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ANALYSIS OF WASTE REDUCTION DATA FOR UNITED STATES AIR FORCE BASES

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Kimberly G. Murray

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DEDICATION

This paper is dedicated to my brother, Benny, who taught me that people can accomplish anything as long as they carry enough sunshine in their hearts to get them through the rainy days.

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ABSTRACT

Waste reduction; a process that reduces the production rate of waste that must be disposed of by a combination of source reduction, recycling, improved management, and treatment; is an effective way for hazardous waste generators to reduce both the amount of waste that they must dispose of and the amount of money that they spend on hazardous waste disposal. Therefore, since the United States armed forces are major generators of hazardous waste, it is very important that they practice waste reduction. But, since the performance of waste reduction studies at some of the relatively small Air Force bases cost from $65,000 to $112,000 per study, data on past waste reduction activities must be developed into a form that shows waste generators that the return resulting from a waste reduction program is well worth the cost of setting it up. This paper describes the collection of data from completed waste reduction studies at 12 United States Air Force Bases, the trends found from analysis of these data, and the development of a mathematical model that can be used to predict the results (potential annual waste reduction, potential annual cost savings, required capital investment, and potential payback period) of performing a waste reduction study at an Air Force base at which no full scale waste reduction program has previously been implemented. The paper also includes a test case example to validate the mathematical model and an example which estimates the amount of potential annual waste reduction and cost savings that the United States could realize by performing waste reduction studies at all United States Air Force bases.

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LIST OF ACRONYMS

AFB	Air Force Base
AGE	Aerospace Ground Equipment
ATC	Air Training Command
AWDC	Average Waste Disposal Cost
AWP	Annual Waste Production
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CFR	Code of Federal Regulations
CWA	Clean Water Act
DC	Disposal Cost
DoD	Department of Defense
DOE	Department of Energy
DRMO	Defense Redistribution Marketing Office
EPA	Environmental Protection Agency
GAO	General Accounting Office
HAZWRAP	Hazardous Waste Remedial Actions Program
IRP	Installation Restoration Program
LSI	Lear Siegler, Incorporated
MAC	Military Airlift Command
MEK	Methyl Ethyl Ketone
NDI	Non-Destructive Inspection
NPV	Net Present Value
OSHA	Occupational Safety and Health Act
OTA	Office of Technology Assessment
PACS	Potential Annual Cost Savings
PAWR	Potential Annual Waste Reduction
PBP	Payback Period
RCRA	Resource Conservation and Recovery Act
SAC	Strategic Air Command
SARA	Superfund Amendments Reauthorization Act
SIR	Savings to Investment Ratio
SPACS	Specific Potential Annual Cost Savings
TO	Technical Order
USAF	United States Air Force
USDF	Uniform Series Discount Factor
WQA	Water Quality Act

CHAPTER 1

INTRODUCTION

1.1. Background Information

The United States armed forces are major generators of hazardous waste. In fact, the Air Force, Army and Navy collectively generated over 400,000 tons of hazardous waste in 1986.[1] Although the regulatory requirements to develop and use better disposal techniques have made hazardous waste disposal a safer operation, they have not eliminated the possibility of a future release of the hazardous waste or made it possible to safely reclaim the land contaminated by the hazardous waste buried in it. The best way to avoid future problems and preserve our limited supply of usable land is to practice waste minimization, which is any activity that reduces "hazardous waste that is generated or subsequently treated, stored or disposed of."[2] The Pollution Prevention Act of 1990 establishes the following hierarchy:

> ...pollution is to be prevented or reduced at the source whenever feasible pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.[3,4]

The first two parts of this hierarchy, source reduction and recycling, are known as waste minimization.

In the mid-1980's, the Department of Defense (DoD) set a goal to reduce the amount of hazardous waste disposed of by 50% by the end of year 1992. The DoD specified waste minimization and treatment as the means by which to accomplish this reduction. Throughout this paper, the reduction of waste to be disposed of by a combination of source reduction, recycling, improved management, and treatment will be referred to as **waste reduction**.

1.2. Problem Definition

Waste reduction should appeal to generators because, due to the ever increasing cost of improved treatment and disposal technologies (which has increased "as much as 300 percent over the past decade due to the ban on land disposal of hazardous waste, minimum technology requirements for hazardous waste units, and limited treatment and disposal capacity"[5]), reducing the amount of waste they must dispose of results in an appreciable reduction in their operating cost. In addition to financial savings, less tangible benefits to generators include: 1) compliance with federal regulations 2) reduction in potential liability 3) protection of public and worker health and safety and 4) protection of the environment.[2,6] But, the set-up of an effective waste reduction program requires the guidance of someone experienced in waste reduction. Therefore, a generator must either hire personnel or contract consultants to perform a waste reduction study, make recommendations, and train personnel to implement the recommendations. Either option will be expensive. For example, the performance of waste reduction studies by consulting firms at some of the relatively small Air Force bases costs approximately $65,000 to $112,000 (See Table 3.1).[7] Therefore, because legislation sets no requirements on the effectiveness of a waste minimization program and the DoD's 50% reduction goal is not mandatory, some incentive is needed to encourage waste reduction efforts at the base level.

1.3. Goal

To encourage generators to invest in the resources needed to develop a waste reduction plan, data on past waste reduction activities must be presented in a form that shows generators that the return from a waste reduction program is worth the cost of expert advice. The goal of this paper is to collect data from available waste reduction studies and synthesize it into a meaningful form. Because a large volume of data must be collected, the data will be entered into a computer database, and computer software such as Dbase or Foxbase will be used to allow relatively quick collection of specific portions of the data for analysis. These data portions will then be analyzed using graphical and statistical methods to identify the existence or the lack of two types of trends. First, commonalities on which processes produce the most waste, offer the most potential annual waste reduction and cost savings, and require the most capital investment to achieve a waste reduction will be analyzed. Second, mathematical relationships between parameters such as annual waste production and potential annual waste reduction will be analyzed and evaluated to determine whether or not various waste reduction parameters, such as annual waste reduction and cost savings, can be predicted for similar generators. The scope of this project will be limited to United States Air Force installations under the following commands: 1) Strategic Air Command (SAC) 2) Air Training Command (ATC) and 3) Military Airlift Command (MAC).

CHAPTER 2

LITERATURE REVIEW

2.1. Definitions

A waste reduction guide published in 1989 by the Office of Defense Waste and Transportation Management defines waste reduction as "waste minimization plus treatment to reduce either the volume or toxicity of waste requiring disposal."[8] Although this definition will be used throughout this paper, it should be noted that a 1986 Office of Technology Assessment publication defines waste reduction to be synonymous with source reduction.[9]

Source reduction, which is the preferred approach to waste minimization, is "any activity that reduces or eliminates the generation of hazardous waste at the source, usually within a process."[2] The five approaches to source reduction are: 1) the reuse of potential waste within existing operations, 2) changes in the basic technology and equipment of production, 3) better plant management or housekeeping, 4) changes in raw materials, and 5) changes in design, composition, or specifications of end products.[4,9,10]

Recycling, which is the waste minimization approach that should be used when all source reduction possibilities have been exhausted, is the use, reuse, or reclamation of waste material. "Use and/or reuse involves the return of a waste material either to the originating process as a substitute for an input material, or to another process as an input material...Reclamation is the recovery of a material from a wastestream."[11]

Treatment is any process that reduces the volume, toxicity, or mobility of a waste prior to storage or disposal.[8] It includes the destruction, detoxification, and neutralization of wastes into less harmful substances.[2] Some of the most common treatments used in a waste reduction program are the incineration of used oil for energy recovery (volume reduction) and the neutralization of battery acid (toxicity reduction).

2.2. Establishment of a Waste Reduction Program

According to EPA's *Waste Minimization Opportunity Assessment Manual* the establishment of a waste reduction program involves four major phases: planning and organization, assessment, feasibility analysis, and implementation.[2,4]

Although the **planning and organizational phase** requires the least amount of technical ability, it is the most crucial phase since the next three phases will not exist or succeed without its success. It includes getting management commitment, setting goals, and organizing the program task force.

The **assessment phase** builds the foundation of the entire waste reduction program. It includes the collection of data, prioritization and selection of assessment targets, selection of people for assessment teams, review of data and inspection of site, generation of waste reduction options, and screening and selection of options for further study. Data collection provides detailed information on waste streams (types and amounts of raw materials used, types and amounts of wastes generated, operations producing wastes...). In addition to providing the basis for the development of waste reduction options, this data allows the prioritization of waste streams and operations to be assessed in the event that time or money limitations prevent the assessment of all waste streams. The program task force is then divided into teams that each concentrate on a particular waste stream or operation. After studying the written descriptions of the facility's operations, the task force visits the facility to verify documentation and collect any additional information needed to generate waste reduction options. Team members can then apply previous experience, training, and technical literature to generate waste reduction options based. These options are then studied to identify the ones that offer the best waste and cost reduction potential. This screening process rates options by considering characteristics such as ease of implementation and preferability according to the order of the pollution prevention hierarchy.

Options that pass screening then enter the **feasibility analysis phase**. This phase includes technical and economical evaluation and selection of options for implementation. The technical evaluation involves consideration of worker safety, product quality, space availability, compatibility with present operating procedures, utility availability, production interruption, special operating skill requirements, service acceptability, and creation of other environmental problems. If the option does not require a large financial or time investment, the option can simply be temporarily implemented to evaluate the effects described above. Otherwise, careful study must be given the option before implementation. The economic evaluation involves the calculation of such parameters as payback period, return on investment, and net present value. After these evaluations are completed, the best option for each waste stream is chosen and recommended.

The **implementation phase** involves four final steps: justification of projects and obtainment of funds, installation of equipment, implementation of processes, and evaluation of project performance. Some recommendations may not be implemented due to the failure to obtain needed funds. Successful implementation requires that personnel be properly trained (i.e. to perform new processes or operate new equipment). Finally, the success of the various implemented recommendations should be evaluated in order to decide which options will be most successful for future waste reduction projects.

These four steps can be more easily accomplished through the use of several forms developed by the Environmental Protection Agency (EPA) and illustrated in the *Waste Minimization Opportunity Assessment Manual*.[2,4]

2.3. Air Force Waste Reduction Studies

The Hazardous Waste Remedial Actions Program (HAZWRAP) possesses a number of documents that report on waste reduction studies performed at military bases. A portion of these documents, referred to as waste minimization reports, report on waste reduction studies at Air Force bases. Because recent environmental legislation has redefined many regulatory terms (as described previously), the contents of these reports would presently be more correctly reflected by the term waste reduction. Various consulting firms performed the studies and wrote the reports. Although this has resulted in slightly varying report formats, the contents of the reports are basically the same. These reports contain five major types of information: 1) a description of the regulatory need for waste reduction, 2) a description of the establishment of the waste reduction program, 3) a description of the installation under study, 4) an overview of waste reduction techniques, and 5) a presentation of findings.

The description of the regulatory need for waste reduction concentrates on relative sections of the Resource Conservation and Recovery Act and Amendments (RCRA); the

Clean Water Act (CWA); the Water Quality Act (WQA); the Comprehensive Environmental Response, and Compensation, and Liability Act and Amendments (CERCLA); and proposed legislation that is not yet law. This documentation thoroughly reviews the legislation that encourages the performance of waste reduction. Because this legislation is very dynamic, much of this information is now outdated in the earlier reports. It is an important section, though, because differences in regulatory status may explain differences in types of recommendations made with respect to time.

