limited to those which are the color white.

F. LOCAL LANDFILL²²

The previous section identified the situation in the State of California. It insinuated that a "refuse emergency" in California was quickly approaching. The local situation is much different. Residents of the Monterey Peninsula utilize the services of the Monterey Regional Waste Management District. The District operates a sanitary landfill on 570 acres of property north of Marina. This property is District-owned.

The sanitary landfill disposal site, located adjacent to the Salinas River, was appraised in 1984 at \$10,000,000. This site is expected to accommodate 32 million tons of waste. According to Mr. R. Shedden, District Engineer, if all recycling reduction goals are met, the remaining life expectancy of the landfill is 100 years.

The site services 853 square miles and includes nearly 170,000 people.²³ The areas served includes Marina, Monterey, Del Ray Oaks, Carmel, Pacific Grove, Sand City, Seaside, unincorporated areas of Pebble Beach, Carmel, Big Sur, Carmel Highlands, Carmel Valley, Castroville, Corral De Tierra, Laguna Seca, Moss Landing, San Benancio, and Toro Park. In Fiscal Year 91-92, the site received 311,864 tons of solid

²²Appreciation for information contained in this section is given to the Monterey Regional Waste Management District, specifically to Mr. Richard D. Shedden, PE, District Engineer.

²³ Figures include Fort Ord

wastes. Of the total received, 15.2 percent or 47,514 tons were recycled or diverted.

Numerous comprehensive recycling projects are proceeding at the landfill. Recovery programs for cardboard, newspaper, glass, wood, plastics, metals, concrete, asphalt, building materials and household hazardous wastes are continuing. One program to eliminate items of "worth" from the landfill involves a used material store. Landfill employees remove items which have value from the refuse. This is done when either dumped at the site or at the gate. These items are accumulated and sold in a "flea market". Items such as bowling balls, which will not readily decompose, are removed by this program. The employees also remove items such as plastic gardening pots and resell them to local nurseries. All these programs reduce waste disposal and costs.

The district management controls costs to entice users to recycle. Document 2 in Appendix D is a sample rate schedule for the landfill. Section F identifies which loads are free. The District allows all items that are readily recyclable or "clean" to be disposed of for free. For a hauler of waste concrete, it is quite a cost savings to dispose of his/her load for free. Benefits from this program are recognized by the landfill, because clean concrete is crushed on site and sold to contractors for road bedding. This recycled asphalt/concrete mix meets California Department of Transportation Specifications for road bedding. Similarly,

clean wood waste is charged a reduced rate of \$5/ton. This wood is chipped and sold to a local power plant for fuel.

There are plans to construct an intermediate processing facility on the site. The facility will separate and sort all recyclable waste material. This will reduce waste tremendously. Anticipated costs of this facility are approximately \$1.5 million.

This landfill operates on a cost-benefit basis. If a market is available and the costs for removal of the material from the waste stream are not too high, the items are recycled.

Revenues are being generated from numerous sources. Methane recovery earns \$400,000 per year. Wood, metal, sand and crushed concrete/asphalt sales earn significant profits. This is important because the costs of handling these wastes are increasing. The preparation of the new disposal area in the landfill is ongoing and will cost over \$1.5 million. This site is 25 acres and will last for only 8 years. The revenue generating programs help keep costs at \$14.00 per ton.

A problem arises because items that are bulky and take up space but are not valuable are not being removed. Yard waste or "green waste" is still landfilled because there is no market. There are plans for future removal, but because the landfill has such a long life expectancy, there is no hurry. Another item is waste paper: if mixed with trash, it is landfilled. Current separation costs far exceed the benefits.

Proposed solutions to the problem mentioned in the previous paragraph are forthcoming. The California Solid Waste Management Act mandates a 50 percent reduction in waste disposed and "taxes" waste disposal. Thus, the District must recycle all materials possible. The problem with this act, however, is that it masks the problem. The lack of markets for recycled materials reduces recycling. Somehow demand must be increased.

Another factor that should increase participation is potential fee increases; up to 30 percent next year with additional increases in the future. In general, the higher fees result from space shortages, landfill closing expenses and to encourage recycling. However, the local landfill conditions differ because space limitations are not a current problem. Local fee increases cover additional expenses, make up for the smaller volume landfilled and persuade people to recycle rather than pay the tipping fee. Landfilling in the future may no longer be the cheapest alternative.

G. SUMMARY

This chapter presented the regulations that require recycling. It started with federal mandates and proposed legislation. During this discussion, several market conditions were addressed. Government initiatives by GSA and the Post Office were presented and DOD rules were discussed. Funding regulations and possible sources were addressed.

These sources must be checked when developing a qualified recycling program to assure their availability.

DOD responsibilities and directives have been briefly explained to indicate the key players in the recycling game. Specific requirements of the Naval Postgraduate School program were also addressed. Chapter II detailed the actual program.

Discussion of the California Codes and mandates were addressed. A problem with the California Code is that it is written to apply generically to all landfills in the state. Mandating 50% recycling in Monterey may not make economic sense because of the long life expectancy of Monterey's landfill. The state government, however, looks at the state as a whole when generating this type of legislation. Therefore, residents of Monterey pay more than their marginal cost to dispose of waste. This violates the rules of the free market and is inefficient.

Market conditions are not always "free" in refuse removal. Since many landfills are either controlled by municipal governments or compete with those that are, prices are held artificially low. Another reason landfill rates are low in Monterey is because it is very difficult to justify high fees to the public when landfill space is expected to last at least 50 years.

This chapter presented a description of a productive landfill. It briefly described the operation of the local landfill serving the Monterey Peninsula, including the Naval

Postgraduate School. This facility is very concerned with actively pursuing local markets and providing state-of-the-art solid waste management.

In Fiscal Year 1990, the Navy and Marine Corps generated 4.525 million tons of solid waste at a cost of \$102 million. This cost averages \$22.65/ton. [Ref.6] On the Monterey Peninsula, costs are below average. As costs continue to rise at rates as high as 30 percent, this area's costs may fast approach those of other installations.

IV. METHODOLOGY

This chapter addresses the procedures and means of collecting data. The first section identifies the method for collecting price data and the second delineates procedure for documenting quantities.

The theoretical framework for data collection follows techniques identified in, "Research Methodology & Business Decisions," by Buckley, Buckley and Chiang. [Ref.27]

A. PRICES

Price data incorporates the most current information available. Various data collection methods were used as appropriate to the specific data. All manufacturer prices that do not include shipping have been increased by 10 percent.

1. Labor Prices

The following areas require labor costs represented as hourly rates.

- Current supply personnel involved in waste paper recycling.
- Military manpower costs in the current recycling effort.
- Labor cost for janitorial service per hour.
- Wage rate for materials collection personnel.
- Wage rate of recyclable materials coordinator.

The Civilian Personnel Office at the Naval Postgraduate School provides labor rates, which are used to the maximum extent possible. Employees interviewed provide actual employee grades for personnel involved with recycling. Specific archival documents include civilian pay scales and payrolls. Contract janitorial costs are based on the current Department of Labor minimum wage rates.

2. Containers

In the current recycling program, cardboard boxes are the basic containers for collecting recyclable materials. Since purchasing and using these containers involves no cost or cost savings, the costs for these containers are not considered relevant. These costs are also immaterial because the modified program still reuses cardboard boxes in computer rooms. This reuse involves a significant portion of the current boxes used for collection.

The revised program purchases new recyclable material accumulation containers. These containers will be purchased through the General Services Administrations, Federal Supply Schedule. Price quotes come from the most recent schedule. The research anticipates replacement of several containers per year. Reduced purchase quantities may create price deviation. Purchasing in bulk lots should be used to the maximum extent possible. The thesis calculates all prices using the present value of future expenditures.

Required Container Purchases:

- Desk-top bins/folders (2 per employee).
- 22.5 gallon containers for copy rooms.
- 11 gallon containers for low quantity producers.

Containers used to transport materials by janitorial personnel are not considered because no new containers will be required if the waste paper recycling program is revised.

3. Equipment

A review of existing programs determines requirements for special equipment. Cost estimates for this equipment utilize industry publications. The cost of vehicles required for transporting materials is the only anticipated equipment cost. This cost includes vehicle maintenance and fuel expended to collect recyclables. Calculations include the vehicle currently used by Supply for collection.

4. Landfill Fees

Collection of data on landfill fees uses Archival and Opinion Research. Current fees are derived from the fee listing, Appendix D, document number 2. Interviews with Mr. R. Shedden, District Engineer, Monterey Regional Waste Management District provides estimates of future fees.

5. Supplies

Market rates and Federal Supply Schedules provide costs for additional supplies required by the janitorial contractor. The only possible supply change is plastic bags. Since refuse collection decreases proportionately to increased recycling, no additional costs for these items are estimated. If increased quantities become relevant, this would be the only cost increase because current bags are the same as required by the new program.

6. Contract Charges

In addition to direct costs, any modification of the janitorial contract incurs/saves administration, profit and overhead charges. Previous modifications provide these costs.

The Facilities Support Contract Office at the Naval Postgraduate School has requested a contract modification to change contract line items. Therefore, there will be no costs associated with changing methods of contracting as proposed in the revised program. This thesis uses quantity estimates provided by the waste study, Appendix E-3 and costs based on actual existing contract line items. Without better segregated cost data, these unit prices are the best available.

7. Waste paper

Current prices for recovered waste paper are based on the Solid Waste Annual Report Fiscal Year 90. Current trade publications provide prices for the new program. New

procedures educate participants and "cleanse" the waste paper stream. Consequently, going market rates are forecast for the new program.

8. Education

Print Shop personnel provide prices for additional educational literature. Other prices come from Federal Supply Schedule contracts. No additional costs are factored for CATV advertising. The costs for operating the CATV bulletin board system are fixed. They are the same whether using the current recycling program or instituting a new program.

9. Rentals

Existing contract costs for dumpster rental and removal, minus disposal fees provides an estimate for renting a dumpster for end of quarter cleanouts. This dumpster will be placed at the Excess Property Warehouse.

10. Vehicles

The Transportation Division of the Public Works Department provides estimates for vehicle costs.

B. QUANTITIES

Several methods are used to derive quantities for the cost-benefit calculations of this thesis. Estimating percent of paper currently recycled and quantity of paper available for future recycling uses Empirical Research Techniques. The research also seeks Archival evidence and opinions of subject matter experts.

1. Research

This thesis includes a study of current disposal practices. This study examines dumpsters to evaluate quantity and composition of refuse. Documentation includes container location, approximate percentage full and any special items observed.²⁴ This study samples dumpsters to determine volume generated. Standard volume to weight conversion tables provide the means to identify tonnages. Using this study, current disposal tonnages are extracted as are possible future increases in recyclable paper.

Concurrently, data is collected on the quantity of paper purchased. Determining future recycling rates uses correlations between available refuse and known quantities of paper.

2. Actual Quantities of Paper

As mentioned in the previous section, documentation includes actual quantities of paper brought to the Naval Postgraduate School. Supply Departments records furnish this information. Literature research provides information on paper received through the mail. A portion of the mail will be considered recyclable materials. Also, a small portion of the paper brought onto the base from outside copy companies becomes waste.

²⁴ Sample document located in Appendix D, number 4.

3. Labor

J. Bolster, Supervisor, Excess Property, Supply Department, estimates quantities of labor currently used to collect waste paper. Mr. Bolster's assistance and expert opinion furnish estimates for the amount of time it will take to collect recyclable paper in the new revised program.

Research literature supplies additional information on both time required by participants and quantities expected for recycling.

As mentioned earlier, the revised recycling program frequently uses Mr. Bolster's advice. The estimates also use time spent at other installations for similar collections. These quantities along with hourly rates and fringe benefits develop into estimates of the labor cost differential between old and new programs. Estimates solicited from Mr. Bolster determined that no additional time is required to transport paper from the Print Shop to the excess property warehouse. As new paper is delivered to the Print Shop by Supply, the recyclable paper is collected.

Mr. Coesart, Facilities Support Contracts Office, Public Works Department, provides assistance for calculating additional hours that will be required by the janitorial staff.