The steps taken to establish the base's waste reduction program are both summarized and described in detail. Although the steps are not specifically arranged according to the four phases described in Section 2 of this chapter, they obviously follow the basic concepts described there.

The planning and organization phase involves the development of a project work plan which describes the objectives, procedures, schedule, deliverables, and participants to be included in the program.

The assessment phase is different from the description in Section 2.2 in that, because the entire base is studied for waste reduction, the prioritization of operations or waste streams to be assessed is not performed and there is no mention of the establishment of teams to evaluate specified processes. Data collected includes the study of the Installation Restoration Program (IRP) Phase I Reports (which report on the conduct of "inventories which would identify and assess past disposal practices and sites"), the Used Solvent Elimination Program Plans, available waste stream characterization documentation, spill plans, and base maps. The collection of this data could include the review of as many as 29 documents, the interview of as many as 11 personnel, and the investigation of as many as 11 waste generation areas. While some of this data can be collected prior to seeing a base, much of it will be collected during the initial site visit. Following this visit, the team will generate a number a waste reduction options (usually several options for each waste stream).

At this point, the team will perform a market analysis to find out what technologies, systems, and services are available to the base. With this information, they perform a simple feasibility analysis on the options. After a follow-up visit (necessary to conclude the feasibility analysis), the team submits, revises, and resubmits a report containing the waste reduction recommendations.

Although the actual implementation of the recommendations is the responsibility of base personnel, the team will provide guidelines and training to help ensure successful implementation. The guidelines are presented in a written document containing directions on how to implement, manage, and evaluate the waste reduction program. It also contains directions on how to establish a waste reduction program (as described above).

The description of the base under study includes physical, historical, and functional information. The physical information includes the specification of the base location, size, and boundaries. The historical information includes the dates of major construction and a chronological listing of the types of missions carried out at that base. The functional information describes the types of aircraft used at that base, how it is used and what maintenance is performed on it. Also included is a description of the use of and maintenance on support equipment (such as vehicles and aerospace ground equipment).

The overview of waste reduction techniques includes definitions and descriptions of source reduction, recycling, and direct waste treatment and the hierarchy that should be followed in applying these technologies. Because of the dynamic nature of legislation concerning environmental protection, many of the definitions and descriptions in these reports are dependent on the date on which the report was written.

The bulk of this report contains the presentation of the waste reduction team's findings. Initially, the report stresses the importance of both institutional and technical approaches to a waste reduction program. Institutional recommendations include the involvement of all levels of management (from top management to shop technicians), the development of a waste tracking and reporting system, the creation of program evaluation criteria, and the demand of periodic and frequent status reporting. Also described are potential institutional obstacles and suggested institutional incentives that will help overcome such obstacles. The rest of this presentation describes the technical approaches suggested by the team. Groupings of similar processes performed at various locations on the base (referred to as shops) are described in separate sections. Each section contains a description of the processes performed in that shop, the types and amounts of waste generated by each process, and, for each type of waste, an analysis of the possible waste reduction options, a recommendation of the option judged to be the best (based on a number of considerations), and an estimation of the amounts of waste reduction and cost savings that would result from the successful implementation of this recommendation. If the recommendation requires some capital investment, the amount of the investment is estimated and the reader is referred to an appendix which contains a detailed economic analysis of the investment. At the end (and sometimes at the beginning) of the report, there is a summary table which contains, for each process, the recommendations made, the potential waste reduction and potential cost savings resulting from the implementation of that each recommendation, the required investment and estimated payback period, and a brief note describing the other benefits related to the implementation of the recommendation. Although the processes and waste streams found at the Air Force bases are often very similar, the recommendations made for these similar waste streams vary because of variations in state laws, local market availability, weather conditions, personnel preferences, existing base capabilities, and the personal preferences of the waste reduction team.[12-23]

2.4. Financial Studies

Although many financial studies associated with waste reduction are probably available, the two discussed here describe methodologies to 1) predict the savings associated with the implementation of a waste reduction option and 2) prioritize waste minimization options in order to optimize the benefit obtained on an investment.

2.4.1. Benefit Assessment Methodology: A draft copy of the Environmental Protection Agency's *Pollution Prevention Benefits Manual* describes a methodology for summarizing the benefits expected from a waste reduction program. The methodology calculates savings by comparing the current costs with the estimated cost after implementing each waste reduction recommendation. The costs are separated into four tiers, according to the source of the cost. Tier 0 includes usual costs such as labor, equipment, raw materials, disposal, and energy costs. The manual refers the reader to the *Waste Minimization Opportunity Assessment Manual* for guidance on waste reduction assessment. It then provides a worksheet and instructions for calculating the difference between the current and post-reduction costs. This difference is the savings referred to in the reports described in the previous section. Tier 1 includes hidden costs such as monitoring/testing, training, inspection, and other regulatory costs. This cost is not as obvious to generators as the costs in Tier 0 because they are often charged to overhead rather than to the departments actually producing the wastes. The first step in estimating these costs requires the completion of a questionnaire to determine the regulatory status of the facility (both currently and after reduction). This questionnaire includes consideration of RCRA, CERCLA, SARA (Superfund Amendments Reauthorization Act), CAA, CWA, and OSHA (Occupational Safety and Health Act). Once regulatory status is established, hidden expenses and capital costs required to comply with each of the regulations considered in the questionnaire can be estimated for both current and post-reduction operations using tables supplied in the manual. The costs associated with each of the regulations are summed for each of the 18 categories listed in the worksheet. These values are then entered into the worksheet and set aside for later use. Tier 2 includes potential liability costs which consider the fines and penalties associated with non-compliance and other liabilities referred to as future liabilities. The estimation of the potential cost of penalties and fines involves the identification of all regulations and requirements for which the facility could be fined for non-compliance and the use of both statistics on recorded penalties and fines (given in the manual) and data on the facility's record for penalties and fines. Estimation of future liability involves the identification of all activities to which future liability can attach and the prediction of expected liability using 1) data on claims, awards and settlements in known liability cases; 2) estimates of the year in which the liability might be incurred; and 3) estimates of the percentage of the liability that the facility would have to pay (in case other facilities might have to share the responsibility for future problems). Liabilities associated with treatment or storage in tanks, transportation, disposal in landfills, and any other possible sources of liability are then entered into a worksheet and saved for future use. Tier 3 involves the qualification and quantification of less tangible benefits. The first step is to decide weather or not the reduction action will strengthen consumer acceptance, employee/union relations, and/or the corporate image. The second step is to translate these changes into a dollar amount. Again, these estimates are entered into a worksheet and saved for later use. The evaluation of these three tiers in the waste reduction reports discussed above will be discussed later.

The data in these worksheets can then be used to calculate three financial indicators; the net present value, the internal rate of return, and the annualized cost savings. The net present value is the present value of the annualized cost savings over the project lifetime. The internal rate of return is the expected long-term return on an investment in a waste reduction program. The annualized cost savings is the equal amounts of dollar savings (or losses) expected every year over the lifetime of the project. To evaluate the economic feasibility of the project, these three indicators are compared to the financial criteria given in the manual.[24]

2.4.2. Optimization Methodology: In a publication on waste reduction project evaluation by Sandia National Laboratory, a methodology is developed to evaluate and prioritize waste minimization proposals. This methodology is needed by the Department of Energy to apply to the number of DOE facilities around the country needing funds to implement proposed waste minimization activities. The methodology evaluates proposed activities on the basis of 5 major criteria: 1) economic feasibility, 2) effects on environmental, safety, and health issues, 3) effect on operational issues, 4) effect on intangibles, and 5) technical risk. Each of these criteria are further broken down into 3 or 4 more detailed levels. Each criteria level contains questions with 5 possible answers which are assigned an integral value from 1 to 5 (1 for little or no benefit, 5 for the most benefit possible). The methodology consists of a total of 50 questions. A complex system of weighting factors is developed to make the methodology sensitive to the relative importance of various criteria. The proposed activity obtains a final score when all 50 questions for a proposed activity are answered and the system of weighting and summing is applied to the numerals representing each answer. This methodology is applied to all proposed activities so that, in the end, each proposal has a numerical score that reflects the amount of benefit associated with its implementation. A linear programming technique is then used to compare the waste minimization budget with the costs and scores of the proposed activities to choose the group of proposed activities that should be funded in order to achieve the most benefit with the funds available. (Note, this does not mean that the activities chosen are necessarily those with the highest individual scores.) Finally, the choices are reviewed by waste minimization experts to verify that the methodology has not produced erroneous results.[25]

2.5. Need for Additional Work

The financial models and assessment guidelines described above can be very helpful to an environmental engineer or consulting firm who has been hired to perform a waste reduction study at a facility. But, since the Air Force waste reduction studies described above each cost approximately $65,000 to $112,000, there is a need for information that can show Air Force officials whether or not the benefits of a waste reduction program justify the cost of expert advice. Although this type of information is available in the waste reduction reports, it is not in a form that can either be readily translated into a measure of benefit or applied to a base with a different mission or size. Therefore, it would be very helpful to collect the information from the reports, analyze it, and transform it into a form that can be easily understood and quickly applied to various bases. Consultants have currently completed only 20 to 25 waste reduction studies at U.S. Air Force bases for HAZWRAP and the U.S. Air Force currently consists approximately 100 Air Force bases and stations.[26] Therefore, the availability of information could help to accomplish waste reduction at the remaining Air Force bases is very desirable.

CHAPTER 3

DATA COLLECTION

The waste information that an Air Force base has available from waste management records is the amount of annual waste production and the disposal cost for each type of hazardous waste. The estimated results that Air Force officials are most interested in are 1) the potential annual reduction in waste that must be disposed of, 2) the annual cost savings associated with this reduction, 3) the amount of capital investment required to implement the waste reduction program, and 4) the payback period that would result from the estimated annual savings and the capital investment. This information need to be collected from past waste reduction activities to present to generators to help them decide whether or not the cost of hiring waste reduction experts is justified by the results. The annual waste production and disposal cost data must be collected in order to look for correlations between this known information and the 4 waste reduction results listed above. Much of this information is available in the HAZWRAP waste reduction reports described in the Literature Review. Table 3.1 contains information on the 12 Air Force bases whose waste reduction reports were used for data collection. These 12 reports are the only waste reduction reports that were available at the time that the data collection was performed. A report that has been completed since the data collection was performed was used as a source of data for use in the test case. Other reports are presently being written. The command (in Table 3.1) that the base belongs to describes the mission of that base, which, to some extent,

Table 3.1. Air Force bases used for data collection.

COMMAND	BASE	COST OF STUDY[1]	DATE OF STUDY[2]	CONSULTANT[2]
Strategic Air Command	Barksdale	$111,679	Jan. 1990	1
	Beale	$89,447	Oct. 1989	2
	Carswell	$96,000	Oct. 1989	3
	Castle	$94,040	Jan. 1990	2
	K.I.Sawyer	$65,517	Sep. 1989	2
	Loring	$73,000	Apr. 1989	4
	Plattsburgh	$68,653	Feb. 1989	2
Air Training Command	Keesler	$100,000	Dec. 1988	2
	Lowry	$100,000	Dec. 1988	1 & 2
	Randolph	$100,000	Dec. 1988	1 & 2
Military Airlift Command	Charleston	$91,400	Jul. 1989	2
	Hurlburt	$87,500	Sep. 1990	2

[1] Cost estimates for all SAC bases except Carswell [7]. Cost estimate for Carswell [27]. Cost estimates for the 3 ATC bases are estimates. More exact figures for three bases were not available.[28] Cost estimates for MAC bases [26].

[2] [12-23]

firm that performed the study and wrote the report. Each number (1 through 4) refers to a different consulting firm.

As described in the Literature Review, these reports are divided into sections by groupings of related processes (generally known as shops). For example, the shop referred to as Vehicle Maintenance at most Air Force bases performs both automotive body maintenance (such as painting) and engine maintenance (such as oil and antifreeze changes). Each of these sections begins with a description of the processes performed at the shop and continues with sub-sections describing waste generation, waste reduction options, and waste reduction recommendations.

Annual waste production data were collected from the waste generation sub-dictates the processes performed there. The consultant column refers to the consulting section. These data were recorded in either gallons or pounds per year, depending on how the writers recorded it in the reports, for each type of waste produced by that shop. Since most wastes are liquids, most waste production data are given in gallons per year. The reports list the production of most solid hazardous wastes, such as filters or aerosol cans, in units of pounds, though.

Estimates on potential annual waste reduction and the resulting cost savings are made in either the options or the recommendations sub-section, but most often in the recommendations sub-section. The recommendations sub-section analyzes the options, recommends the best one, and evaluates the potential annual waste reduction and the resulting cost savings for that recommendation. The potential annual waste reduction was recorded in either gallons or pounds per year (depending on which units its corresponding production rate was recorded in) and cost savings was recorded in dollars per year.

In order to minimize the investment required to implement a waste reduction program, most recommendations involve process or material changes or the reuse of a potential waste. Occasionally, though, an equipment change is necessary to significantly reduce waste production rates. If a recommendation involves an equipment purchase, the estimated cost of that equipment is often presented in either the options or recommendations sub-section. In those cases in which the recommendation obviously requires an investment but no estimate was given, the estimated cost was obtained by contacting the writers of the report, who were consistently able to provide the information.

Once annual cost savings and capital investment data were collected, payback periods could be calculated. Although this information is sometimes available in the reports, its calculation is not always performed in a consistent manner. Therefore, the payback period was initially calculated for data collection as:

$$\text{Payback Period} = \frac{\text{Capital Investment}}{\text{Annual Cost Savings}} \tag{3-1}$$

However, the performance of a more complex economic analysis, which is specified in the Naval Facilities Engineering Command *Economic Analysis Handbook*, produced payback periods that were, in some cases, considerably larger than those produced by the use of equation 3-1. Therefore, all of the payback periods were re-calculated according to the following procedure (which is that procedure specified in the Naval Facilities Engineering Command *Economic Analysis Handbook*). The Handbook defines a savings to investment ratio (SIR) as:

$$\text{SIR} = \frac{\text{NPV (savings)}}{\text{NPV (investment)}} \tag{3-2}$$

where the NPV (savings) is the net present value of the annual cost savings and the NPV (investment) is the net present value of the capital investment (which in this case will be simply the initial capital investment since later predicted investments were considered as operating costs and subtracted from the savings). The NPV (savings) is calculated as:

$$\text{NPV (savings)} = \text{annual savings} * \text{uniform series discount factor} \tag{3-3}$$

This equation can only be used when the annual cost savings is uniform and the savings begins at approximately the same time that the investment is made. Since the payback period is the time required for the NPV (savings) to equal the NPV (investment), the uniform series discount factor (USDF) corresponds to the payback period when the SIR = 1 (see equation 3-2). Therefore, the following equation can be used to solve for the uniform series discount factor:

$$\text{USDF} = \frac{\text{NPV (investment)}}{\text{annual cost savings}} \qquad (3\text{-}4)$$

This USDF value can then be compared to a table in an appendix to find the corresponding payback period.[29] Since the USDF never corresponded exactly to an even year, linear interpolation was used to find a more exact estimate of the payback period. The following is an example of this procedure.

Example 1: The first database entry (see Appendix A), which is for Loring Air Force Base, provides an annual cost savings of $30182/yr and requires a capital investment of $65955. Using equation 3-1, the payback period for this recommendation is 2.185 years. Using equation 3-4, the USDF = 2.185. From Appendix C in the _Economic Analysis Handbook_, USDF for 2 year and 3 year payback periods are 1.736 and 2.487, respectively. Linear interpolation can be used as follows to solve for a more exact estimate of the payback period:

$$\text{payback period} = 2 \text{ yrs} + 1 \text{ yr} * (2.185\text{-}1.736)/(2.487\text{-}1.736) \qquad (3\text{-}5)$$

This calculation results in a payback period of 2.598 years (about 16% different from the 2.185 years that resulted from the simple analysis).

The largest difference that the change in the payback period calculation made was from the simple method result of 8.54 years to the complex method result of 20.23 years (for Castle Air Force Base.)

At the end of most of the reports is a table that summarizes all of the information described above. Occasionally, entries in this table were found to be in conflict with corresponding information presented elsewhere in the text. These conflicts were results of writers correcting data in one place and failing to correct it throughout the report. Again, the report writers had to be contacted to resolve these conflicts.

Writers also had to be contacted to resolve questions about technical orders (TO's). TO's are military orders that specify that a process be carried out in a particular way or using a particular material. These TO's may prevent the implementation of an option calling for a procedural change or material substitution. In some cases, review of the option resulted in the conclusion that quality control would not be compromised by the implementation of it. In such cases, the TO's were in the process of being changed to accommodate the implementation of the waste reduction option. In other cases, review of the option led to the conclusion that, in order to preserve the quality control of the operation, the TO could not be changed and, therefore, the option could not be implemented.[28] The report writers revealed which TO's could (and would) be changed and those that could not.

In order to analyze the data, annual waste production and reduction data needed to be in a uniform set of units. As mentioned above, the majority of this data was collected in units of gal/yr and only a few pieces of this data were collected in units of pounds/yr. In fact, only 13 types of waste were recorded in pounds/year. Therefore, to minimize the work and the error introduced by using conversion factors, an effort was made to convert those data collected in pounds/yr into units of gal/yr. To get a uniform set of units, factors to convert from pounds to gallons for each type of data were searched for from the waste reduction reports, the report writers, and other technical handbooks. These factors were found for 8 waste streams (see Table 3.2).

Table 3.3 shows the 5 waste streams for which no conversion factors were found. Data for these waste streams were excluded from analysis. While this exclusion introduced some error into the analysis, the error is minimum since the number of waste streams excluded is small.

It should be noted that many of these conversion factors are rough estimates and may introduce some error into the data collection, but the error introduced by the conversion factor will be much less than the error introduced by excluding the data from analysis completely.

During analysis of cost savings data, it was found that waste disposal costs were needed to account for variations in cost savings values among bases. Although much of this information was included in the waste reduction reports, a great deal of it was not. These missing data could have been provided by the consultants that wrote the reports if it had been requested while the report was being written. The consultants did not retain this data after submission of the final report, though. Therefore, when the waste disposal cost was not available for a waste stream, it was estimated from waste disposal costs for similar waste streams at that base or at another base whose known disposal costs were similar to those for the base for which data was being collected. Notes corresponding to the data listed in Appendix A identify those waste disposal costs that

Table 3.2. Approximate unit conversion factors.

WASTE STREAM	CONVERSION FACTOR
Aerosol Cans	100 cans = 55 gal[1]
Abrasive Waste	325 lbs = 100 gal[2]
Absorbent	200 lbs = 55 gal[1]
Batteries (lead)	1 casing = 1 gal[3]
or	30 lbs = 1 gal[1]
Filters	2.94 lbs = 1 gal[4]
Mercury	113 lbs = 1 gal[5]
Refrigerant	11.1 lbs = 1 gal[6]
Shop Rags	1 lb = 1 gal[7]

[1] Approximation [15]

[2] Found by comparing disposal costs at Beale ($1.00/lb) and Charleston ($3.25/gal) and assuming that the disposal costs should be equivalent if the units are equivalent. Because units vary from base to base, though, some error was probably introduced by this assumption.[13,22]

[3] Approximation [30]

[4] Also found by assuming disposal costs ($/lb and $/gal) at different bases were equivalent. More error might also have been introduced by assuming that all filters are made of the same material (equal densities). [12,19]

[5,6,7] [31], [32], [12], respectively

Table 3.3. Wastes for which no conversion factors were found.

WASTE STREAM	BASE	PRODUCTION (LB/YR)	REDUCTION (LB/YR)	SAVINGS ($/YR)
Asbestos	Loring	10806	0	4332
Freon Gas Tanks	Castle	200	0	0
Pads/Oil	Loring	1735	1735	800
Sodium Hydroxide	Loring	800	800	320
Superoxide Cartridges	Keesler	420	340	700

were estimated and where the estimate was obtained.

The data were not changed to account for the date on which the report was finalized because the finalization dates range only from December of 1988 to September of 1990 (see Table 3.1). Therefore it was assumed that the economic changes over such a relatively short period of time would have little effect on the data.

The information described above was entered into a computer database of 552 records. Each of these records contains the following information:

a. Name of Air Force Command
b. Name of base
c. Name of shop (process)
d. Name of waste produced
e. Volume of waste produced annually (usually for a liquid)
f. Potential annual volume reduction
g. Weight of waste produced annually (usually for a solid)
h. Potential annual weight reduction
i. Annual cost savings associated with the reduction
j. Recommendation capable of producing the stated reduction
k. Memo describing this recommendation in some detail
l. Amount of investment required to implement recommendation
m. Payback period (years)
n. Disposal cost per gallon (or pound) of waste

A complete listing of this database is presented in Appendix A.

CHAPTER 4

DATA ANALYSIS

4.1. Trends in Waste Stream Data

As the data were collected, some general trends about some of the waste reduction parameters of interest became apparent. Figure 4.1 illustrates the percentage of waste that a particular process contributes to the base's total annual waste production. The center group of columns shows how the waste production is distributed for the 12 bases in this study and the last column contains the average distribution of waste production for the 12 bases. As the figure shows, the waste production distribution varies a great deal from base to base. However, some general conclusions can be made from study of this information. First, the final column identifies those shops which most commonly produce hazardous waste. For example, those shops that produce waste at least 75% of the bases in the study (at least 9 out of 12) are the AGE (aerospace ground equipment), auto hobby, corrosion control, jet engine, NDI (non-destructive inspection), vehicle maintenance, and wheel and tire shops. The second column from the right identifies the largest waste producers, which are the corrosion control, fuels management, and vehicle maintenance shops, as those shops that produce the largest percentage of the waste for all 12 bases combined. Note, however, that, although the fuels maintenance shop is one of the largest waste producers, it is not one of the most common waste producers. Second, the chart shows that many bases have unique or evenexclusive processes that are major waste producers (e.g. liquid fuels maintenance).