4. Personnel

The quantity of facility, staff and student population at the Naval Postgraduate School is found by combining data from the Civilian Personnel Office and the Registrar. This data assists in determining the costs of recycling and the number of desk-top containers required. Conservatism dictates that each person employed by this facility in a "white-collar" job, civilian and military, shall be provided two desk-top containers.²⁵ The student population provides insight for determining quantities of paper available for recycling.

5. Copiers

The total number of copiers and their locations are cataloged. Mr E. Spencer, Director Visual & Information & Reproduction, Supply Department, provides the locations of the machines and documentation of actual quantities of high-grade paper used in copiers and laser printers at the Naval Postgraduate School. The number of copiers also determines the quantity of 22.5 gallon containers needed. The locations are plotted to identify which facilities require additional 11-gallon containers.

6. Vehicles

Vehicle operating hours governs vehicle cost. Therefore, vehicle charge is based on current and proposed

²⁵ Defined as other than wage-grade.

collection man-hours. These hours provide an estimate of vehicle operating time.

7. Contracts

The Facilities Support Contracts Office furnishes estimates of reduced refuse frequency schedule savings.

C. CONCLUSION

Various locations supply data. Very little of this data is capable of standing alone. Chapter V combines prices and quantities with literary research to estimate costs and benefits.

All costs and benefits are listed as their present values. Many of the quantities are based on opinion or prior research, making them less reliable. When computing expected costs, sensitivity analysis helps reinforce unreliable data. Chapter VI performs sensitivity analysis where necessary.

V. DATA PRESENTATION

The research assesses the waste stream to identify the quantity and character of waste generated. With tight markets, the quality of waste paper supplied is important. Paper packs must be clean to obtain the highest possible price for the Naval Postgraduate School. [Ref.28]

The waste stream analysis assumes that the Naval Postgraduate School population has a positive attitude toward recycling but is not fully informed about the current waste disposal situation. These opinions were corroborated by casual contacts with personnel employed at and attending the Naval Postgraduate School.

This chapter organizes data in three areas. First, it presents information on the existing program. Next, the estimated annual costs of the revised program are given. Finally, the chapter estimates start-up costs for the new program. Chapter VI identifies the payback period for the new program, explains peculiarities in the data and identifies gains expected in future years. Data is presented in tabular format with sources and assumptions annotated as required.

Costs do not include those that are similar for the existing and revised options.²⁶

A. EXISTING DISPOSAL & RECYCLING COSTS.

Description	Quantity	Price per unit	Total Annual
Disposal costs (public works)			
1. Refuse Pickup	1,142 tons	\$36.23	\$41,375
2. Refuse Tonnage	1,142 tons	\$18.62	\$21,264
3. Collection of Refuse in Bldgs.			\$15,910.72

Paper Collection Costs

Supply Dept.			
4. Director	96 hrs.	\$26.77	\$2,569.97
5. Collection Personnel	96 hrs.	\$13.67	\$1,312.32
6. Vehicle A.Usage	96 hrs.	\$.8	\$76.80
B.Fuel	72 gal.	\$1.2	\$86.40
7. Wrapping		\$100/yr	\$100
8. Forklifts		\$0	\$0
9. Storage Trailer		\$0	\$0
10. Transportation to Fort Ord	10 trips	\$45.25	\$452.54

Revenue

11. Paper Sales	22 tons	(\$43)	(\$948.17)
12. Refuse Avoidance	22 tons	(\$18.62)	(\$410)

Net Revenue - Paper Collection\Disposal Costs			\$81,789.58
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²⁶ Some of these items are listed and assigned a zero cost to merely identify that the research has considered them.

Description of terms

(line 1) The SWAR FY90 estimated that 3,144 tons of waste were disposed of in FY90 at a cost of \$151,646.84. This equates to \$48.23/ton. Refuse pickup costs are determined by subtracting the landfill fees (\$12/ton) from the total costs (\$48.23/ton). Thus, refuse collection costs equal \$36.23/ton. Reference 29 provides equations to estimate tonnages for base generated refuse.²⁷ Using standard equations for refuse generation rates at universities, the estimated refuse is 1,142 tons/year. Other data suggests that approximately 3.58 lbs./person/day are generated in housing units. This equates to 1,920 tons per year at the Naval Postgraduate School. Using this estimate, the base generated 1,224 tons of refuse last year. This is consistent with the estimated 1,142 tons/year for on-base generated waste.

(line 2) The refuse tonnage disposal cost uses anticipated future landfill fees. The Monterey Peninsula Waste Management District landfill in Marina projects these fees for next year.

(line 3) In-building refuse collection costs include all contractor direct and indirect costs. The Facilities Support Contracts Division of Public Works provides these costs from the Schedule of Deductions in the current janitorial contract. Actual costs based on a per hour unit price are not available without a detailed study. This study may involve data that the

²⁷ The 3144 tons includes all housing refuse and is therefore inappropriate for use in this thesis.

contractor considers proprietary. However, \$15,910.72 represents the amount the government actually pays for the service rendered.

(line 4) Mr. J. Bolster, Excess Property Manager, Supply Department, estimated that he currently spends a maximum of 8 hours per month on recycling.²⁸ This includes training of personnel, organizing a pick-up schedule, answering customer questions, collection, warehouse time, documentation preparation and transporting of materials to DRMO, Fort Ord. Mr. Bolster stated that the current program is simple so it requires little of his time. The existing program relies heavily on word-of-mouth and employee self-initiation for its survival.

(line 5) Two collection personnel spend a maximum of 8 hours total per month on waste paper recycling. This time includes pick-up, organizing and preparing material for shipment.²⁹ The cost estimate assumes that monthly costs include two personnel, one E5 and one E4, working 2 days a month for 2 hours a day. This comes to a total of 8 hours a month. Labor costs are based on rates established by the Defense Business Operating Fund (DBOF). These rates are \$12.32/hr for an E4 and \$15.02/hr for an E5. This thesis charges these costs to the existing program, even though they

²⁸ Personal interviews with Mr. Bolster.

²⁹ Personal interviews with Mr. Bolster.

are not actually incurred. These costs are opportunity costs because the labor used on this program is not available for other projects. Therefore, this labor is not free.

(line 6) Time spent by the collection personnel is a basis for estimating the costs for a collection vehicle. Liz Owens, Public Works Transportation, provided the hourly cost for a government vehicle. The fuel cost assumes approximately 3 gallons of gas per trip. This includes travel and idling fuel. The average fuel cost is assumed to be \$1.20/gallon.

(line 7) Wrapping material is used to prepare the waste paper for delivery to DRMO, Fort Ord. DRMO requires all recovered material to be palletized. J. Bolster estimates the cost of the wrapping material at less than \$100/year. To establish a conservative cost estimate, this analysis used \$100.

(lines 8 & 9) Costs for forklifts and storage trailers are not included because they are the same whichever program is chosen. The forklift to move material is present in the Excess Property Warehouse whether Supply uses it for recycling 1 hour a month or 10 hours a month. The thesis anticipates no additional forklift purchases due to the revised program.

(Line 10) Costs for transporting materials to Fort Ord include a vehicle and driver. Currently there are 2 trips per month with combined loads of excess property and waste paper. Each load includes approximately 6-8 pallets of paper. A truckload of paper contains 14 pallets. Therefore, 10 full

truckloads of paper per year are delivered to DRMO. The cost per trip is estimated assuming 2 hours per trip for a tractor and driver (WG-08). Two hours allows for driving and unloading time.

(line 11) Paper revenue for FY90 was \$948.17 [Ref.30].

(line 12) Avoided costs are estimated using the anticipated landfill rate of \$18.62 per ton. Calculations assume 22 tons of avoided materials, as estimated in the Solid Waste Annual Report FY90. [Ref.30] This 22 tons corresponds with the 10 trips identified in line 10. The pick-up cost is not recovered because no method currently exists to adjust the contract for reduced tonnages.

The net cost of the current disposal and recycling program for purposes of this thesis is \$81,789.58, as indicated on page 79. This figure should be used for comparison purposes only. Several items are the same in both programs and are not assigned costs.

B. NEW DISPOSAL AND RECYCLING PROGRAM COSTS - ANNUAL

Description	Quantity	Price per unit	Total Annual
Disposal costs (Public Works)			
1. Refuse Pickup	1,132 tons	\$36.23	\$41,012.36
2. Refuse Tipping Fees	1,132 tons	\$18.62	\$21,077.84
3. Collection of Refuse in Buildings			\$14,662.37
4. Transportation to Ft Ord	36 trips	\$45.25	\$1,629

Paper Collection Costs

Supply Department

5. Excess Property Coordinator	12 hr/mth x12mths	\$26.77	\$321.24
6. Storage Trailer	0	\$0	\$0
7. Forklifts	0	\$0	\$0

MWR

8. Collection Personnel (WG-04) ³⁰	21.66mh/wk x52wk/yr	\$15.42	\$17,367.85
9. Vehicle			
A. Usage.	19.5hr/wk x52wk/yr	\$.8	\$811.20
b. Fuel	364 gal	\$1.2	\$436.80
10. Director (GS-09)	40hr/mth x 12mth	\$19.69	\$9,451.20
11. Wrapping Material	1	\$125/yr	\$125
12. Container Replacement			

³⁰ WG-04 is used with a standard pick-up truck.

Desk top	500	\$.351	\$175.50
Copy Room 22.5 gal.	7	\$52	\$364
11 gal.	4	\$27.45	\$109.80
13. Decal Replacement	56	\$.5475	\$30.66
14. Poster Replacement	5	\$.35	\$1.75
15. Education Costs			
(director)	1	\$500	\$500
(handouts)	1,500	\$.06	\$90
16. Advertising Costs	1	\$150	\$150
17. Dumpster Rental	4/year	\$25	\$100

Revenue

18. Paper Sales			
High-grade	(tons) 54.9	(\$50)	(\$2,745)
Computer paper	(tons) 99.3	(\$10)	(\$993)
Low-grade	(tons) 12	(\$125)	(\$1,500)
19. Refuse Avoidance			
Revenue	(tons) 166.2	(\$18.62)	(\$3,094.64)
20. Disposal Avoidance			
Revenue	(tons) 166.2	(\$31.10)	(\$5,168.82)
21. Refuse Disposal			
Adjustment	12mth	(\$1,519.28)	(\$18,230)
New Revenue - paper collection\disposal costs			\$76,685.11
Net Revenue old program			\$81,789.58
Annual savings for new program			\$5,104.47

Description of terms

(lines 1 & 2) Refuse pick up and tipping fees are computed using the same costs as in the existing system. Tipping fees will continue to increase in the future. The effect of continued increases is discussed in Chapter VI.

The quantity of materials disposed of under the new program has been reduced due to anticipated refuse reduction efforts. Mandatory two-sided copying and reuse of materials will reduce waste. Similarly, the quantity of waste should decrease due to increased environmental awareness. This thesis conservatively estimates a 10 ton reduction due to these factors. Therefore, the net waste generated is assumed to be 1,132 tons.

(line 3) The janitorial contract needs to be modified to implement the new recycling program. The modifications include changing of all 5-day per week trash collections to 3-day per week refuse, 1-day per week high-grade paper and 1-day per week low-grade paper collection. This involves no additional effort by the janitorial personnel. Less effort is actually needed because paper will be left curbside and will not require transportation to the dumpsters. However, since this is minor in nature no credit is anticipated.

Increases in refuse collection are required in all buildings at Heritage Harbor and several other locations. Appendix E-1 shows the modified collection schedule. In addition, refuse container liner replacement in Herrmann Hall

was changed from daily to weekly, because trash will no longer be removed daily. Unless unsanitary, daily replacement is not necessary. This change will be implemented unless sanitary restrictions apply.³¹

(line 4) Excess Property Coordinator time will be reduced to 1-hour per month. This is the amount of time required to prepare the shipping paperwork and act as liaison between DRMO, Fort Ord and MWR.

(line 5) Costs for transportation to Fort Ord still include a vehicle and driver. The quantity of trips required is expected to increase to 3 per month. This is not proportional to the increase in paper, due to improved packing and consolidation. Time per trip remains 2 hours.

(lines 6 & 7) These costs are the same as the existing program. They are considered fixed costs.