SHOP	% CONTRIBUTION TO TOTAL BASE PRODUCTION												% CONTRIB. TO OVERALL PRODUCTION	# OF BASES THAT CONTRIBUTE
	LORING	K.I.SAWYER	PLATTSBURG	BARKSDALE	BEALE	CARSWELL	CASTLE	LOWRY	RANDOLPH	KEESLER	CHARLESTON	HURLBURT		
AGE	0.37%	0.40%	0.14%	0.59%	5.93%	25.16%	3.83%	0.00%	0.00%	39.10%	0.00%	1.26%	5.11%	9
AIRCRAFT WASH RACK	0.00%	5.94%	0.00%	0.00%	1.38%	0.00%	14.65%	0.00%	0.00%	0.00%	6.28%	0.00%	2.53%	4
AUTO HOBBY SHOP	0.00%	0.25%	0.80%	25.26%	0.55%	12.84%	0.36%	19.71%	0.00%	26.73%	0.00%	0.53%	4.42%	9
CENTRAL HEAT PLANT	0.00%	0.00%	0.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	31.72%	0.00%	2.46%	2
CORROSION CONTROL	11.07%	51.90%	11.14%	8.92%	44.22%	11.09%	16.70%	23.79%	97.62%	12.70%	15.41%	8.52%	34.21%	12
FUELS MANAGEMENT	76.06%	18.99%	66.94%	30.28%	0.00%	0.00%	14.88%	0.00%	0.00%	0.00%	2.62%	40.25%	21.35%	7
JET ENGINE	0.99%	0.20%	0.30%	4.59%	1.92%	3.02%	3.64%	0.00%	0.00%	0.00%	2.67%	0.49%	1.29%	9
LIQUID FUELS MAINT	0.00%	0.00%	0.00%	0.00%	0.05%	0.00%	0.13%	0.00%	0.00%	0.00%	16.71%	0.00%	1.28%	3
MUNITIONS MAINT	0.16%	0.51%	0.07%	1.28%	0.00%	0.00%	0.67%	0.00%	0.00%	0.00%	0.00%	17.57%	0.80%	6
NDI	0.68%	0.24%	1.14%	1.24%	0.41%	1.50%	3.65%	0.00%	0.38%	0.67%	0.90%	0.22%	0.81%	11
OPERATIONAL MAINT	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.16%	0.00%	0.00%	0.00%	0.14%	1
PHASE DOCK	0.00%	0.00%	0.00%	0.00%	0.00%	3.34%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.15%	1
PHASE INSPECTION	2.56%	0.00%	0.00%	2.70%	0.18%	0.00%	27.07%	0.00%	0.00%	0.00%	0.00%	0.00%	1.97%	4
PNEUDRAULICS	0.33%	0.17%	0.00%	3.98%	0.86%	2.52%	2.18%	0.00%	0.00%	0.00%	0.72%	0.00%	0.71%	7
REFUELING MAINT	0.00%	0.00%	0.00%	0.00%	1.66%	17.84%	4.36%	0.00%	0.00%	0.00%	0.00%	0.00%	1.31%	3
REPROGRAPHICS	0.00%	0.01%	0.00%	0.29%	0.03%	0.00%	1.13%	2.58%	0.00%	1.66%	0.09%	1.10%	0.30%	8
TRAINING AIDS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.55%	0.00%	5.22%	0.00%	0.00%	0.38%	2
VEHICLE MAINT	4.77%	20.25%	15.79%	7.78%	38.14%	13.11%	3.45%	51.25%	0.46%	13.92%	14.86%	17.50%	16.79%	12
WHEEL & TIRE	0.41%	1.14%	2.95%	9.82%	1.10%	2.03%	0.76%	0.00%	0.35%	0.00%	2.06%	7.09%	1.84%	10
ALL OTHER	2.61%	0.01%	0.12%	3.27%	3.57%	7.55%	2.54%	1.12%	0.02%	0.00%	5.98%	5.49%	2.16%	11
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.00%	

Figure 4.1. Distribution of annual waste production among various processes as a percentage of the base total annual waste production for each base.[12-23]

The data for the corrosion control shop is the sum of the data from the corrosion control and metals cleaning and treatment shops, the Lear Siegler, Incorporated (LSI) operations, and hanger 48 painting operations (which is how the shops are listed in Appendix A) because, although the operations are not carried out in one location, they all perform corrosion control operations.

Figure 4.2 illustrates the percentages of potential annual waste reduction that processes contribute to the base's total potential annual waste reduction. This figure illustrates trends similar to those described for the annual waste production distribution. A quick comparison of the last 2 columns in Figures 4.1 and 4.2 shows that the percentage of contribution and the number of bases for which that process contributes is about the same for both annual waste production and potential annual waste reduction. This implies that, not only are most waste streams reducible, but also that the amount of potential annual waste reduction is proportional to the amount of annual waste production.

Figure 4.3 contains the percentage that the waste produced by each process can be reduced (reduction/production). Although the individual base percentages vary all the way from 0% to 100%, the average percentage of reduction for a process (from the last column) ranges from about 40% to 100%. NA (not applicable) is inserted where there is no waste production and, therefore, no reduction is possible. The last column in Figure 4.3 confirms the previous implication that, in general, most waste streams are reducible. The proportionality between percentage contributions to annual waste production and potential annual waste reduction by a process is explained by the high percentages in the last column.

SHOP	% CONTRIBUTION TO TOTAL BASE REDUCTION												% CONTRIB. TO OVERALL REDUCTION	# OF BASES THAT CONTRIBUTE
	LORING	K.I.SAWYER	PLATTSBURG	BARKSDALE	BEALE	CARSWELL	CASTLE	LOWRY	RANDOLPH	KEESLER	CHARLESTON	HURLBURT		
AGE	0.40%	0.00%	0.18%	1.23%	0.55%	23.50%	4.23%	0.00%	0.00%	37.63%	0.00%	1.26%	4.53%	8
AIRCRAFT WASH RACK	0.00%	6.85%	0.00%	0.00%	1.56%	0.00%	20.44%	0.00%	0.00%	0.00%	6.53%	0.00%	3.23%	4
AUTO HOBBY SHOP	0.00%	0.00%	1.05%	2.72%	0.35%	13.77%	0.00%	2.04%	0.00%	30.48%	0.00%	1.01%	3.30%	7
CENTRAL HEAT PLANT	0.00%	0.00%	0.77%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	36.64%	0.00%	3.21%	2
CORROSION CONTROL	10.77%	53.31%	4.17%	17.72%	49.99%	10.75%	20.29%	48.21%	97.27%	10.55%	15.76%	10.49%	34.76%	12
FUELS MANAGEMENT	82.81%	15.10%	67.61%	23.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.45%	20.90%	20.06%	6
JET ENGINE	0.77%	0.06%	0.39%	12.05%	0.97%	2.07%	2.59%	0.00%	0.00%	0.00%	2.26%	0.93%	0.99%	9
LIQUID FUELS MAINT	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.10%	0.00%	0.00%	0.00%	12.11%	0.00%	1.04%	3
MUNITIONS MAINT	0.09%	0.05%	0.08%	2.15%	0.00%	0.00%	0.07%	0.00%	0.00%	0.00%	0.00%	16.25%	0.44%	6
NDI	0.74%	0.23%	1.14%	1.12%	0.28%	1.66%	3.06%	0.00%	0.42%	0.51%	0.59%	0.19%	0.70%	11
OPERATIONAL MAINT	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.52%	0.00%	0.00%	0.00%	0.14%	1
PHASE DOCK	0.00%	0.00%	0.00%	0.00%	0.00%	3.52%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.18%	1
PHASE INSPECTION	1.39%	0.00%	0.00%	0.00%	0.15%	0.00%	35.07%	0.00%	0.00%	0.00%	0.00%	0.00%	2.07%	3
PNEUDRAULICS	0.28%	0.00%	0.00%	6.74%	0.56%	2.54%	2.13%	0.00%	0.00%	0.00%	0.31%	0.00%	0.53%	6
REFUELING MAINT	0.00%	0.00%	0.00%	0.00%	1.14%	19.17%	6.06%	0.00%	0.00%	0.00%	0.00%	0.00%	1.54%	3
REPROGRAPHICS	0.00%	0.00%	0.00%	0.66%	0.00%	0.00%	1.57%	7.33%	0.00%	0.37%	0.09%	1.90%	0.23%	6
TRAINING AIDS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.17%	0.00%	4.68%	0.00%	0.00%	0.38%	2
VEHICLE MAINT	1.89%	23.25%	20.66%	3.66%	42.52%	14.13%	2.03%	35.31%	0.19%	15.78%	16.99%	25.76%	19.29%	12
WHEEL & TIRE	0.45%	1.12%	3.86%	20.43%	0.02%	2.01%	0.38%	0.00%	0.57%	0.00%	1.74%	13.53%	1.67%	10
ALL OTHER	0.42%	0.01%	0.09%	7.66%	1.89%	6.88%	1.99%	3.94%	0.04%	0.00%	5.54%	7.79%	1.70%	11
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

Figure 4.2. Distribution of potential annual waste reduction among various processes as a percentage of the base total potential annual waste reduction for each base.[12-23]

SHOP	% REDUCTION FOR EACH PROCESS												AVERAGE % REDUCTION
	LORING	K.I.SAWYER	PLATTSBURG	BARKSDALE	BEALE	CARSWELL	CASTLE	LOWRY	RANDOLPH	KEESLER	CHARLESTON	HURLBURT	
AGE	100.00%	0.00%	95.65%	50.00%	8.14%	84.63%	79.13%	NA	NA	84.39%	NA	52.58%	68.13%
AIRCRAFT WASH RACK	NA	100.00%	NA	NA	100.00%	NA	100.00%	NA	NA	NA	90.00%	NA	98.12%
AUTO HOBBY SHOP	NA	0.00%	100.00%	2.59%	55.49%	97.18%	0.00%	2.91%	NA	100.00%	NA	100.00%	57.38%
CENTRAL HEAT PLANT	NA	NA	100.00%	NA	NA	NA	NA	NA	NA	NA	100.00%	NA	100.00%
CORROSION CONTROL	89.39%	89.06%	28.59%	47.73%	99.49%	87.76%	87.11%	57.10%	60.91%	72.85%	88.53%	64.52%	77.98%
FUELS MANAGEMENT	100.00%	68.93%	77.17%	18.93%	NA	NA	0.00%	NA	NA	NA	47.95%	27.22%	72.12%
JET ENGINE	71.54%	28.33%	97.56%	63.10%	44.64%	62.20%	50.93%	NA	NA	NA	73.12%	100.00%	59.09%
LIQUID FUELS MAINT	NA	NA	NA	NA	45.45%	NA	54.55%	NA	NA	NA	62.73%	NA	62.59%
MUNITIONS MAINT	49.52%	8.17%	90.91%	40.38%	NA	NA	7.39%	NA	NA	NA	NA	48.50%	42.04%
NDI	100.00%	81.36%	76.34%	11.83%	60.64%	100.00%	60.04%	NA	66.67%	66.67%	57.00%	46.30%	67.09%
OPERATIONAL MAINT	NA	NA	NA	NA	NA	NA	NA	NA	80.00%	NA	NA	NA	80.00%
PHASE DOCK	NA	NA	NA	NA	NA	95.50%	NA	NA	NA	NA	NA	NA	95.50%
PHASE INSPECTION	49.97%	NA	NA	0.00%	75.00%	NA	92.86%	NA	NA	NA	NA	NA	80.61%
PNEUDRAULICS	77.78%	0.00%	NA	43.42%	57.14%	91.22%	69.89%	NA	NA	NA	37.50%	NA	56.84%
REFUELING MAINT	NA	NA	NA	NA	60.49%	97.33%	99.73%	NA	NA	NA	NA	NA	90.08%
REPROGRAPHICS	NA	50.00%	NA	55.56%	0.00%	NA	100.00%	80.00%	NA	19.58%	93.75%	90.74%	60.70%
TRAINING AIDS	NA	NA	NA	NA	NA	NA	NA	57.61%	NA	78.71%	NA	NA	76.89%
VEHICLE MAINT	36.30%	99.55%	100.00%	26.13%	98.11%	97.66%	42.22%	19.42%	25.00%	99.42%	99.00%	77.14%	88.18%
WHEEL & TIRE	100.00%	85.51%	100.00%	50.00%	1.27%	90.00%	35.38%	NA	100.00%	NA	73.04%	100.00%	69.71%
ALL OTHER	14.87%	100.00%	55.00%	56.39%	46.53%	82.59%	56.23%	98.86%	95.24%	NA	80.18%	74.41%	60.30%

Figure 4.3. Percentage by which the annual waste production for each process can bc reduced.[12-23]

Figure 4.4 presents percentages of contribution to total potential annual cost savings. Again, the corrosion control, fuels management, and vehicle maintenance shops are the dominant contributors. The major difference between this data and the data in Figures 4.1 and 4.2 is the appearance of some large percentages in the "ALL OTHER" category at Loring and Barksdale. These large percentages are due to unique processed carried out at these bases.