(line 8) Collection personnel involves 1 wage-grade employee who performs recycling collection. This person will be dedicated to recycling 3-1/2 days per week. One day for high-grade paper, one day for low-grade. In addition, twice a month this person will collect computer paper on request. After collecting paper from buildings, this employee must separate it into boxes and prepare it for shipping. Boxes will be obtained from housing move-ins coordinated with the

³¹ This change should occur whether the new program is implemented or not. However, if not implemented it is unlikely that the \$533,000 contract will be modified.

Household Goods section of the Supply Department. The recovery of boxes is on an as needed basis. Monthly anticipated time required:

Collection- 4 min/container/wk ³² x 220 boxes =	14.66mh/wk
Box recovery	.5mh/wk
Sorting & securing paper	6.00mh/wk
collection of computer paper & securing	<u>.5mh/wk</u>
TOTAL	21.66mh/wk

This person is responsible for picking up only clean materials. They must leave contaminated paper and report all discrepancies to their supervisor. The supervisor resolves conflicts.

The pay rate that MWR is required to pay a laborer to perform this task is less than what is required by Civil Service. Different rules apply for employment using nonappropriated funds. However, for the sake of continuity and comparability this thesis uses the Civil Service wage required for a laborer to collect waste paper. Chapter 6 further analyzes this area.

(line 9) MWR provides the collection employee with a vehicle. During collection this vehicle is charged the same rate as in the existing program, .8/hr. The vehicle is used

³² Includes paper at door or loading dock. This is a simple pickup and loading onto collection vehicle. This time allotment allows for 7.33 hours a week to pick-up each type of paper.

for collecting paper and recovering boxes, approximately 19.5 hrs/week. Expected fuel use is 7 gallons per week.

(line 10) MWR must hire or assign a director to manage the white-paper recycling program.³³ This person answers questions regarding the program, organizes educational material, coordinates with Supply for delivery to Fort Ord, ensures adequate advertising and supervises the collector. This person is responsible for coordinating with Building Managers and Public Works to correct unacceptable disposal practices. This person also is the point of contact with MWR Headquarters. This person's objective is to decrease waste and increase recycling as a percentage of waste.

This job should take no longer than 20 hours per month. To ensure adequate commitment to the job, this person should be allotted 40 hours per month. This time will increase as the recycling program grows.

(line 11) Costs for wrapping material are expected to increase slightly for the new program. More material will be collected. However, using larger boxes for paper storage will reduce shrink-wrap use. Some pallets will be sufficiently stable to be taped together. The costs of \$125 is assigned to MWR in the revised program.

(line 12) Due to the composition of the small desk-top containers, approximately 40% of them will need to be replaced

³³ I recommend that the level of the director be no lower than a GS-09.

yearly. Thus, the average expected life is 5 years. The larger containers are much sturdier and are expected to last longer. Therefore, costs include replacing 4 of the 11 gallon containers per year and 7 of the larger containers per year. This equates to roughly a 10% replacement factor. This thesis uses prices obtained from Federal Supply Schedule Contractors for these containers. Sources are listed in Appendix E-2.

(lines 13 & 14) This cost assumes that 10% of the posters and 5% of all stickers will need to be replaced each year. Sticker replacement coincides with container replacement and posters will need to be replaced due to defacement. For purposes of these line items, assume all stickers are the same and cost \$.5475 each.

(line 15) Education costs involve training seminars for the program director and new employee/student orientation packages. Travel expenses should not exceed \$500 per year and orientation information purchased in bulk should not exceed \$.06 each, according to Lynda Yokogawa, Print Shop Manager.

(line 16) Advertising includes articles in the Classmate, the Quarterdeck and Coast Weekly. The costs of these items are included in the director's time. This program encourages the director to become an expert at manipulating free advertising. Using the available media to proclaim gains in recycling encourages further participation. Other free advertising includes articles on the CATV bulletin Board and Senior Officer attention to recycling at staff meetings.

Periodically, information booths may be set up during special events and distinct "reminders" can be mailed. The costs of manning this booth and these reminders should not exceed \$150/year.

(line 17) The current contract provided costs for dumpster rental. These costs are for a 1 week rental, 4 times per year. The cost for rental, collection and disposal of a 2 cubic yard dumpster averages \$40 per week if collected 3 times. Assuming the container averages 75 % full at each pick up this equates to .45 tons per week. At \$14 per ton this equals \$33 for collection and container rental. Since the majority of this cost is collection, less than \$ 20 per week would be the rental fee. This thesis more realistically uses \$25 per week.

(line 18) Market rates effective 31 August 1992 provide recovered paper prices. The sources used for these prices include Waste Age's Recycling Times, The Paper Stock Report, and Resource Recycling. Paper prices have been increasing for the past few months. This trend should continue as demand for recycled fibers continues to grow. These prices seem realistic.

The difficult part of this section was determining the expected quantity of recovered material. Research indicates that the school uses nearly 15 million sheets of white bond copier paper annually. This weighs approximately 71 tons. Other sources of paper include the Print Shop (52 tons), mail,

outside print companies, students and professors. In addition, the computer center purchases nearly 40 tons of computer paper per year. Information contained in University and College Solid Waste Reduction and Recycling [Ref.29] estimates that 15% of all waste from colleges and universities is high-grade/computer paper. It also estimates that 29% is low-grade recoverable paper. This equates to 171 tons and 331 tons, respectively. The estimate for high-grade/computer paper appears low. A more realistic estimate accounts for the following quantities:

52 tons - print shop

40 tons - brought in from outside

20 tons - misc and mail

40 tons - purchased computer paper

total 223 tons

Therefore, the estimated available tonnage of high-grade paper is $223 - 40 = 183$ tons, of low-grade/colored paper is 331 tons, and of computer paper is 40 tons.

Research indicates that a good recycling program will recover only 20% of the waste paper generated. This includes paper coffee cups and other unacceptable materials. Two key factors indicate that a higher percentage can be recovered at the Naval Postgraduate School. First, because it is at a military installation, a program endorsed by the Superintendent will be more readily adopted. Second, the existing program recovers nearly 5% with no advertising.

Combining advertising and command emphasis with making the program effortless by having janitors collect the material should allow recovery of nearly 30% of the waste paper generated.

High-grade paper	-- 183 tons x .3 = 54.9 tons
Low-grade/colored paper	-- 331 tons x .3 = 99.3 tons
Computer paper	-- 40 tons x .3 = 12 tons

(lines 19 & 20) Since recycled paper will not go in the landfill, this is a cost savings of \$18.62 per ton. This program also requires that refuse frequencies be studied and reduced accordingly. There are additional savings on disposal costs due to this re-evaluation. These savings are based solely on recycling.

(line 21) This study briefly looked at disposal frequencies. While many of the frequencies were appropriate, several were too high. These frequencies should be modified to more efficiently collect refuse.³⁴ The savings for this program and waste study data are reflected in Appendix E-3 and E-5.

³⁴ This change should be made whether the new program is accepted or not. However, past experience has shown that if the program is not accepted no changes will be made. The current contract frequencies will remain in effect.

C. START UP COSTS

The start-up costs of this program include purchasing all materials and initial training. These costs are estimated as follows:

Description	Quantity	Price	Total
Morale Welfare Recreation			
1. Purchase Containers			
Desk top	2,512	\$.351	\$881.71
Large container	145	\$52	\$7,540.00
Mid-size container	75	\$27.45	\$2,058.75
2. Purchase Pickup Cart	1	\$208.95	\$208.95
Containers	9	\$32.95	\$296.55
3. Stickers			
White paper only	240	\$.5475	\$131.40
Computer paper only	240	\$.5475	\$131.40
Mixed paper	240	\$.5475	\$131.40
Specialty stickers	400	\$.26	\$104
4. Posters	100	\$.35	\$35
5. Initial Advertising	1	\$75	\$75
6. Initial Education	4,000	\$.06	\$240
7. Wrapping Material -			
Initial purchase	1	\$100	\$100
8. Training for Director	1	\$500	\$500
Public Works			
9. Labor for contract	0	\$0	\$0
modifications			
Total Start-up Costs			\$12,164.26

Description of terms

(line 1) MWR must purchase desk-top, large and mid-sized, containers. Sources for these containers are listed in Appendix E-2.

The number of personnel employed by the school determines quantities of containers required by the new program. Each non-wage grade employee, each officer attached as staff, and 50% of the enlisted personnel attached as staff will receive two containers, one for white paper and one for colored.

Civilian employees not WG	-	1118	
Officers	-	94	
Enlisted	-	<u>44</u>	
		1250	people x 2 containers
		2512	total containers

Large containers shall be positioned next to copy machines. This places containers near the largest paper generators. Frequently, copiers are near or in mail rooms. These areas provide an excellent source for low-grade paper. Therefore, a second container for low-grade paper will be located by the copiers. There are 69 copiers in use at the Naval Postgraduate School. The locations are listed on Appendix E-4. This translates to 138 containers. Chapter 2 recommends purchasing an additional 5% of the large containers. This makes the total purchase 145 containers. Buildings without copiers receive mid-size (11 gallon) containers. Appendix E-4 also lists mid-size container

locations. The revised program requires 75 mid-sized containers. Buildings that serve as computer centers box their paper. They do not receive containers. Similarly, some facilities do not get containers because they produce too little paper.

(line 2) The paper collector will use a pushcart with 26-gallon containers for accumulating paper. The truck will carry approximately 11 containers for collection. The price source for these containers is contained in Appendix E-2.

(line 3) The new program requires purchasing recycling stickers to specify where to dispose of materials. Stickers identifying white paper, mixed paper and computer paper will be displayed both on and near recycling containers. Specialty stickers containing an NPS recycling logo will also be included on containers and in other prominent, acceptable locations. Identifying labels come in orders of 120. Specialty stickers do not have this restriction. The revised program will purchase 240 each of the white paper, mixed paper and computer paper labels, and 400 specialty labels.

(line 4) Awareness posters identifying recyclable materials will be placed throughout campus. Lynda Yokogawa of the print shop estimates the costs of these posters at \$.35 each.³⁵ This program requires displaying no more than 100 posters.

³⁵ Purchased in batches of 100.

(line 5) As described in the Annual Costs Notes, the Director shall maximize the use of free advertising. Articles explaining the new program with expected gains should be welcomed by local publications. The only item required is a display board explaining recycling and its virtues. This board can be made out of plexiglass, plywood and hinges, by Public Works or Self-Help at a cost of less than \$75.

(line 6) Initial education consists of a newsletter type handout promoting conservation, waste reduction and recycling. It should start with a memo from the Superintendent on why recycling is important. It should describe all existing programs and explain the new program and organization. It should also provide names and phone numbers of appropriate key personnel. Finally, the handout should contain explicit instructions on what materials are recyclable. If possible, a calendar identifying collection days can be included. Extra handouts should be published. Handouts will be delivered to all students and employees of NPS. The estimated costs of these handouts is \$.06 each, and approximately 4000 should be printed.

(line 7) MWR must purchase wrapping material for palletizing collected paper. According to Mr. J. Bolster, Supply Department, \$100 covers this purchase.

(line 8) MWR must provide initial training for its recycling director. This training costs no more than \$500. A one-week course or seminar is sufficient to initiate the

program. The cost of the directors time for this training is included in the yearly time spent for managing this program. Recycling requires yearly supplementary training.

(line 9) Labor for contract modifications is incurred by Public Works employees. This thesis considers this cost fixed. No additional money must be paid due to the modification. The Public Works employees would be paid the same whether or not the program is implemented.

D. CONCLUSION

Since the cost of the revised program (\$76,685.11) is lower than the cost for the existing program (\$81,789.58), the revised program appears to be cost effective on a yearly basis. Some potential problems do exist with the results. Chapter 6, discusses uncertainties in some of the estimated values. It provides a slightly more detailed analysis of some of the values and evaluates the or potential problem areas.

VI. THEORETICAL ANALYSIS

A. INTRODUCTION

Chapter V discussed the costs and benefits from the proposed recycling program. This chapter builds on and explains information presented in that chapter. It provides additional detail on why certain values were used and provides insight on their reliability. Areas discussed in this chapter include: tonnage estimates of both recyclables and refuse, future improvements to the recycling program because of learning curve effects and landfill fee increases, a proposal for program management by Public Works and an evaluation of payback period for the Public Works operated program.