Finally, Figure 4.5 shows the percentage of contribution of each process to the total capital investment required for the implementation of a waste reduction program. The amount of capital investment listed in this figure does not include the cost of contracting a consulting firm or hiring an environmental specialist to perform the waste reduction study. The most obvious point of interest in this figure is that, on average, almost 80% of the investment is required by the corrosion control shop. Individual base investment percentages for the corrosion control shop vary from 0% to 100%, though. Because these percentages contrast the trend in the previous figures in which the corrosion control shop has a high percentage (but not as high as 80%) and all bases had <u>some</u> percentage for the corrosion control shop (none had a zero percentage). Figure 4.6 compares investment data to production and savings data for the corrosion control shop by itself, for the corrosion control shop and the vehicle maintenance shop combined (since those two shops most consistently contribute to the investment), and for the base as a whole. The figure also contains information on the contractor thatperformed the study. At the bottom of the figure is a row labelled 'r-value.'. Robert S. Witte's statistics textbook describes the correlation coefficient, commonly known as the r-value, as a value that:

SHOP	% CONTRIBUTION TO TOTAL BASE SAVINGS												% CONTRIB. TO OVERALL SAVINGS	# OF BASES THAT CONTRIBUTE
	LORING	K.I.SAWYER	PLATTSBURG	BARKSDALE	BEALE	CARSWELL	CASTLE	LOWRY	RANDOLPH	KEESLER	CHARLESTON	HURLBURT		
AGE	0.45%	0.01%	0.22%	0.74%	0.67%	24.58%	1.20%	0.00%	0.00%	14.03%	0.00%	1.41%	3.45%	9
AIRCRAFT WASH RACK	0.00%	1.27%	0.00%	0.00%	2.33%	0.00%	20.27%	0.00%	0.00%	0.00%	5.72%	0.00%	1.94%	4
AUTO HOBBY SHOP	0.00%	0.00%	1.25%	0.10%	0.61%	14.49%	0.17%	0.40%	0.00%	15.09%	0.00%	0.06%	2.41%	8
CENTRAL HEAT PLANT	0.00%	0.00%	1.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	36.21%	0.00%	3.53%	2
CORROSION CONTROL	34.29%	67.78%	7.35%	40.41%	47.27%	7.98%	26.24%	63.12%	97.33%	46.32%	15.15%	33.33%	47.30%	12
FUELS MANAGEMENT	30.47%	2.87%	62.85%	3.86%	0.00%	0.00%	1.95%	0.00%	0.00%	0.00%	1.94%	10.66%	9.81%	7
JET ENGINE	0.83%	0.04%	0.49%	10.99%	2.30%	2.54%	6.52%	0.00%	0.00%	0.00%	2.61%	0.51%	1.41%	9
LIQUID FUELS MAINT	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.13%	0.00%	0.00%	0.00%	12.44%	0.00%	1.17%	3
MUNITIONS MAINT	0.12%	0.09%	0.11%	1.29%	0.00%	0.00%	0.31%	0.00%	0.00%	0.00%	0.00%	18.03%	0.26%	6
NDI	0.65%	0.47%	1.39%	0.56%	0.65%	1.71%	4.49%	0.00%	0.48%	0.74%	0.71%	0.20%	0.95%	11
OPERATIONAL MAINT	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.21%	0.00%	0.00%	0.00%	0.23%	1
PHASE DOCK	0.00%	0.00%	0.00%	0.00%	0.00%	3.47%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.38%	1
PHASE INSPECTION	1.94%	0.00%	0.00%	0.00%	0.09%	0.00%	24.85%	0.00%	0.00%	0.00%	0.00%	0.00%	1.17%	3
PNEUDRAULICS	0.34%	0.00%	0.00%	3.69%	0.02%	2.18%	1.21%	0.00%	0.00%	0.00%	0.33%	0.00%	0.42%	6
REFUELING MAINT	0.00%	0.00%	0.00%	0.00%	1.43%	20.86%	5.94%	0.00%	0.00%	0.00%	0.00%	0.00%	2.72%	3
REPROGRAPHICS	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	1.13%	11.33%	0.00%	1.00%	0.11%	0.96%	0.30%	5
TRAINING AIDS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.56%	0.00%	14.43%	0.00%	0.00%	0.63%	2
VEHICLE MAINT	4.65%	26.99%	22.80%	6.65%	40.83%	13.69%	3.49%	19.37%	0.20%	7.89%	15.95%	13.84%	17.10%	12
WHEEL & TIRE	0.51%	0.49%	2.24%	8.12%	0.02%	1.66%	0.27%	0.00%	0.69%	0.00%	2.35%	9.39%	1.20%	10
ALL OTHER	25.75%	0.01%	0.18%	23.59%	3.76%	6.84%	1.82%	1.22%	0.09%	0.50%	6.48%	11.61%	3.62%	12
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

Figure 4.4. Distribution of potential annual cost savings among various processes as a percentage of the base total potential annual cost savings for each base.[12-23]

SHOP	% CONTRIBUTION TO TOTAL BASE INVESTMENT												% CONTRIB. TO OVERALL INVESTMENT	# OF BASES THAT CONTRIBUTE
	LORING	K.I.SAWYER	PLATTSBURG	BARKSDALE	BEALE	CARSWELL	CASTLE	LOWRY	RANDOLPH	KEESLER	CHARLESTON	HURLBURT		
AGE	0.00%	0.00%	0.00%	0.00%	0.18%	24.58%	4.07%	0.00%	0.00%	0.00%	0.00%	0.00%	1.87%	3
AIRCRAFT WASH RACK	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0
AUTO HOBBY SHOP	0.00%	0.00%	35.16%	0.00%	0.00%	11.19%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.06%	2
CENTRAL HEAT PLANT	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0
CORROSION CONTROL	100.00%	58.58%	54.95%	75.67%	0.00%	16.90%	89.09%	49.68%	96.17%	97.58%	0.00%	69.04%	78.55%	10
FUELS MANAGEMENT	0.00%	0.00%	0.00%	8.35%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.38%	1
JET ENGINE	0.00%	0.00%	0.00%	0.00%	0.00%	4.55%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.29%	1
LIQUID FUELS MAINT.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0
MUNITIONS MAINT.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0
NDI	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0
OPERATIONAL MAINT.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0
PHASE DOCK	0.00%	0.00%	0.00%	0.00%	0.00%	4.63%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.30%	1
PHASE INSPECTION	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0
PNEUDRAULICS	0.00%	0.00%	0.00%	0.00%	0.00%	6.83%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.44%	1
REFUELING MAINT	0.00%	0.00%	1.10%	0.00%	0.00%	3.37%	0.63%	11.87%	0.00%	0.00%	0.00%	0.00%	1.66%	4
REPROGRAPHICS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	53.57%	0.00%	0.32%	1
TRAINING AIDS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.21%	0.00%	2.42%	0.00%	0.00%	0.80%	2
VEHICLE MAINT	0.00%	3.35%	8.79%	15.98%	37.19%	7.25%	0.00%	33.24%	2.23%	0.00%	0.00%	6.89%	7.51%	8
WHEEL & TIRE	0.00%	38.08%	0.00%	0.00%	0.00%	6.26%	0.00%	0.00%	1.60%	0.00%	46.43%	11.33%	2.88%	5
OTHER	0.00%	0.00%	0.00%	0.00%	62.63%	14.44%	6.21%	0.00%	0.00%	0.00%	0.00%	12.74%	3.93%	4
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

Figure 4.5. Distribution of required capital investment among various processes as a percentage of the base total required capital investment for each base.[12-23]

BASE NAME	CORROSION CONTROL			CORROSION CONTROL + VEHICLE MAINT			BASE-WIDE			CONTRACTOR THAT PERFORMED STUDY
	ANNUAL WASTE PRODUCTION (GAL/YR)	REQUIRED CAPITAL INVESTMENT ($)	POTENTIAL ANNUAL SAVINGS ($/YR)	ANNUAL WASTE PRODUCTION (GAL/YR)	REQUIRED CAPITAL INVESTMENT ($)	POTENTIAL ANNUAL SAVINGS ($/YR)	ANNUAL WASTE PRODUCTION (GAL/YR)	REQUIRED CAPITAL INVESTMENT ($)	POTENTIAL ANNUAL SAVINGS ($/YR)	
LORING	7275	73530	36582	10410	73530	41547	65734	73530	106670	4
K.I.SAWYER	62883	7000	349006	87413	7400	487956	121157	11950	514915	2
PLATTSBURGH	9060	2500	22910	21896	2900	93956	81300	4550	311698	2
BARKSDALE	3635	16100	21885	6805	19500	25488	40732	21277	54157	1
BEALE	54005	0	142187	100590	5000	265105	122128	13444	300805	2
CARSWELL	3612	5071	22846	7880	7245	62027	32561	30000	286306	3
CASTLE	7124	28411	29603	8595	28411	33541	42662	31889	112799	2
LOWRY	3730	27200	28350	11765	45400	37050	15679	54751	44918	1 & 2
RANDOLPH	84137	156676	484243	84537	160176	485245	86188	156676	497529	1 & 2
KEESLER	6242	36300	46220	13082	36300	54090	49154	37200	99785	2
CHARLESTON	8585	0	36950	16863	0	75869	55723	2800	243934	2
HURLBURT	2100	19500	8645	6414	21447	12234	24648	28245	25941	2
AVERAGE	21032	31024	102452	31354	33942	139509	61472	38859	216621	
r-value	0.498		0.621	0.240		0.403	0.008		0.219	

Figure 4.6. Comparison of annual waste production rates and potential annual costs savings to capital investments for corrosion control shops alone, corrosion control and vehicle maintenance shops combined, and for entire bases.[12-23]

"can equal any value between +1.00 and -1.00. The sign of r indicates the type of linear relationship, whether positive or negative, whereas the value of r, without regard to sign, indicates the strength of the linear relationship...A value of r in thedirection of +1.00 or -1.00 indicates a strong (highly regular) relationship, and a value of r in the neighborhood of 0 indicates a weak (relatively irregular) relationship."[33]

In fact, according to the Engineer in Training Review Manual (sixth edition), a good line fit is indicated by a correlation coefficient greater than 0.85.[34] Each correlation coefficient listed was obtained by performing a linear least squares regression on the two columns of data above it with the investment data always being used as the dependent variable. (For example, the first value, 0.498, is the correlation coefficient obtained by performing a linear least squares regression of capital investment required for the corrosion control shop on the annual waste production from the corrosion control shop.) These comparisons were performed to search for a correlation between capital investment and some other parameter (production and savings). Since the highest value listed, 0.621, is less than the 0.85 required for the regression to be considered a good fit, it can be concluded that the correlation between required capital investment and annual waste production or potential annual cost savings for any of the three groupings shown in the figure is poor. The figure also shows that there is no correlation between the size of the capital investment required and the consultant that performed the study.