The issues mentioned in the preceding paragraph are the most critical and/or controversial cost areas. These points are central to the decision-making process for expanding the recycling program.

B. TONNAGES

1. Refuse

This thesis derived refuse tonnages using generic equations for similar university settings. This value was confirmed by subtracting the expected housing tonnage from the estimated total weight contained in the FY90 Solid Waste Annual Report. The value of refuse was therefore obtained and

confirmed using standard equations and supported by estimates made by subject matter experts.

This research discovered that the Naval Postgraduate School estimated tonnage in the Solid Waste Annual Report by totaling the maximum volume of all dumpsters collected per year and converting this volume to a weight. This assumes that all dumpsters are 100% full at the time of pickup. Appendix E-3 shows that frequently this is not the case.

The value of 1,142 tons per year should be further evaluated to provide more reliable refuse amounts. This could be accomplished by weighing the refuse removed from the school. The contractor would be required to weigh their vehicles prior to arriving on base, proceed directly to the landfill upon completing collection and provide a weight slip from the landfill.³⁶ This should be done until sufficient data is collected to generate statistically significant results. The data could then be extrapolated to find a tonnage figure for the entire year. Unfortunately, on-base housing would require separate collections for measurement purposes.

This study would provide a degree of detail far superior to what is currently available, but is beyond the scope of this thesis. A study such as this should be welcomed by Public Works for use in evaluating future contract

³⁶ The requirement to weigh the trucks upon entry is due to the fact the trucks routinely collect from other customers prior to arriving at the school.

modifications. In addition, a waste-content assessment would be useful. This would involve evaluating samples of base refuse. This provides a weight conversion factor as well as a potential recovery evaluation. The recycling coordinator would be able to identify other potential income sources using this data.

2. Recyclables

The waste assessment proposed in the previous paragraph provides a better definition of the contents of the waste stream at the Naval Postgraduate School. From the brief evaluation presented in Appendix E-3, it is obvious that large quantities of paper and cardboard are in the waste stream. Removing these items will significantly reduce required disposal.

The only remaining uncertainty is whether additional recyclable materials are present in significant quantities. Thus, the quantities of cardboard and paper estimated in Chapter V are probably conservative estimates of recoverable materials. Removal of 80% of the available cardboard from the waste stream could save up to 93 tons [Ref.29]. This value could go even higher if the quantities of cardboard observed in data collection, Appendix E-3, are verified.

C. FUTURE PERIODS

1. Learning Curves

Gains in recycling will be seen in future periods due to learning curve effects. Collection personnel will become more adept at handling recyclable material as will employees. As time progresses, the percent of materials recovered will grow. The drop in collection time and increase in collection quantity will make the recycling program more profitable.

2. Cost Increases

In the next 5 years, landfill disposal costs can be expected to increase annually up to 30%. Costs will increase to offset increased costs for running the landfill. They will also increase to more accurately reflect the opportunity cost of declining landfill capacity. These increases improve the profitability of the new recycling program by \$929 in year 1; another \$1,207 in year 2; \$1,570 in year 3; \$2,041 in year 4 and \$2,653 in year 5. This equates to an additional undiscounted savings of \$8,400 over 5 years. Currently, costs are so low that there is little incentive to recycle. Why recycle at \$ 100 per ton when you can landfill at \$ 30 per ton. As costs increase, the more valuable items, or items which recycle easiest, will be removed from the waste stream.

D. PUBLIC WORKS MANAGEMENT

An analysis of the data presented in Chapter 5 shows that there is an improper allocation of costs and benefits. Specifically, Public Works saves an estimated \$26,704.15,³⁷ Supply saves \$3,824.25,³⁸ and MWR incurs an additional costs of \$25,423.93.³⁹ In total, there is a net savings of \$5,104.43 per year with the program.

The plan must be revised to more equally distribute the benefits and costs. This will provide a greater incentive for each part of the command to participate. If Public Works provides the WG-04 collection personnel and vehicle and the GS-09 Recycling Director, Supply provides the wrapping materials and MWR supplies all other materials, pays for education and advertising and receives the revenues, the costs and savings are then distributed more equitably.

This way Public Works incurs additional costs of \$1,362.90,⁴⁰ Supply saves \$3,699.25⁴¹ and MWR receives an additional \$2,768.12⁴². The additional cost incurred by

³⁷Original cost \$78,592.26, new cost \$51,085.11.

³⁸Original cost \$4,145.49, new cost \$321.24.

³⁹Original cost \$(938.17), new cost \$24,475.76.

⁴⁰Original cost \$78,592.26. new cost \$79,955.16.

⁴¹Original cost \$4,145.49, new cost \$446.24.

⁴²Original cost \$(948.17), new cost \$(3,716.29).

Public Works will be saved over time by improved performance of collection personnel or additional contract reductions.

There are several unresolved issues. First, OPNAV 5090.1A requires that recycling costs be recovered from the proceeds. Only if the cost savings are considered proceeds will compliance be achieved. Second, cooperation for material replacement and educational funding must occur between Public Works and MWR. Without cooperation, failure of the program is likely. Commitment and attention by senior management can help overcome this second obstacle.

Another concern is that Public Works assumes a new task by collecting paper. This can be overcome by requiring the janitorial contractor to collect and box all paper. This eliminates the requirement for government collection personnel. The rate for a janitor required by the contract is \$6.90 per hour. Even if overhead and profit costs double this rate to \$13.80, it is lower than the \$15.42 paid a government worker. Assuming the vehicle cost would be the same and would be added to the contract, a minimum savings of \$1.62 per hour x 52 weeks x 21.66 man-hours or \$1,824.64 would result. This eliminates the earlier estimated additional cost to Public Works and provides them a net savings for the year. This also increases the yearly savings due to this program by \$1,824.64 to \$6,929.11.

E. PAYBACK PERIOD

If the program is enacted as recommended in Section D above, the discounted payback period for the initial investment by MWR is 6.07 years. This reflects a 10% Cost of Capital as recommended by NAVFAC P-442 Economic Analysis Hand Book [Ref.31].

$$\$12,164.26 = \$2,768.12 \times ((1-(1+r)^{-n})/r)$$

$$r = .1 \text{ (10 \%)}$$

$$n = 6.07 \text{ years}$$

As mentioned in previous chapters, several methods of funding are available for the start-up costs.

F. CONCLUSION

This chapter discussed several problems with the proposed recycling program. It also showed methods to overcome these problems. As shown in Section D, it is important to give each command component an incentive to adopt this program. Not only did changes to the new program make it more politically acceptable, it made it more cost effective. The only drawback is that having the contractor package the paper entrusts the contractor with the cleanliness of the paper, and thus potential revenues.

Chapter VII provides conclusions to the thesis, makes recommendations, and identifies areas for further research.

VII. CONCLUSION

We don't inherit the earth from our ancestors, we borrow it from our children.

-- Theodore Roosevelt

The quotation identified above best illustrates this thesis's intention. Numerous directives and regulations mandate recycling. There are also many ways around these regulations. Clauses in directives frequently exempt commands from compliance where it can be proven not to be "economically efficient."

This thesis draws on the overall importance to increase recycling based on both demand by higher authority and the desire of the Navy to be environmentally responsible. It is an opportunity for the Navy to do something for the local community. The local community is significantly impacted as landfills close.

This chapter reviews the need for recycling at the Naval Postgraduate School. It mentions why recycling fails to catch on in communities across the country. It briefly discusses what is being done around the country and in the government to ease the solid waste disposal "crisis" and promote waste paper recycling.

The chapter proposes an answer to the research question identified in Chapter I: is it economically efficient to replace the existing office paper recycling program at the Naval Postgraduate School? This chapter also makes recommendations for other facility management changes. Finally, the chapter identifies areas for future research.

A. WHY RECYCLE?

The U.S. Environmental Protection Agency Report, "Characterization of Municipal Solid Waste in the United States; 1992 Update" estimated that over 51.9 million tons/year of waste will need to be recovered in order to meet the goal of 25% Solid Waste recovery by 1995. A more demanding goal of 35% has been set for the year 2000. To do this the U.S. must recover:

- 12% of all plastics
- 40% of all glass
- 40% of all metal
- 64% of all yard waste
- 50% of all paper

Figure 6 shows the Navy's waste recovery in Fiscal Year 1990. This indicates the Navy's need to improve its disposal practices if it intends to meet the goals set by the EPA.

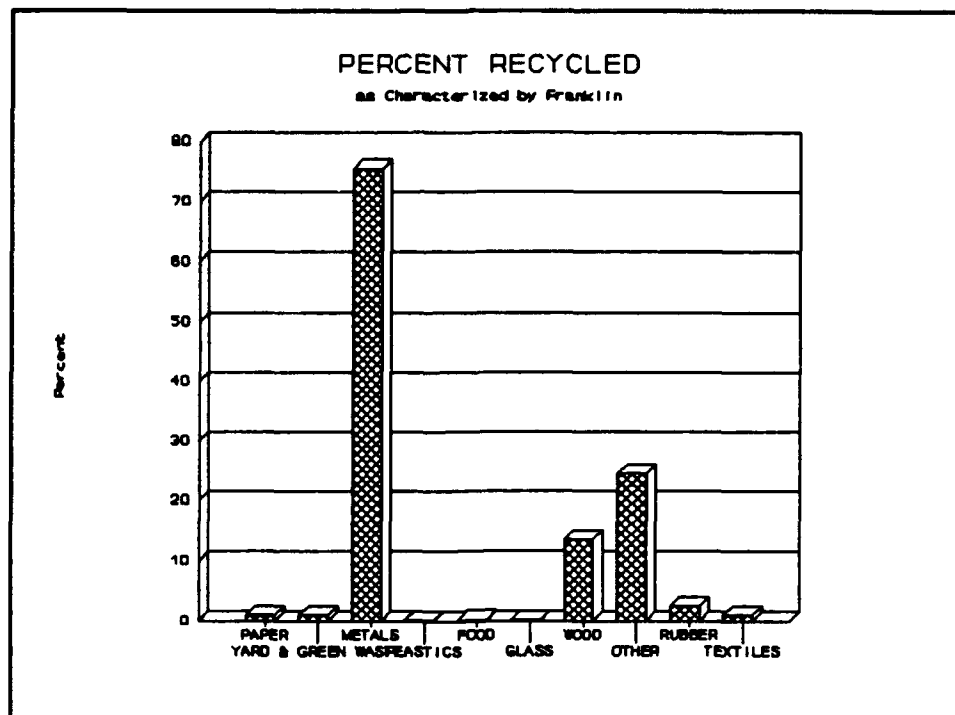


Figure 6 SWAR FY90 - Based on EPA Municipal Average, 1988

Americans as a whole have significantly changed their disposal habits. Between 1980 and 1990, waste generation grew by 2.8% per year. Between 1990 and 2000 the growth rate is expected to be 1.3% per year. This is an improvement but waste generation continues to climb. The EPA estimates that 80% of all landfills open today will be closed by the year 2008 [Ref.2]. Siting new landfills is exceedingly difficult and is often cost prohibitive. The Navy has similar problems with their disposal. Figure 7 shows expected remaining landfill capacities for Naval facilities.