The large values for potential annual cost savings for the corrosion control shop correspond to large rates of waste production but not with large values of capital investment because the large production rates are caused by a waste stream that consists of large volumes of contaminated water. Water (contaminated by paint, solvent, or stripper) can usually be reduced by a material substitution or a process change (requiring no investment). Therefore, it might be assumed that the amount of the capital investment would depend on the waste stream characteristics (the type of waste and how it is produced). However, Figure 4.7 shows two waste streams (stripper and methyl ethyl ketone, MEK) that occur under similar circumstances (both are produced by corrosion control operations) for the 12 bases and lists the waste production rate, the capital investment required to reduce the waste, and the type of recommendation made. For those bases that do not have this waste stream, NA (not applicable) is entered. This figure shows that, even for similar wastes produced by similar operations, the type of recommendation made and the amount of investment required varies a great deal. Comparison of stripper information for Castle and Hurlburt AFB's also shows that the type of recommendation made and the amount of capital investment required is not consistent for a given consulting firm. Carswell is a unique situation in that the recommendation at that base was to implement a base-wide recycling program for all spent strippers and solvents. The cost of the recycling equipment was distributed among all of the processes in proportion to the percentage of total production of that waste that the process contributes. The recommendation to filter the methyl ethyl ketone (MEK) at Castle AFB requires no investment because the filtration unit purchased to reduce another waste stream can be used. Other recommendations to filter the waste require varying amounts of capital investment because (according to the number of stripper or solvent vats used in the process) more than one filtration unit may have to be purchased. The cost of the filtration unit for the stripper at Hulburt was assumed

BASE	STRIPPER			METHYL ETHYL KETONE		
	ANNUAL WASTE PRODUCTION (GAL/YR)	REQUIRED CAPITAL INVESTMENT ($)	TYPE OF RECOMMENDATION	ANNUAL WASTE PRODUCTION (GAL/YR)	REQUIRED CAPITAL INVESTMENT ($)	TYPE OF RECOMMENDATION
LORING	6105	65955	NEW TECHNOLOGY	1120	7575	RECYCLE
K.I.SAWYER	165	4000	FILTER	324	0	NONE
PLATTSBURG	2400	1500	NEW EQUIPMENT	1200	0	NONE
BARKSDALE	600	4000	FILTER	1100	12100	NEW EQUIPMENT
BEALE	NA	NA	NA	55	0	NONE
CARSWELL	822	2339	RECYLE	240	683	RECYCLE
CASTLE	684	28411	NEW TECHNOLOGY	1300	0	FILTER
LOWRY	930	9300	FILTER	NA	NA	NA
RANDOLPH	660	20100	NEW EQUIPMENT	6100	17000	FILTER/DISTILL
KEESLER	200	900	FILTER	NA	NA	NA
CHARLESTON	250	0	NONE	1275	0	MATERIAL SUBTITUTION
HURLBURT	660	4000	FILTER	1000	15000	DISTILL
AVERAGE	1123	11709		1143	4363	

Figure 4.7. 2 comparisons (1 for each type of waste) of recommendations and required capital investments for wastes that are produced under similar circumstances at 12 bases.[12-23]

to be approximately equal to that at Barksdale (since the recommendation is the same and the waste production rate is approximately equal). Since different recommendations and investments were suggested for such seemingly similar waste streams, some of the consultants that performed many of the studies used in this analysis were consulted for additional explanation. Discussion with these waste reduction engineers resulted in the conclusion that the following 4 factors were the major causes of variations in capital investments at various bases. First, the amount of waste reduction already performed at the base affects the recommendations required to get further reduction. For example, if many of the material substitutions and process changes have already been implemented, more complicated equipment and technology changes may be required to achieve an additional high percentage of reduction. Second, the equipment already available at the base affects the amount of equipment that must be purchased. For example, many bases use a contractor to service their solvent (parts washing) vats. These contractors usually supply solvent vats and solvent, and then they remove the spent solvent for recycling and replace it with fresh solvent at predetermined intervals. Even though the contractor handles the solvent, the base is still responsible for any liability associated with the waste solvent. Recommendations are often made to reduce this waste stream by either material substitution, vat filtration, or burning of the waste solvent for energy recovery. To accomplish this, the contractor service must be discontinued and the Air Force base must purchase their own parts washing vats. Third, the mission performed at a particular base may affect the capital investment required. Different bases maintain different types of aircraft. In some cases, the preservation of the integrity of quality control requires that maintenance be performed according to strict technical specifications. These specifications may make the implementation of simple waste reduction options such as material substitution or process change impossible. The alternative option may require the purchase of new equipment. Fourth, the firm or person designing the waste reduction program may affect the amount of capital investment required. As in any engineering design, different people evaluate the pros and cons of various options differently. These differences in evaluations result in differences in recommendations and, therefore, differences in capital investments.[30,35]

The observations on Figures 4.1 through 4.5 lead to the conclusion that, although the general trends found in the last column of each figure give a good indication of the most common process/waste reduction relationships, exceptions to these trends occur frequently and should be expected.

4.2. Introduction to Mathematical Model Development

As described in section 2.2 of this paper, the first of 4 phases involved in the estimation of a waste reduction program, planning and organization, begins with getting management commitment. The goal of this study, described in section 1.3, is basically to find a way to get management commitment (from Air Force base officials) by estimating the results of performing a waste reduction study at a given base. Although the information described above could be very useful to someone designing a waste reduction program, more condensed information is needed to present to base officials (who are interested in overall results rather than details). Therefore, the detailed data described above was summed for entire bases (consisting of 12 data points) and analyzed using statistical and graphical methods. Table 4.1 displays the data for these 12 bases.

Since the units for annual waste production, potential annual waste reduction, and average waste disposal cost for the wastes listed in Table 3.3 are not the same as the units used in Table 4.1, the values for these 3 parameters for the wastes listed in Table 3.3 had to be excluded from the totals listed in Table 4.1. Although the units for potential annual cost savings, capital investments, and payback periods for the wastes listed in Table 3.3 are consistent with the units used in Table 4.1, the values for the latter 3 parameters for those waste streams listed in Table 3.3 also had to be excluded from the totals listed in Table 4.1 so that the analysis of correlation between various parameters would not be affected by the exclusion of some of the data and the inclusion of corresponding data. Table 3.3 shows that only 5 waste streams had to be excluded. Their exclusion is justified because all 5 of the excluded waste streams are unique to only one base and only one process. Therefore, they are not truly representative of waste production, and therefore waste reduction, characteristics at Air Force bases. In addition, two of the wastes, asbestos and sodium hydroxide at Loring Air Force Base, were one time occurrences that are not products of normal base operations. As above, values for capital investment do not include the cost of contracting a consulting firm or hiring an environmental specialist to perform the waste reduction study.

The data in Table 4.1 has been used in the analyses described below. The result of the study, a mathematical model, uses the input of only two parameters, annual waste production (gal/yr) and average waste disposal cost ($/gal), in order to estimate potential annual waste reduction (gal/yr), annual cost savings ($/yr), capital investment ($), and payback period (yrs). Although additional input parameters such as feedstock costs might make the results more accurate, their collection would result in a much larger time

Table 4.1. Summary of waste reduction data collected as sums for each of the twelve bases in the study. [12-23]

(I) BASE NAME	(II) PRODUCTION/ REDUCTION (GAL/YR)	(III) SAVINGS ($/YR)	(IV) CAPITAL INVEST. ($)	(V) PAYBACK PERIOD (YRS)	(VI) AVG. DISP. COST ($/GAL)
LORING	65734/ 60377	106670	73530	0.76	0.6504
K.I.SAWYER	121157/ 105046	514915	11950	0.03	4.2558
PLATTSBURGH	81300/ 62124	311698	4550	0.02	5.5313
BARKSDALE	40732/ 9789	54157	21277	0.43	1.1878
BEALE	122128/ 107491	300805	13444	0.05	2.6504
CARSWELL	32561/ 29500	286306	30000	0.12	9.6130
CASTLE	42662/ 30581	112799	31889	0.31	3.3264
LOWRY	15679/ 4418	44918	54751	1.37	0.7542
RANDOLPH	86188/ 52684	497529	156676	0.35	9.0609
KEESLER	49154/ 43106	99785	37200	0.41	1.2428
CHARLESTON	55723/ 48238	243934	2800	0.01	4.9540
HURLBURT	24648/ 12920	25941	28245	1.21	1.6727

investment, destroying the simplicity which is one of the project goals. The development of the relationships capable of making these predictions is described below.

4.2.1. Potential Annual Waste Reduction Prediction: The equation for predicting the potential annual waste reduction was developed by plotting annual waste production vs. annual waste reduction for the 12 bases (column I of Table 4.1) and performing a linear least squares fit to obtain the equation of the line that best fits the data by minimizing the sum of the residuals squared. (A residual is the difference between the predicted value of the dependent variable and the actual value of the dependent variable for a given value of the independent variable.)[36] This statistical analysis produces the equation of a line of the form:

$$PAWR = C_0 + C_1 * AWP \qquad (4\text{-}1)$$

where AWP (annual waste production, gal/yr) is the total volume of hazardous waste that a given base disposes of annually, PAWR (potential annual waste reduction, gal/yr) is the amount by which the given annual production can be reduced by implementing a waste reduction program, C_0 is the y-intercept of the line, and C_1 is the slope of the line. Known values for annual waste production and potential annual waste reduction were entered into a computer program (STATGRAPHICS) and the program solved for the values of C_0 and C_1. This operation produced the following equation:

$$\boxed{PAWR = -9{,}473 + 0.9218 * AWP \qquad (4\text{-}2)}$$

After collecting annual waste production data, a base could use this easily solved equation to estimate potential annual waste reduction that would result from the performance of a waste reduction study. The regression line and the raw data are shown in Figure 4.8. STATGRAPHICS calculated a correlation coefficient (r) of 0.962 for this line fit. As stated previously, a correlation coefficient near 1.00 (above 0.85) is considered a significant correlation. STATGRAPHICS also calculated standard errors on the values of C_0 and C_1 of $\pm$ 5,814 and $\pm$ 0.0830, respectively, and the standard error on the estimate (which in this case is potential annual waste reduction) of $\pm$ 9,653 gal/yr. The dashed lines in Figure 4.8 represent the 95% confidence limits. These bands are produced by a frequency analysis (done internally by STATGRAPHICS) and mean that as future data points are plotted on the graph, 95 out of 100 of the data points should fall between the 95% confidence limits.[36] Figure 4.8 shows that the 95% confidence bands are closest together at the average production rate of 61,472 gal/yr and gradually spread further apart on each side of this value. At the average production rate of 61,472 gal/yr, the confidence bands are closer together than the standard error on the potential annual waste reduction estimate of $\pm$ 9,653 gal/yr and slightly farther apart than the sample standard deviation near the edges of the graph (as production rates approach 0 and 150,000 gal/yr). Therefore, although $\pm$ 9,653 gal/yr can be used as the standard error on the potential annual waste reduction estimate (gal/yr), use of the confidence bands on the graph provides a better estimate of the amount of error an estimate will contain depending on where the estimate occurs on the regression line. (Plotting the sample standard deviation on the graph would produce two straight lines, one on each side of the regression line, that are 9,653 gal/yr different from the y-value for any given x-value. If additional data points were then plotted on the graph, more points would fall outside of the deviation bands near the edges of the graph than