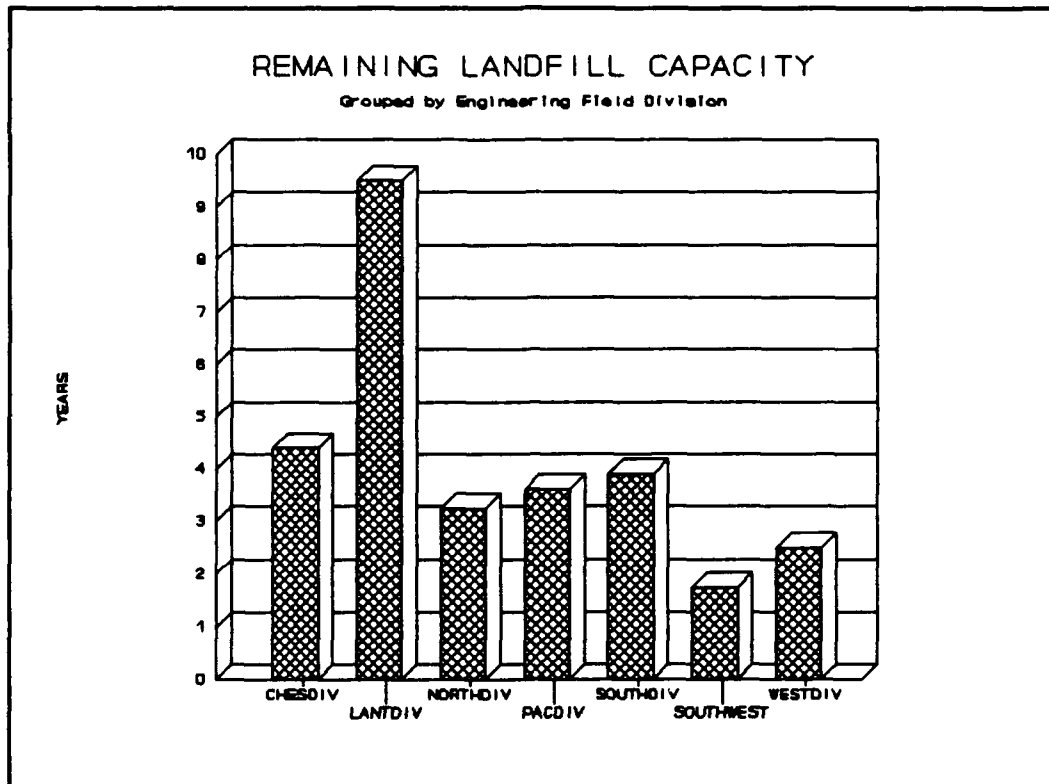


Figure 7 Source: NEESA - Solid Waste Annual Report FY90

With the exception of LANTDIV no Engineering Field Division has more than 4 1/2 years of capacity remaining. Two courses of action are available, to expand capacity and/or to reduce waste.

In addition to conserving landfill space, increased recycling improves the environment. For each ton of recycled paper, 17 trees, 3 cubic yards of landfill space, 60 pounds of air pollution, 7000 gallons of water and 4100 KWH of energy are saved. [Ref.32] Other startling facts include:

- High-grade printing, copying and writing paper is the single largest component in a landfill making up nearly 15% of landfill waste.
- The current paper recycling rate is 35% lower today than it was 40 years ago.
- Only 6% of office, computing, printing and magazine paper is recycled in the United States.
- More paper will go into landfills in 1995 than today even if the paper industry meets its target of 40% paper recycling.

-[Ref.32]-

Increased paper recycling may also make sense due to rising landfill fees. Landfill fees are escalating, reflecting economic realities of declining capacity. At the same time, base operating budgets are contracting. Better waste management is becoming a critical concern for all Commanding Officers. A \$10/ton increase in waste disposal translates to a nearly \$20,000 increase in the cost of maintaining the Naval Postgraduate School. Currently the Naval Postgraduate School pays only \$14/ton in tipping fees. Other Navy facilities pay in excess of \$135 to \$180 per ton [Ref.6].

The final reason for recycling is that directives have mandated it. The President has ordered federal facilities to comply with local regulations and local regulations mandate solid waste reduction. Similarly, DOD Inst. 5090.1A of October 1990, Chapter 10-5.3, requires a solid waste recycling plan. This facility does not currently have a plan. This was

identified in an Environmental Compliance Evaluation prepared by the WESTDIV Commanding Officer on 22 Jan 92. This evaluation also encouraged the base to expand its Solid Waste Recycling Program and to increase recycling awareness. Public Works is in the process of establishing a Solid Waste Disposal Plan and the recommendations in this thesis go a long way toward improving waste paper recycling.

B. POTENTIAL PROBLEMS

Recycling is beset by numerous problems. The primary problem is that high start-up costs are not countered by short-term results. In addition, recycling programs are generally deemed expendable by senior management when budgets contract. City after city has canceled or delayed their recycling programs due to recent budget cuts. Therefore, recycling must be self-sufficient and the initial investment risk must be minimized.

A final problem with many recycling programs involves inadequate public education. This is the case with the existing paper recycling program at the Naval Postgraduate School. Because the customers do not understand how and what to recycle, they throw many reusable items in the trash.

C. WHAT IS BEING DONE?

1. Around the Nation

Many ambitious recycling programs have been established throughout the Nation. Many colleges have started recycling programs. Rutgers University in New Jersey and the University of Minnesota have two of the most successful programs, respectively avoiding 2,460 and 2,555 tons of refuse each year. These programs recover paper, oil, yard waste, food waste, metal, batteries, pallets and numerous other items. They serve as examples for other universities and show what any military base is capable of recovering.

Other ambitious programs are being undertaken by several states. Rhode Island has recently banned incinerators and set a recovery goal of 70%. California has a goal of 50%. Other state governments have set similar goals.

2. Government

As previously mentioned, the federal government has adopted numerous initiatives to increase recycling. From Executive Orders to Federal Mandates, the government encourages recycling. Federal regulations require states to purchase recycled products if using federal funds. In 1990, the National Recycling Coalition received a grant from the EPA to establish the Resource Advisory Council to address recycling issues. They have issued recommendations on labeling recycled products. This could help build a demand

for recycled materials. If consumers develop a preference for products manufactured from post-consumer waste, recycling will be more attractive.

The government is making initiatives to purchase products made from recycled materials. The Naval Postgraduate School purchases paper products, toner cartridges, motor oil and auto batteries made from recycled materials. The school has also taken action to establish a Solid Waste Management Plan and Qualified Recycling Program. These items should be completed by 30 March 1993. This thesis has found, however, that every day of delay in revising the current disposal practices wastes money. This money could be used by Public Works, Supply and Morale, Welfare and Recreation.

D. RECOMMENDATIONS

The research question on whether it is economically efficient to replace the existing office paper recycling program was answered affirmatively in Chapters V and VI. Savings could be realized by all departments by implementing the proposed program. These savings result because it is cheaper to recycle than to not recycle, regardless of outside regulations.

1. The Program

This program hinges on the fact that each affected department must benefit to get their support. The current recycling program is completely funded by the Supply

Department and benefits MWR. No wonder the program is not seriously advertised or "pushed." Why should Supply make this program work? What is in it for them? Similarly, MWR makes money no matter how little effort they devote. They will exert minimal effort, and in the case of paper, zero effort.

With the current program, revenues to MWR will increase slightly if they advertise. Assume advertising improves the current program by 50%. Revenues would improve by $11 \text{ tons} \times \$43/\text{ton} = \$473$. The cost of the advertising includes a coordinator's time, approximately 30 hours/year at GS-09 which equals \$803.10, plus the cost of the advertising board, \$75. The total cost is \$878.10 for \$473 benefit. It is not cost beneficial for MWR to act alone in improving the recycling program. However, the new program has something for everyone.

The cost/benefit analysis in Chapter V showed that the revised recycling program proposed in Chapter III is economically more efficient than the existing waste paper recycling program. Chapter VI identified potential changes/additions to this program to make it more feasible and politically acceptable. As mentioned earlier, a problem with the existing system involves motivation and an unequal distribution of costs and benefits. By revising the recycling program as shown in Chapter III, and implementing it per Chapter VI, each affected division benefits.

In the new program, MWR acts as the financier, they incur the burden of fronting the material and operating costs. They, however, recover all revenues from recycling. MWR has the highest risk under this program. If markets for recovered material slump or participation falters, they lose revenues.

Public Works saves money under this revised program by reducing contract costs considerably. They have an incentive to maximize recycling to minimize disposal costs. If a 50% reduction in volume can be accomplished, Public Works can reduce the refuse contract accordingly. As contract costs rise, this becomes a larger incentive.

The Supply Department gains through this program by essentially getting out of the paper recycling business.

a. Additional Changes

This thesis further recommends recovering cardboard from the waste stream. A portable compactor can be contracted to collect the material. Each facility will be responsible for transporting cardboard to this facility. The avoided landfill fees and solid waste contract reductions are far in excess of the cardboard collection and removal costs. At the current time, cardboard is not cost effective as a recyclable material. It brings between \$-5 and \$10 per ton on the market. This may change. If it does, this program provides a clean source of cardboard. This program can save an estimated

\$4,624 per year.⁴³ Adding cardboard recycling complies with research asserting that the only good recycling program is a full recycling program. If cardboard is recycled, the base would recycle paper, cardboard, cans, newspapers and other reusable materials.

Keeping in line with the complete recycling program concept, it is recommended that Public Works sort their mixed debris dumpster. This dumpster contains concrete, landscaping waste and miscellaneous other materials. A study can be performed to investigate the feasibility of establishing a compost pile. This compost facility would further reduce the solid waste stream and provide a rich source of landscaping material. Furthermore, if broken concrete is sorted and hauled separately to the Marina landfill, there is no disposal charge. This further reduces disposal costs.

Another area to be addressed involves source reduction. One third of the environmental challenge is recycling, another third is reuse and the final third is reduction. A significant impact on the waste stream can be made by eliminating waste before it even comes on the Naval Postgraduate School property. If determined to be cost effective, the following areas should be considered:

- Mandatory two-sided copying (over 15 million sheets of paper used in FY92).

⁴³ 93 tons x (\$18.62 (Landfill avoided costs) + \$31.10 (avoided collection costs)) = \$ 4,624

- Reduce junk mail sent to the school.
- Reduce junk mail generated on campus.
- Avoid purchases of disposables. (eg. kitchens, offices, etc.)
- Reuse boxes, envelopes and packing materials.

E. AREAS OF FUTURE RESEARCH

As mentioned in the previous section, recycling is just one of three areas that must be addressed at the Naval Postgraduate School. Future research should review procurement practices to ensure that the Navy and the school are procuring recycled items where doing so is efficient. Care must be taken to ensure that additional costs for these items do not exceed their added benefit. Recycled products from outdoor furniture to "post it" pads are available and must be procured wherever doing so is efficient. The Military can "jump start" the market by demanding items be made from recycled materials. This would provide incentives for developing additional recycled products.

Another area for study would involve the social costs of reducing solid waste. Landfills that reach their capacity drive up costs and create future disposal problems. Conservation reduces groundwater contamination and carbon dioxide production.

Finally, other environmental areas at the Naval Postgraduate School should be explored, such as energy

conservation. This analysis would turn up numerous areas for savings.

This thesis should help revise the way the Navy and Naval Postgraduate School think about waste paper recycling. Incremental savings can be made by acting environmentally more responsibly. As budgets tighten and resources shrink, it would be inappropriate not to reduce waste to its most economically efficient level or not to increase it to its most economically efficient level.

APPENDIX A -- ACRONYMS

CATV	Controlled Access Television
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CNO	Chief of Naval Operations
COMNAVMILPERSCOM	Commander Naval Military Personnel Command
COMNAVSUPSYSCOM	Commander Naval Supply Systems Command
CPO	Computer Printout (non-laser printer)
CSIP	Component Sponsored Investment Program
CY	Cubic Yard
DBOF	Defense Business Operating Fund
DOD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
DRMR	Defense Reutilization and Marketing Region
DRMS	Defense Reutilization and Marketing Service
EFD	Engineering Field Division
EPA	Environmental Protection Agency
FASCAP	Fast Payback Capital Investment Fund
FY	Fiscal Year

GAO	General Accounting Office
GSA	General Services Administration
HWAR	Hazardous Waste Annual Report
MILCON	Military Construction
MO-213	NAVFAC Solid Waste Management Manual
MWR	Morale, Welfare and Recreation
NAVPGSCOL	Naval Postgraduate School
NAVFAC	Naval Facilities Engineering Command
NEESA	Naval Energy & Environmental Support Activity
NIMBY	Not In My Back Yard
NPS	Naval Postgraduate School Monterey
O&M	Operations and Maintenance
OCNR	Office of Chief of Naval Research
OMB	Office of Management and Budget
OPN	Other Procurement Navy
OPNAVINST	Chief of Naval Operations Instruction
PCR	Pollution Control Report
PIF	Productivity Investment Funds
POC	Point of Contact
PWC	Public Works Center
PWD	Public Works Department
PWO	Public Works Officer
QRP	Qualified Recycling Program
RCRA	Resource Conservation & Recovery Act
SWAR	Solid Waste Annual Report

SWMP	Solid Waste Management Plan
TQM/TQL	Total Quality Management/Total Quality Leadership
UIC	Unit Identification Code

APPENDIX B --GLOSSARY

Activity -- An independent Navy or Marine Corps. command performing a specific mission. Each activity has their own UIC.

Code of Federal Regulations (CFR) -- A written set of regulations which are used to implement laws such as the Resource Conservation and Recovery Act (RCRA).

Commercial Solid Waste -- See post-consumer waste.

Commingled -- The mixing of various types of materials for a single collection.

Composting -- The controlled biological decomposition of organic solid waste under aerobic (in the presence of oxygen) conditions. The transformation of organic waste materials into soil amendments such as humus or mulch.

De-inking Process -- A process by which inks and contaminants are removed from existing paper. The traditional method of de-inking has involved the use of chlorine bleach. This process however produces dioxins which, in 1985, were reported to cause cancer in rats. Modern processes use Hydrogen peroxide in the bleaching process.

Economic Analysis -- (1) "pre-expenditure" analyses designed to assist a decision-maker in early identification of the best new project/program to adopt; (2) a systematic approach to the problem of choosing how to employ scarce resources to achieve a given objective in an efficient and effective manner.

Facility -- Building and structures located on a Navy or Marine Corps installation.

Gross Discards -- Total quantity of all solid waste generated.

High-Grade Paper -- Includes letterhead, dry copy papers, miscellaneous business forms, stationery, typing paper, tablet sheets and computer printout paper and cards, commonly sold as "white ledger", "computer printout" and "tab card" grade by the waste paper industry. Consistent with EPA guidelines, high-grade paper is included within commercial solid waste category.

Installation -- A Navy or Marine Corps base of operators composed of a number of Navy or Marine Corps activities, units and commands, located on the property of the host activity. An installation is an activity that has several tenant activity. The installation is normally surrounded by a fence.

Integrated Waste Management System -- the complementary use of source reduction, recycling, incineration and landfilling to comprehensively manage garbage. Also known as Integrated Solid Waste Management.

Landfill -- See Sanitary Landfill.

Life-Cycle Costs -- the total to the government of acquisition and ownership of an alternative over its full useful life.

NAVFAC MO-213 Solid Waste Management -- This publication is a tri-service solid waste management planning guide for Defense Department personnel who are responsible for non-hazardous waste disposal.

Net Discards -- Gross discards minus the quantity of material recovered through recycling.

Non-paper material -- binderclips, paper fasteners, etc.

Office Waste -- Solid waste generated in the buildings, room or series of rooms in which the affairs of a business, professional person, branch of government, etc., are carried on; excludes waste generated in cafeterias, snack bars, or other food preparation and sales activities.

OPNAVINST 5090.1A -- Chief of Naval Operations Instruction Manual for the Navy Environmental Program entitles "Environmental and Natural Resources Program Manual."

Post-Consumer Waste -- All types of solid waste generated by stores, offices, clubs, cafeterias, mess halls, households and other such non-manufacturing activities, and waste generated at industrial facilities such as office and packing waste.

Present Value -- the present worth of past or future benefits or costs determined by applying discount procedures to make alternatives comparable regardless of time differences in the money flows.

Qualified Recycling Program -- An organized recycling operation in which an installation may receive up to 100% of the proceeds from recyclable materials if specific criteria are met.

Recycling -- A resource recovery method involving the collection and treatment of a waste product for use as a raw material in the manufacture of the same or another product (e.g. ground glass used in the manufacture of new glass).

Resource Recovery -- A term describing the extraction and utilization of materials that are used as raw materials in the manufacture of new products, or the conversion into some form of fuel or energy source. An integrated resource recovery program may include recycling, waste-to-energy, composting and/or other components.

Sanitary Landfill -- Land waste disposal site that is located to minimize water pollution from a wall and leaching. Waste is spread in thin layers, compacted and covered with a fresh layer of soil each day to minimize pests, disease and air pollution.

Sensitivity Analysis -- a procedure employed to test the degree of uncertainty in cost estimates, which might cause the second best alternative to become recommended. The procedure is to evaluate the high/low ranges of input values and examine the extent these changes could flip the ranking of alternatives in the analysis.

Shrink-Wrapped -- Shrink-wrapping is a method of securing goods for transport. An elastic material encases the goods which adds stability and prevents separation.

Sludge -- The precipitate in a sewage tank

Solid Waste -- (1)As defined in RCRA regulations (40 CFR part 1) "garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and others discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities..."

(2)As defined in OPNAVINST 5090.1A "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. It does not include solid or dissolved materials in domestic sewage, solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to National Pollution Discharge Elimination System (NPDEA) permitted under the Clean Water Act or Source, 1954.

(3)Solid waste does not include medical waste.

Source Reduction -- Reducing, at the point of production, the volume or toxicity of material used before the products are purchased, used or discarded. This includes reuse of materials, items, or products prior to recycling and extension of shelf life.

Source Separation -- The separation of recyclable materials at their point of generation by the generator.

Tipping Fees -- Fees charged by disposal facilities. Usually on a per ton or per cubic yard basis.

Waste Office Paper -- Letterhead, dry copy papers, miscellaneous business forms, stationary, typing paper, tablet sheets, and computer printout and cards. Classified wastes are explicitly excluded, except as applicable. Security directive allows their inclusion.

White-coated appliances -- Refrigerators, washing machines, dryers, dishwashers, et al. Not limited to those which are the color white.

APPENDIX C --REGULATIONS

PL 89-222, Solid Waste Disposal Act

PL 97-214, 01 Oct 82, Military Construction Codification Act

PL 98-215, Resource Conservation and Recovery Act (RCRA)

DOD Directive 4165.60, 04 Oct 76, Solid Waste Management
-Collection, Disposal, Resource Recovery and Recycle Program

Deputy Sec Def Memorandum, 28 Jan 83, "Sales of Recyclable
Materials" (10 U.S.C. 2577)

NEESA 5-010A , April 91, Qualified Recycling Program (QRP)
Development Guide

DRMS Directive 4160.5, 21 Sept 88, Recyclable Material Sales
Program

OPNAVINST 7020.6, 29 Nov 74, Trash and Waste Material
Recycling

NAVCOMPTINST 7020.18, 19 Oct 74, Trash and Waste Material Recycling

BUPERSINST 1710.11A, Nov 85, Navy Recreational Operational Policy

NAVFACINST 5600.14, 19 Oct 76, Use of Paper, Reduction of

MWR Desktop reference, Sept 89, "Trash To Cash" Navy Resource, Recovery and Recycling Program (RRRP)

DOD Directive 7310.1, 10 July 89, Disposition of Proceeds from DoD Sales of Surplus Personal Property

OPNAVINST 5090.1A, 02 Oct 90, Environmental and Natural Resources Program Manual

40 CFR 250 -- EPA Guidelines for federal Procurement of Paper & Paper Products Containing Recovered Materials

OCNINST 5090.1, 23 Dec 86, Assignment of Responsibility for Environmental Protection and Enhancement Program OCNR

SECNAVINST 6240.6E, 06 Mar 80, Department of the Navy Environmental Protection and Natural Resources Management Program; Assignment of Responsibility for

NAVFACINST 5090.1, 21 Jun 83, Environmental
Protection/Engineering Program Ashore, Engineering Field
Division (EFD) Responsibilities for

SECNAVINST 7000.23A, 13 Feb 86, Funding of Morale, Welfare,
and Recreation (MWR) Programs

APPENDIX D FORMS & DOCUMENTS

1. Sample scrap paper turn-in document
2. Monterey Regional Waste Management District Disposal Fee Schedule, effective 01 Jan 92
3. Sample Recycling Handout
4. Naval Postgraduate School Map

EXCESS PROPERTY NOTIFICATION MEMO

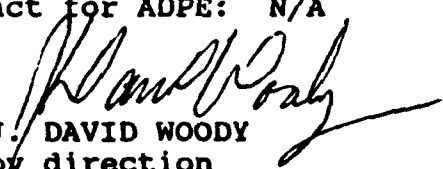
Date: 6 November 92

From: Chairman, Dept of Meteorology (Code MR/Dw)
To: Supply Officer (Code 4215)

Subj: EXCESS PLANT/ADPE/MINOR PROPERTY NOTIFICATION

1. Property is excess to this department and available for redistribution. Material may be screened and inspected at location indicated:

- a. Property Name/Nomenclature: Scrap paper
- b. NSN/Part #
- c. Plant Account Number(s): 62271-
- d. Minor Account Number(s):
- e. Location: ROOM 116, 121B and 222 BLDG 235
- f. Detailed item nomenclature with related capabilities, characteristics, and special instructions:
- g. Manufacturer: Model:
Serial Number:
- i. Quantity: 16 boxes Original cost per item:\$
(If unknown, estimated cost is acceptable)
- j. Current Condition code for non-ADPE: If code F, explain problem briefly in block f.
(Refer to Supply Customer Service Manual Chap 2)
- k. Current Condition code ADPE:
(Refer to Supply Customer Service Manual, Chap 2)
- l. Security Classification: Unclassified
- m. Point of Contact: David Woody, X-2647
- n. Holder of service contract for ADPE: N/A


J. DAVID WOODY
by direction

File: C:\WP51\SUPPLY\EXCSS-B

Monterey Regional
Waste Management District
PO Box 609
Marina, CA 93931-0609

DISPOSAL FEE SCHEDULE
(REVISED 01/01/92)
Hours: Mon-Fri 6:30-5:00
Sat 8:00-4:30

Marina Disposal Site:
14201 Del Monte Boulevard
2 mi. north of Marina
Phone: (408) 384-5313

TYPE OF MATERIAL	IN-DISTRICT	OUT-DISTRICT
A. SOLID WASTE (Basic Rate)		
Minimum Charge (up to 720 lbs)	\$ 5.00	\$ 7.50
Rate Per Ton	14.00	21.00
B. GREASE TRAP PUMPINGS & OTHER LIQUID WASTE		
Minimum Charge (up to 620 lbs)	\$ 14.00	\$ 21.00
Rate Per Ton	18.00	27.00
C. WOOD WASTE		
CLEAN WOOD WASTE	\$ 5.00/load	\$ 7.50/load
(Does not include materials unsuitable for chipping, such as ice plant, palm stalks and fronds, weeds, grass, pine needles, leaves, treated wood, or logs and beams exceeding 1' diameter or 6' in length)		
STUMPS		
(Stumps in excess of 1' diameter at the base or 2' at the rootball will be charged these fees per stump in addition to the basic solid waste rate)		
For each additional 1' add.....	\$ 5.00	\$ 7.50
D. PROBLEM WASTE		
TIRES		
Per Ton Rate (for loads of tires only \$37.50 minimum for up to 500 pounds)	\$150.00	\$225.00
Per Tire Rate		
Minimum Charge	5.00	7.50
Less than 36"	1.50	2.25
36" - 48"	4.50	6.75
48" - 60"	10.50	15.75
Over 60"	21.00	31.50
LARGE FURNITURE AND REFRIGERATORS		
(Add to Basic Rate, Per Item)	\$ 2.50	\$ 3.75
OTHER PROBLEM WASTES		
(Any waste requiring special handling such as loose paper, foam, plastics, rebar and pipe bearing demolition)		
Minimum Charge (up to 620 lbs)	\$ 14.00	\$21.00
Rate Per Ton	23.50	35.25
E. UNCOVERED LOADS MAY BE CHARGED DOUBLE		
F. FREE LOADS		
(Clean separated loads of paper, glass, metal, cardboard, mattresses, boxsprings, concrete, asphalt, fill dirt, and motor oil.)		
G. NO HAZARDOUS WASTE (INCLUDING FRIABLE ASBESTOS) ACCEPTED		
(Limited quantities of household hazardous waste from District residents are accepted at no charge by appointment only.)		

PAPER PRODUCTS PICK - UPS

STEP 1

Have initial paper containers NEAR each desk/paper generator.