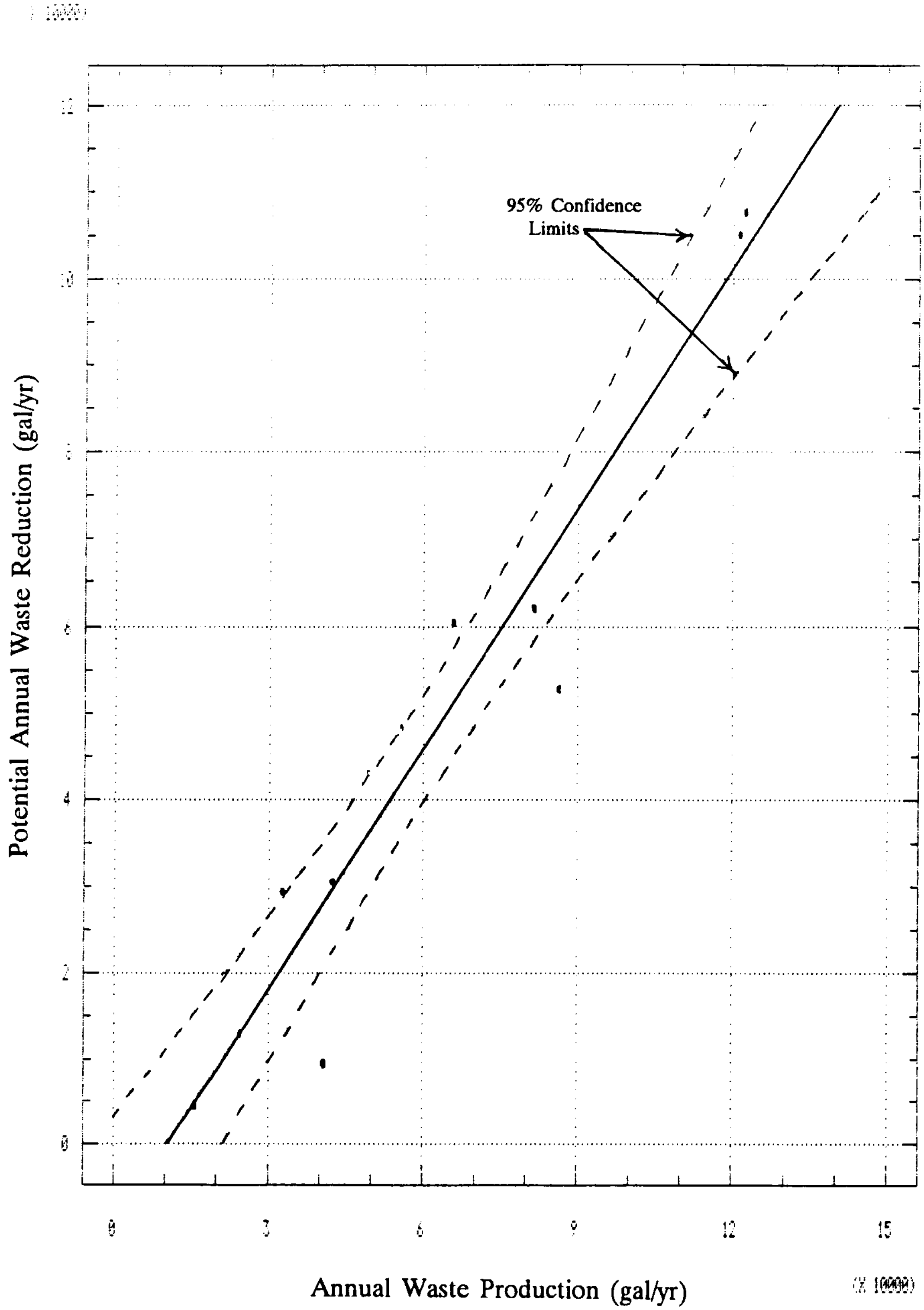

Figure 4.8. Linear regression of potential annual waste reduction on annual waste production. PAWR = -9473 + 0.9218 * AWP, r = 0.962.

near the average.) The fact that the regression line intersects the x-axis at approximately 10,000 gal/yr rather than passing through the origin may imply that a minimum annual waste production rate of 10,000 gal/yr is necessary to realize a cost significant reduction.

4.2.2. Potential Annual Cost Savings Prediction: The potential annual cost savings resulting from a waste reduction study are caused by several contributing factors. Almost all waste reduction actions lower (or eliminate) the cost of waste disposal. Costs associated with raw material or equipment purchase change only for some waste reduction activities, and, when they do change, they may increase as well as decrease. Therefore, the change in the costs for purchase of raw materials and operating equipment can be assumed to have little affect on the base's overall cost savings (since 1) the increases and the decreases will significantly compensate for each other and 2) the cost change for either of these categories is very small compared to the change in the disposal cost). These 3 types of costs all fall under the Tier 0 category described in section 2.4.1 (labor, equipment, raw materials, disposal, and energy costs).

The type of waste being disposed of determines, to a large extent, the magnitude of the disposal cost. Therefore, two bases with the same waste production rate may have very different disposal costs because the wastes that they produce are different. The calculation of an average waste disposal cost for a base ($/gal) would illustrate how much, on average, a base pays to dispose of a gallon of waste. The average waste disposal costs for the bases in the study were calculated as follows:

$$AWDC = \frac{\Sigma(DC_i * AWP_i)}{AWP_i} \qquad (4\text{-}3)$$

where i represents individual waste streams, AWP_i is annual waste production of the ith waste stream in gal/yr, and DC_i is disposal cost per gallon of the ith waste stream in \$/gal. As shown in Table 4.1, the average waste disposal cost for the twelve bases studied varied from \$0.65/gallon to \$9.61/gallon. Although variation in the types of waste that a base disposes of is partially responsible for the rather large variation in average disposal costs, another factor is also partially responsible. The waste disposal agreement made between the generator (the Air Force base) disposer (in this case the Defense Redistribution Marketing Office, DRMO, who handles most of the hazardous waste produced by Air Force bases) varies depending on the disposal facilities available and the date on which the contract was agreed upon (since disposal cost are rising so quickly). In addition to the these two factors, the assumptions made in the waste reduction reports affect the amount used for disposal cost in the reports. The factors mentioned above affect the actual disposal cost but, in the reports, many writers add to the actual disposal cost an additional cost to account for the labor and handling costs encountered before sending the waste to a disposer. All of these factors combine to cause the large variation in average waste disposal costs seen in Table 4.1. So, assuming that the operating cost a base encounters for producing a hazardous waste is mostly due to waste disposal, the operating cost (\$/yr) can be calculated by multiplying annual waste production (gal/yr) times the average waste disposal cost (\$/gal). It follows that the potential annual cost <u>savings</u> can be calculated as:

$$PACS = PAWR * AWDC \tag{4-4}$$

where PACS is the potential annual cost savings (\$/yr). When equation 4-4 was used to estimate the potential annual cost savings and the estimates were compared to the actual values of potential annual cost savings, the standard error was calculated as $\pm$ \$298,926/yr using the following equation:

$$S_e = \frac{\Sigma((ACT_i - EST_i)^2)}{(n - 2)} \qquad (4\text{-}5)[36]$$

This standard error is large (58% of the largest and over 1000% of the smallest cost saving listed in Table 4.1) because an estimate (potential annual waste reduction with it's own standard error) was used to estimate the potential annual cost savings. But, since the annual waste production data is directly correlated to the potential annual waste production (presented in the previous section), annual waste production (gal/yr) time average waste disposal cost (\$/gal) should correlate with annual cost savings. Therefore, a linear least squares fit was performed to, again, produce an equation with the form:

$$PACS = C_0 + C_1 * AWP * AWDC \qquad (4\text{-}6)$$

Known values of annual waste production and average waste disposal cost were multiplied (resulting in the total cost of waste disposal for a base before the implementation of waste reduction options) and entered into the STATGRAPHICS computer program along with known values of potential annual cost savings, and the program solved for the values of C_0 and C_1. This process produced the following equation:

$$\boxed{PACS = 47{,}336 + 0.6757 * AWP * AWDC \qquad (4\text{-}7)}$$

By collecting only two types of information, annual waste production waste disposal costs, a base can use equations 4-4 and 4-8 to estimate the potential annual cost savings that would result from the performance of a waste reduction study. STATGRAPHICS calculated a correlation coefficient of 0.953, standard errors on C_0 and C_1 of $\pm$ 23002 and $\pm$ 0.0677, respectively, and a standard error of the estimate (potential annual cost savings) of $\pm$ \$53,863/yr. This standard error is only 10% of the largest and 200% of the smallest cost savings listed in Table 4.1. Although 200% is a relatively large standard error, it is a large improvement of the 1000% stated above. The data, the regression line and the 95% confidence bands are shown in Figure 4.9. Although the correlation coefficient is very good, the standard error is high because the values of potential annual cost savings are often very high (see Table 4.1). But, again, the use of the confidence bands will provide a better idea of the error for a particular estimate.