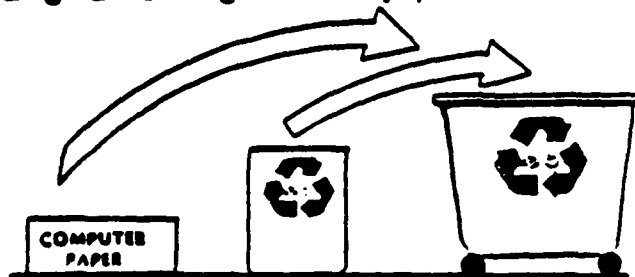
STEP 2

Empty initial paper container into Recycling Cans provided by the Recycling Center.



STEP 3

Weekly pickups will be arranged for with the Recycling Center to empty Recycling Cans and pickup computer paper, cardboard, or tin cans. More frequent pickups may be arranged for high density producers.

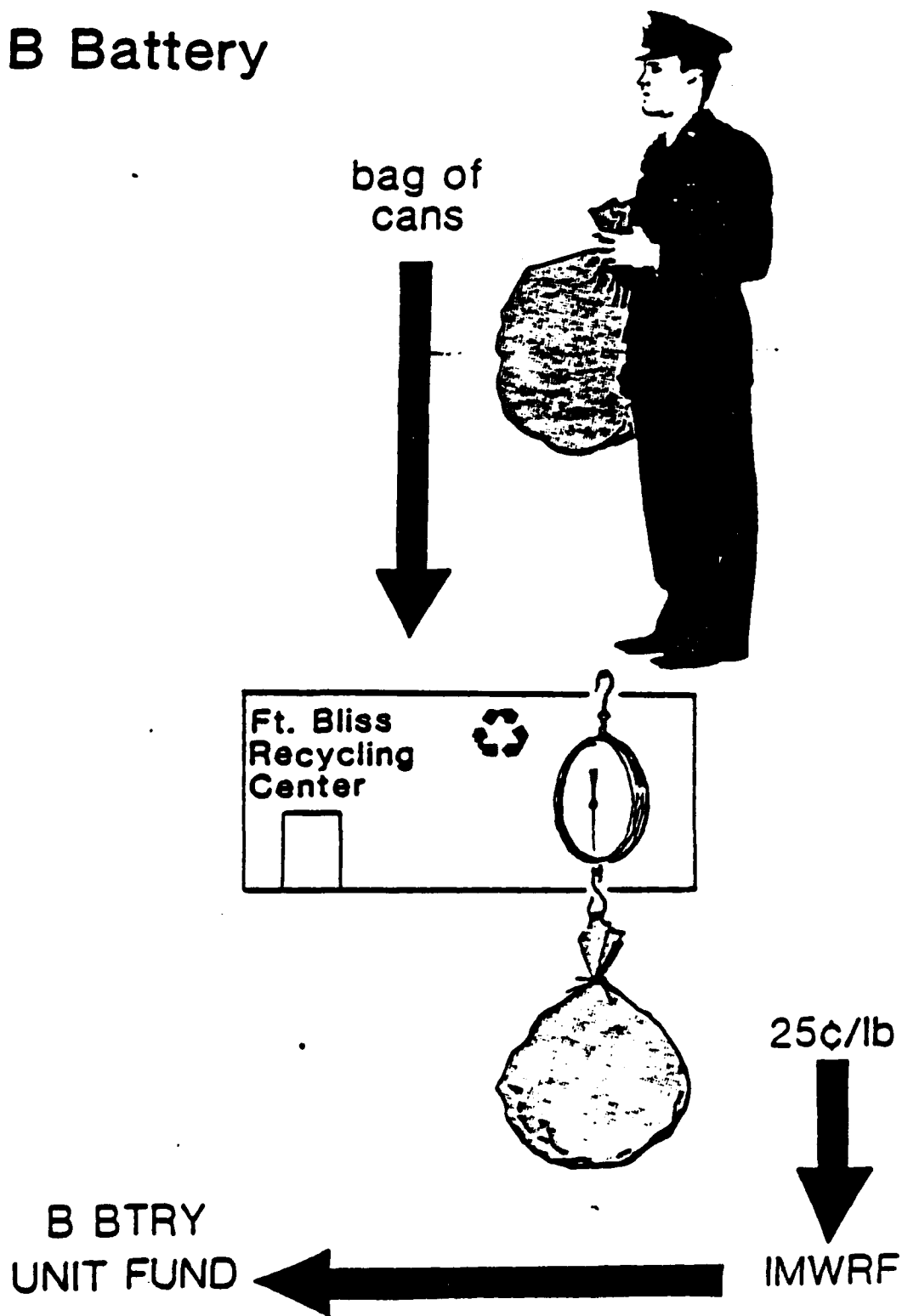


STEP 4

Profits go to the Installation Morale Welfare Recreation Fund.

ALUMINUM CANS

B Battery



APPENDIX E DATA

1. Proposed Janitorial Contract Modification
2. Sources of Supply
3. Waste Disposal Survey
4. Copier and Proposed Midsized Container Locations

NAME	BUDG	SERVICE	FREQ	# OF	SQ FT	PRICE/	TOTAL
PLANT MESH		100 SERVICE					\$0.00
CLASHOUSE		100 SERVICE					\$0.00
CHILDERGARDEN LNB		213 :REPLACE LINERS	1 PER WEEK	52	195	0.00031513	\$3.21
CHILDERGARDEN LNB		213 :REPLACE TPASH	4 PER WEEK	208	195	0.00071159	\$15.06
CHILDERGARDEN LNB		214 :NO SERVICE					\$0.00
CHILDERGARDEN LNB		215 :REPLACE LINERS	1 PER WEEK	52	195	0.00031513	\$3.21
CHILDERGARDEN LNB		215 :REPLACE TPASH	4 PER WEEK	208	195	0.00071159	\$15.06
CHILDERGARDEN LNB		217 :NO SERVICE					\$0.00
CHILDERGARDEN LNB		230 :NO SERVICE					\$0.00
CHILDERGARDEN LNB		4 :REPLACE LINERS	1 PER WEEK	52	6076	0.00031920	\$160.63
CHILDERGARDEN LNB		4 :REPLACE TPASH	1 PER WEEK	260	6076	0.00028113	\$144.60
CHILDERGARDEN LNB		15 :REPLACE LINERS	1 PER WEEK	52	10551	0.00032071	\$168.36
CHILDERGARDEN LNB		15 :REPLACE TPASH	1 PER WEEK	260	10551	0.00035445	\$402.10
CHILDERGARDEN LNB		15 :REPLACE LINERS	1 PER WEEK	52	1483	0.00075213	\$62.17
CHILDERGARDEN LNB		15 :REPLACE TPASH	1 PER WEEK	260	1483	0.00075213	\$114.10
CHILDERGARDEN LNB		18 :REPLACE LINERS	5 PER WEEK	260	2341	0.00031920	\$119.67
CHILDERGARDEN LNB		31 :REPLACE LINERS	4 PER WEEK	208	620	0.00020107	\$25.93
CHILDERGARDEN LNB		31 :REPLACE TPASH	1 PER WEEK	52	401	0.00034581	\$7.21
CHILDERGARDEN LNB		700 :REPLACE LINERS	1 PER WEEK	260	401	0.00025157	\$26.23
CHILDERGARDEN LNB		700 :REPLACE TPASH	1 PER WEEK	260	6876	0.00012842	\$329.60
CHILDERGARDEN LNB		702 :REPLACE LINERS	1 PER WEEK	52	6876	0.00032063	\$114.64
CHILDERGARDEN LNB		702 :REPLACE TPASH	1 PER WEEK	260	20156	0.00017623	\$154.71
CHILDERGARDEN LNB		702 :REPLACE LINERS	1 PER WEEK	52	20156	0.00005411	\$336.02
CHILDERGARDEN LNB		702 :REPLACE TPASH	1 PER WEEK	260	4201	0.00019730	\$172.41
CHILDERGARDEN LNB		155A :REPLACE LINERS	4 PER WEEK	208	500	0.00032037	\$69.99
CHILDERGARDEN LNB		155A :REPLACE TPASH	1 PER WEEK	52	4201	0.00011627	\$12.09
CHILDERGARDEN LNB		355C :REPLACE LINERS	4 PER WEEK	208	500	0.00030523	\$7.94
CHILDERGARDEN LNB		355C :REPLACE TPASH	1 PER WEEK	52	4449	0.00014314	\$33.12
CHILDERGARDEN LNB		375G :REPLACE LINERS	1 PER WEEK	260	4449	0.00012698	\$146.89
CHILDERGARDEN LNB		375G :REPLACE TPASH	1 PER WEEK	260	2499	0.00013919	\$18.09
CHILDERGARDEN LNB		555E :REPLACE LINERS	4 PER WEEK	208	2499	0.00031868	\$165.65
CHILDERGARDEN LNB		575C :REPLACE TPASH	4 PER WEEK	208	2300	0.00012490	\$59.75
CHILDERGARDEN LNB		575C :REPLACE LINERS	1 PER WEEK	52	2300	0.00012490	\$14.94
CHILDERGARDEN LNB		455 :REPLACE TPASH	4 PER WEEK	208	3879	0.00005592	\$11.28
CHILDERGARDEN LNB		455 :REPLACE LINERS	1 PER WEEK	52	3879	0.00025727	\$207.57
CHILDERGARDEN LNB		59 :NO SERVICE					\$0.00
CHILDERGARDEN LNB		336 :NO SERVICE					\$0.00
CHILDERGARDEN LNB		439 :REPLACE TPASH	1 PER WEEK	260	7175	0.00015944	\$297.45
CHILDERGARDEN LNB		439 :REPLACE LINERS	1 PER WEEK	260	7175	0.00015344	\$297.45
CHILDERGARDEN LNB		1300 :REPLACE TPASH	3 PER WEEK	156	951	0.00007078	\$10.50

TEEN CENTER
CHILD DEV CENTER
CHILD DEV CENTER
HOUSING OFFICE

KING HALL
GUM

CHIEF OF POLICE

[illegible]

PROLOGUE

Time (min)	Control (%)	100 μ M DMSO (%)	100 μ M DMSO + 100 μ M DMSO (%)
0	0	0	0
15	10	10	10
30	20	40	40
45	30	60	60
60	40	85	85
75	50	80	80
90	60	75	75
105	70	70	70
120	85	65	65

100

11-11-1964

CHILDREN'S LITERATURE

THE NEW YORK PUBLIC LIBRARY

THE APPENDIX

Highly literate couples

SAFETY DATA SHEET

一一、上

PE

* All increases in frequency do not require additional days.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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If currently 3 days a week require:

9-7. M - pickup trash & white paper

T. S.
P. S.
T. S.
P. S.

TOTAL 664782

\$14,562.37

140

COPY AVAILABLE TO DTIC DOES NOT PERMIT FULLY LEGIBLE REPRODUCTION

2. SOURCES OF SUPPLY

ITEM	COST	SHIPPING	CONTRACTOR
DESKTOP -	.351		FEDERAL SUPPLY
CONTAINERS			SCHEDULE -
			RECYCLED PRODUCTS
			GUIDE
11 GAL			
STACKABLE BINS	74.85	\$7.49	SAFCO
	for 3*		
COMBO	\$47.25*	\$4.73	UNITED RECEPTACLE
CYCLER			
2 BASKET	\$189.95*	\$19	SAFCO
CART ⁴⁴			
EXTRA 26 GALLON-	\$89.85	\$9	SAFCO
CONTAINERS	for 3*		
DECALS	\$.4975	\$.05	SAFCO

* add 10% shipping and handling

⁴⁴ COMES WITH TWO CONTAINERS

3. SOLID WASTE STUDY

Week 1

A DATE	B TIME	C LOCA- TION	D SIZE IN CUYD	E QTY EMP T'D PER WK.	F DAY EMP T'D	G % FULL	H VOL. PER WEEK DxExG cy	I MTHLY. COST	J DY CK ED
9/2	xxx	258	3	1	W	.8	2.40	90.94	TU
9/7	xxx	228	3	2	Mth	0	0.00	161.67	S
9/7	xxx	224	3	3	MWF	.95	8.55	232.52	S
9/8	1952	211	20	3	MWF	.05	3.00	1229.65	TH
9/6	xxx	303W	20	1	F	1.0	20.00	1003.6	TH
9/8	1946	303E	2	3	MWF	.5	3.00	161.67	TH
9/8	1946	303E	3	3	MWF	.25	2.25	90.94	TH
9/10	1536	349	2	2	TF	0	0.00	111.20	TH
9/10	1541	301	3	2	TF	.4	2.40	161.67	TH
9/8	1950	210	2	3	MWF	.8	4.80	161.67	TH
9/6	xxx	220	28	1	M	1.0	28.00	1348.01	S
9/8	1936	330	3	5	MTW ThF	1.15 1	17.25	367.25	TH

9/8	1936	330	3	5	MTW ThF	.9	13.50	367.25	TH
9/8	1936	330	3	5	MTW ThF	.7	10.50	367.25	TH
9/10	xxx	232	20	2	TF	.5	20.00	819.43	TH
9/10	xxx	GARDEN ERS HOLE	30	3	MWF	1	90.00	1613.17	TH
9/2	xxx	191 GC SNACK BAR	2	2	WF	.9	3.60	111.20	TU
9/2	xxx	191 GC MAIN	3	1	W	.7	2.10	90.94	TU
9/2	xxx	214 AA	2	1	W	.8	1.60	60.56	TU
9/2	xxx	PICNIC AREA	3	1	W	.6	1.80	90.94	TU
9/10	1602	336 LM	4	5	MTW ThF	0 ²	0.00	515.45	TH
9/10	1606	187 LM	20	2	TF	.5	20.00	819.43	TH
9/8	2009	438	3	3	MWF	.45 ³	4.05	232.52	TH
9/10	1700	700N ANN	3	2	Mth	.9	5.40	161.67	TH

9/10	1702	700S ANN	20	1	F	1	20.00	409.72	TH
9/10	1705	4 ANN	20	1	F	1	20.00	409.72	TH
		TOTAL COMP.					48		
		TOTAL					282.2		

Weight⁴ 48 cy (compacted) x 500 lb/cy = 12 tons
 282.2 cy x 200 lb/cy = 28.22 tons
 Total 37.82 tons

Week 2

A DATE	B TIME	C LOCA- TION	D SIZE IN CUYD	E QTY EMP T'D PER WK.	F DAY EMP T'D	G % FULL	H VOL. PER WEEK DxExG CY	I MTHLY. COST	J DY CK ED
9/15	1640	258	3	1	W	1 ⁵	3.00	90.94	TU
9/16	1650	228	3	2	Mth	.8	4.80	161.67	S
9/8	1950	224	3	3	MWF	1.1 ⁶	9.90	232.52	S
9/10	1530	211	20	3	MWF	.1 ⁷	6.00	1229.65	TH
9/10	1532	303W	20	1	F	1 ⁸	20.00	1003.6	TH
9/10	1532	303E	2	3	MWF	1 ⁹	6.00	161.67	TH
9/10	1532	303E	3	3	MWF	1 ¹⁰	9.00	90.94	TH
9/14	1538	349	2	2	TF	.9 ¹¹	3.60	111.20	TH
9/14	1537	301	3	2	TF	.9 ¹²	5.40	161.67	TH
9/10	1544	210	2	3	MWF	1 ¹³	6.00	161.67	TH
9/14	xxx	220	28	1	M	1 ¹⁴	28.00	1348.01	S
9/14	2130	330	3	5	MTW ThF	.9 ¹⁵	13.50	367.25	TH

9/14	2130	330	3	5	MTW ThF	.1	1.50	367.25	TH
9/14	2130	330	3	5	MTW ThF	.05	0.75	367.25	TH
9/14	1545	232	20	2	TF	.6 ¹⁶	24.00	819.43	TH
9/15	xxx	GARDEN ERS HOLE	30	3	MWF	.8 ¹⁷	72.00	1613.17	TH
9/15	xxx	191 GC SNACK BAR	2	2	WF	1	4.00	111.20	TU
9/15	1725	191 GC MAIN	3	1	W	1.05 ₁₈	3.15	90.94	TU
9/15	1724	214 AA	2	1	W	.55 ¹⁹	1.10	60.56	TU
9/15	1722	PICNIC AREA	3	1	W	1.15 ₂₀	3.45	90.94	TU
9/15	1847	336 LM	4	5	MTW ThF	.8 ²¹	16.00	515.45	TH
10/8	1630	187 LM	20	2	TF	.6	24.00	819.43	TH
9/10	1606	438	3	3	MWF	.35	3.15	232.52	TH
10/1	1124	700N ANN	3	2	Mth	.8	4.80	161.67	TH

10/1	1125	700S ANN	20	1	F	.9 ²²	18.00	409.72	TH
10/1	1123	4 ANN	20	1	F	.5 ²³	10.00	409.72	TH
		TOTAL COMP.					48		
		TOTAL					253.1		

Weight 48 cy (compacted) x 500 lb/cy = 12 tons
 253.1 cy x 200 lb/cy = 25.31 tons
 Total 34.91 tons

Week 3

A DATE	B TIME	C LOCA- TION	D SIZE IN CUYD	E QTY EMP T'D PER WK.	F DAY EMP T'D	G % FULL	H VOL. PER WEEK DxExG cy	I MTHLY. COST	J DY CK ED
10/6	1631	258	3	1	W	1 ²⁴ +	3.00	90.94	TU
10/9	1400	228	3	2	Mth	.6 ²⁵	3.60	161.67	S
9/15	1906	224	3	3	MWF	.8 ²⁶	7.20	232.52	S
9/15	1908	211	20	3	MWF	.1	6.00	1229.65	TH
10/8	xxx	303W	20	1	F	1 ²⁷	20.00	1003.6	TH
9/15	1900	303E	2	3	MWF	1 ²⁸	6.00	161.67	TH
9/15	1900	303E	3	3	MWF	1 ²⁹	9.00	90.94	TH
10/1	1151	349	2	2	TF	0	0.00	111.20	TH
10/1	1156	301	3	2	TF	1.1	6.60	161.67	TH
10/1	1156	210	2	3	MWF	1.1 ³⁰	6.60	161.67	TH
10/9	xxx	220	28	1	M	1 ³¹	28.00	1348.01	S
10/8	1651	330	3	5	MTW ThF	1 ³²	15.00	367.25	TH

10/8	1651	330	3	5	MTW ThF	.4	6.00	367.25	TH
10/8	1651	330	3	5	MTW ThF	.3 ³³	4.50	367.25	TH
10/1	1200	232	20	2	TF	.1 ³⁴	4.00	819.43	TH
10/1	1153	GARDEN ERS HOLE	30	3	MWF	.5 ³⁵	45.00	1613.17	TH
10/1	1142	191 GC SNACK BAR	2	2	WF	1.0	4.00	111.20	TU
10/ 13	1510	191 GC MAIN	3	1	W	1	3.00	90.94	TU
10/ 13	1513	214 AA	2	1	W	.5	1.00	60.56	TU
10/ 13	1515	PICNIC AREA	3	1	W	1	3.00	90.94	TU
10/ 15	1732	336 LM	4	5	MTW ThF	.8	16.00	515.45	TH
10/ 15	1736	187 LM	20	2	TF	.5	10.00	819.43	TH
9/15	1852	438	3	3	MWF	.75	6.75	232.52	TH

10/ 15	1706	700N ANN	3	2	MTh	.9	5.40	161.67	TH
10/ 15	1707	700S ANN	20	1	F	1	20.00	409.72	TH
10/ 15	1702	4 ANN	20	1	F	.5	10.00	409.72	TH
		TOTAL COMP					48		
		TOTAL					201.6 5		

Weight 48 cy (compacted) x 500 lb/cy = 12 tons
 201.65 cy x 200 lb/cy = 20.17 tons
 Total 32.17 tons

Total waste collected over a three week period.

104.90 Tons

Assuming this to be an average value 1,818 tons per year can be expected to be removed from the Naval Postgraduate School. (excluding housing)

1. composed of nearly 40 - 60% recyclable paper
2. Container next to this dumpster is not on list and is full of broken down cardboard boxes.
3. Contains approximately .3 paper, .7 restroom waste and putricibles
4. Waste is very light and airy.
Compacted weight 500 lb/cy (per CRC Handbook of Environmental Controls, Volume II, Solid Waste)
Uncompacted weight 200 lb/cy (per NEESA 5.0-001A)
5. Household type waste
6. Even mixture of paper, cardboard and restroom refuse.
(cardboard from previous inspection was probably on the bottom)
7. Trashy, little paper, old cushions.
8. Compacted
9. Misc refuse
10. All cardboard, some broken down
11. Carpets and household waste , must move too much household waste.
12. Mixed cardboard , trash
13. Mixed including cardboard
14. Compacted
15. Mostly paper and cardboard
16. Over 40% cardboard
17. Per M Coesart, misc, waste averages nearly full at all times.
18. Located behind snack bar

19. Metal and industrial refuse
20. Food waste
21. Mostly boxes, not broken down
22. Mostly boxes, not broken down
23. 50% bags, 10 % cardboard
24. Household type trash
25. Mostly cardboard
26. 40% paper, misc trash
27. Compacted
28. Much cardboard , broken down
29. Cardboard (broken down) and plastic buckets
30. Over 20% grass trimmings
31. Compacted
32. Mainly styrofoam
33. Boxes which were not broken down.
34. Mainly wood, some trash
35. Mostly yard waste

Copier and Proposed Midsized Container Locations

LOCATION	NAME	BLDG	COPIERS	AREAS REQ'G SMALL CON
AERO-AREA	CLUBHOUSE	191		1
AERO-AREA	CASCADE&TURBINE LAB	213		1
AERO-AREA		214		1
AERO-AREA	COMPRESSOR LAB	215	1	
AERO-AREA	ROCKET MOTOR LAB	217		1
AERO-AREA	AERONAUTICS LAB	230		1
ANNEX	NEPRF	15		1
ANNEX	CHILD CARE	25		1
ANNEX	FNWC	28		1
ANNEX	FNWC	29		1
ANNEX	FNWC	31		1
ANNEX	METEOROLOGICAL BLDG	700		1
ANNEX		702		1
HER-HARB		155A		1
HER-HARB		355C		1
HER-HARB		375G		1
HER-HARB		555E		1
HER-HARB		575C		1
HER-HARB		455		1
LE MESA	TEEN CENTER	58		1
LE MESA		336		1
LE MESA	CHILD DEV CENTER	438		1
LE MESA	HOUSING OFFICE	1300	1	
MAIN AREA	HERMANN HALL	220/220A	11	
MAIN AREA	THESIS STUDY CTR	223/223A	2	
MAIN AREA		303E		2
MAIN AREA		305/427/430	1	2
MAIN AREA	TRANSPORTATION	403/404/406	1	2
MAIN AREA	OCEANOGRAPHY/BEACH LAB	514/218		1
MAIN AREA	SECURITY	200	1	
MAIN AREA	ED MEDIA	203	1	
MAIN AREA		205		1
MAIN AREA	SAUNA/POOL	210		1
MAIN AREA	ENLISTED CLUB	211		1
MAIN AREA	EAST WING H-HALL	221	8	
MAIN AREA	WEST WING H-HALL	222	1	
MAIN AREA	REGISTAR/PRINT SHOP	224	1	
MAIN AREA	SUPPLY WAREHOUSE	229		1
MAIN AREA	SPANAGEL HALL	232	11	
MAIN AREA	BULLARD HALL	233	1	
MAIN AREA	HALLIGAN HALL	234	4	
MAIN AREA	ROOT HALL	235	6	
MAIN AREA	FIREHOUSE	258	2	
MAIN AREA	UEPH	259		1
MAIN AREA	ENLISTED DINING HALL	260		1
MAIN AREA	CHAPEL	300		1
MAIN AREA	SATO HALLWAY	301		1
MAIN AREA	INGERSOL HALL- ACAT RMS	330	5	
MAIN AREA	DUDLEY KNOX LIBRARY	339	3	
MAIN AREA	EXCHANGE WAREHOUSE	349	1	
MAIN AREA	ME LAB	500		1
MAIN AREA	PUBLIC WORKS SHOPS	428	1	
	DLI		3	

	OTHER	3	
TOTAL		69	37

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