4.2.3. Capital Investment Prediction: Several efforts were made to find an accurate way to predict the capital investment that would be required for a base to perform a full-scale waste reduction program. These efforts include the analysis of relationships between capital investment and the consulting firm performing the waste reduction study, annual waste production, potential annual cost savings, and waste production and cost savings from various shops such as corrosion control and vehicle maintenance (see Figures 4.6 and 4.7). As discussed in section 4.1, these efforts failed to produce any correlation that could be used to predict the capital investment. Section

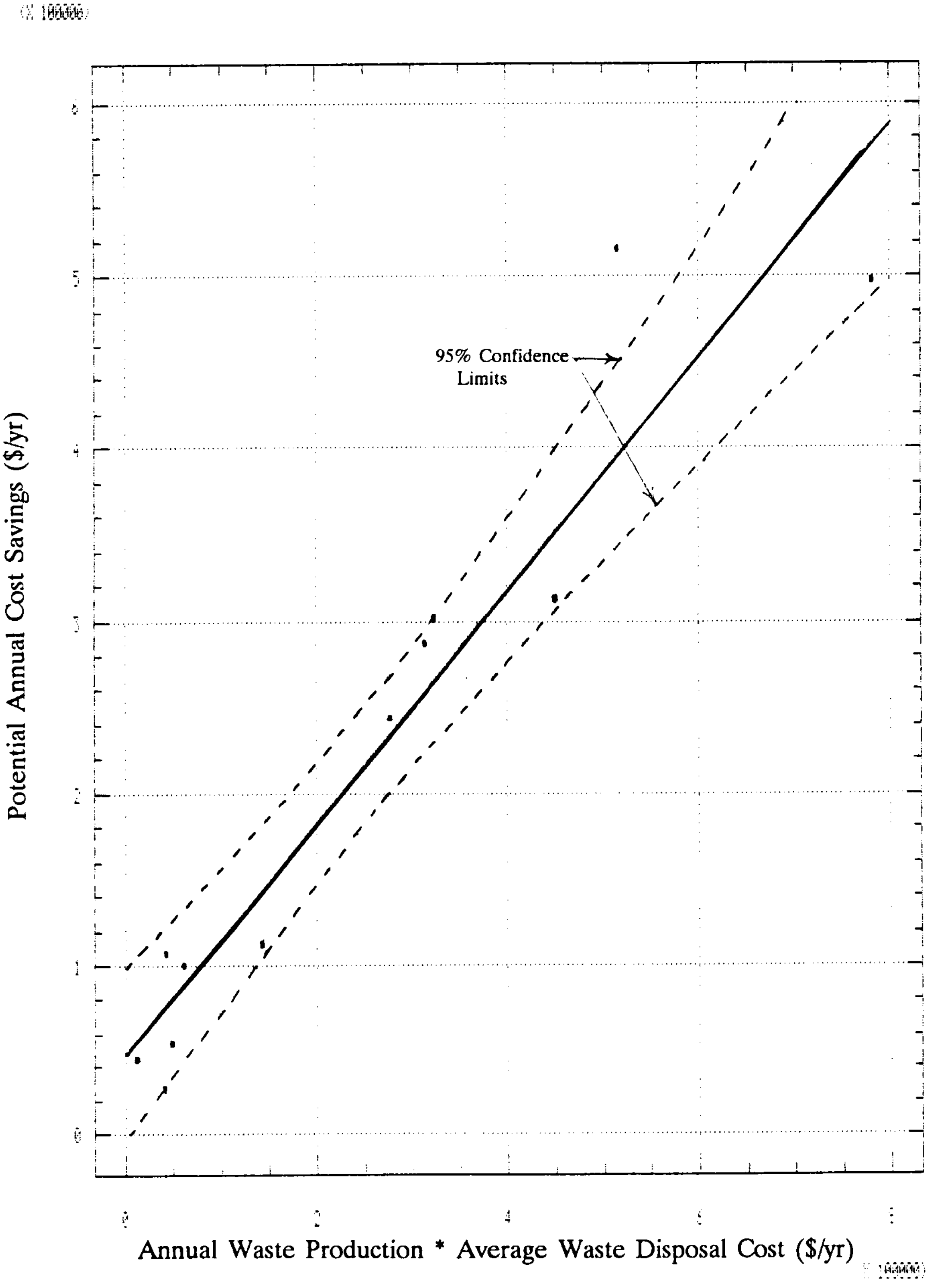

Figure 4.9. Linear regression of potential annual cost savings on annual waste production * average waste disposal cost. PACS = 47336 + 0.6757 * AWP * AWDC, r = 0.953.

4.1 also discusses the reasons for the variation in capital investment estimates. But, since the amount of the capital investment is rarely much larger than the annual savings, it can generally be said that the investment will usually be approximately equal to or less than the annual savings (see Table 4.1). Below are some statistical analyses of the data, though, which may provide a better description of the data distribution.

The average capital investment for the 12 bases in the study was found to be \$38,859 with a standard deviation of $\pm$ \$42,356. Table 4.1 shows that one base, Randolph Air Force Base, requires a much larger capital investment than any of the other bases. (The next highest required capital investment is \$73,530 for Loring Air Force Base.) Randolph Air Force Base is also different from other bases in that almost 98% of its waste is produced by corrosion control process.(See Figure 4.1) (The next highest percentage is 52% for K.I. Sawyer.) A linear regression of capital investment on percentage of waste production contributed by the corrosion control shop produced a correlation coefficient of 0.672. Since this value is considerably less than 0.85, which indicates a good correlation, the regression equation (which, again, would be the equation of a line) should not be used for the prediction of capital investment values. When the outlier (Randolph Air Force Base) was excluded from the mean calculation, the resulting mean investment was \$27,240 with a standard deviation of $\pm$ \$21,466. The large values for standard error imply that the scatter of data about the average is great.

Perhaps a better way analyze the data is by its distribution. Of the capital investment values listed in Table 4.1, the two middle values are \$28,245 and \$30,000.

Therefore, the median ("a value which is greater than half the variates and less than the other half") [37] is calculated as:

$$\text{median} = (\$28{,}245 + \$30{,}000)/2 \qquad (4\text{-}8)\ [37]$$

This calculation results in a median value of $29,123. A value called skewness is used to describe a frequency distributions lack of symmetry.[34] This value is calculated as:

$$\text{skewness} = \frac{3 * (\text{mean - median})}{s} \qquad (4\text{-}9)\ [34]$$

where s is the sample standard deviation. Using equation 4-9 and the mean for all of the capital investment values (outlier not excluded), the skewness for the median value of capital investment is 0.690. A skewness value of 0 means that the distribution is symmetric about the mean, a positive value indicates a long tail on the right side of the mean, and a negative value indicates a long tail on the left side of the mean.[37] Therefore the value of 0.690 indicates that the distribution is "skewed" toward the right (see Figure 4.10)

Another frequency distribution that can be used to describe the range of values for the capital investment is the mode ("a value of the variable...which occurs most frequently").[37] Table 4.2 shows two ways to find the mode value for the capital investment data. The table shows that 5 out of the 12 values are between $20,000 and $40,000. Because of the wide range of capital investment values, the mode ($20,000 to $40,000) gives the best description of the possibility of values for other bases.

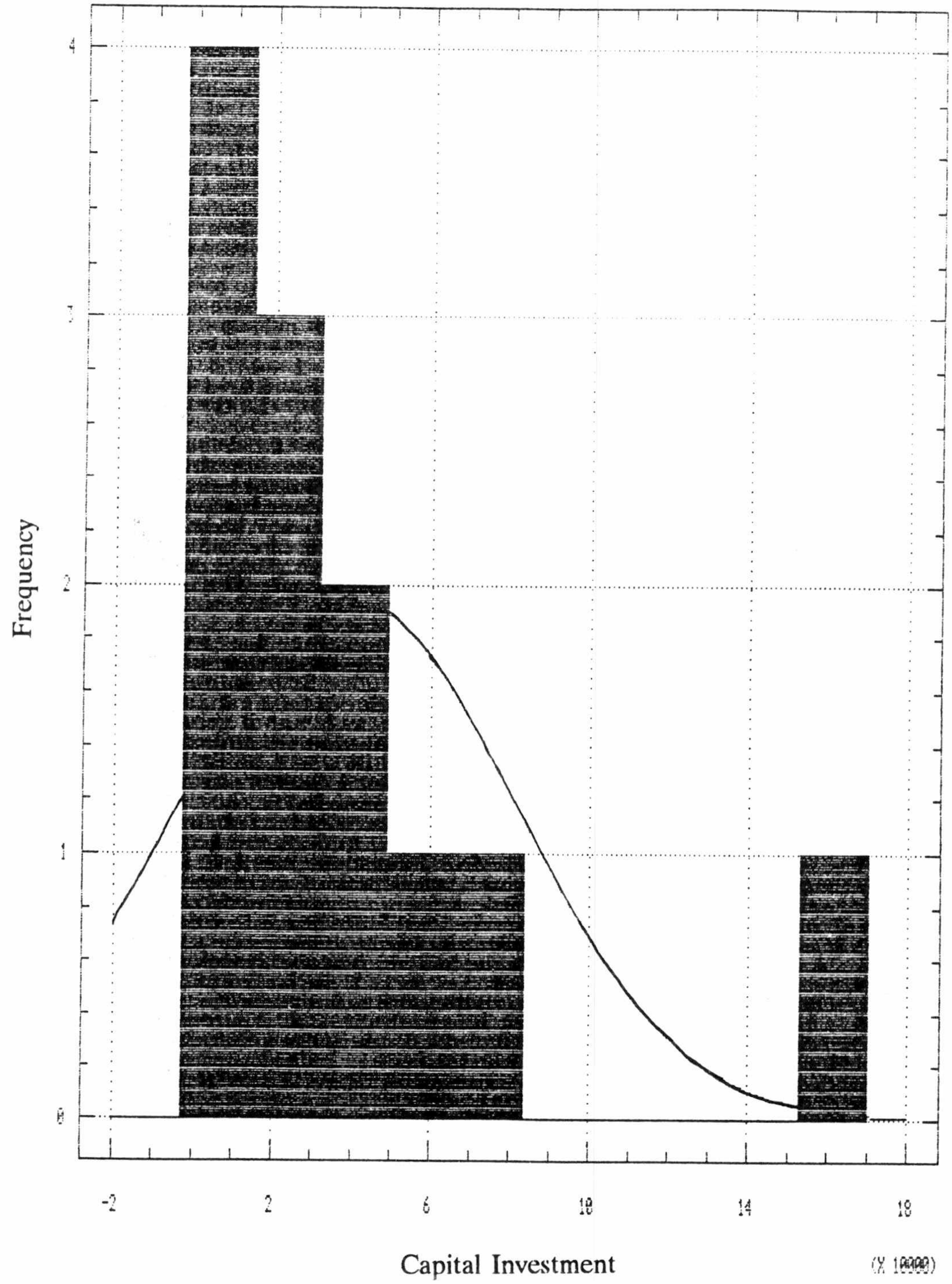

Figure 4.10. Frequency distribution for capital investment. Note the long tail in the right portion of the graph indicated by a skewness value of 0.690.

Table 4.2. Mode values for capital investment.

CAPITAL INVESTMENT ($)	FREQUENCY	CAPITAL INVESTMENT ($)	FREQUENCY
0 - 10,000	2	0 - 20,000	4
10,001 - 20,000	2	20,001 - 40,000	5
20,001 - 30,000	3	40,001 - 60,000	1
30,001 - 40,000	2	60,001 - 80,000	1
40,001 - 50,000	0	OVER 80,000	1
50,001 - 60,000	1		
60,001 - 70,000	0		
70,001 - 80,000	1		
OVER 80,000	1		

4.2.4. Payback Period Relation: The minimum and maximum values for payback periods on the capital investment (not including the cost of the waste reduction study itself) were found to be 0.0115 and 1.2189 years, respectively (see Table 4.1). As shown in Figure 4.11, only 2 of the 12 bases (17%) have a payback period greater than 1 year. Therefore, it might generally be said that the overall payback period for a base is about a year or less. In order to make a more accurate estimate of the payback period, use the relationship illustrated in Figure 4.11, a non-linear curve fit of a relationship between the product of annual waste production times average waste disposal cost (which again results in the total cost of waste disposal for a base) and payback period. The equation entered into the non-linear curve fit STATGRAPHICS program was:

$$PBP = C_0 * (AWP * AWDC)^{C1} \qquad (4\text{-}10)$$

where PBP (payback period, yrs) is the number of years required for the capital

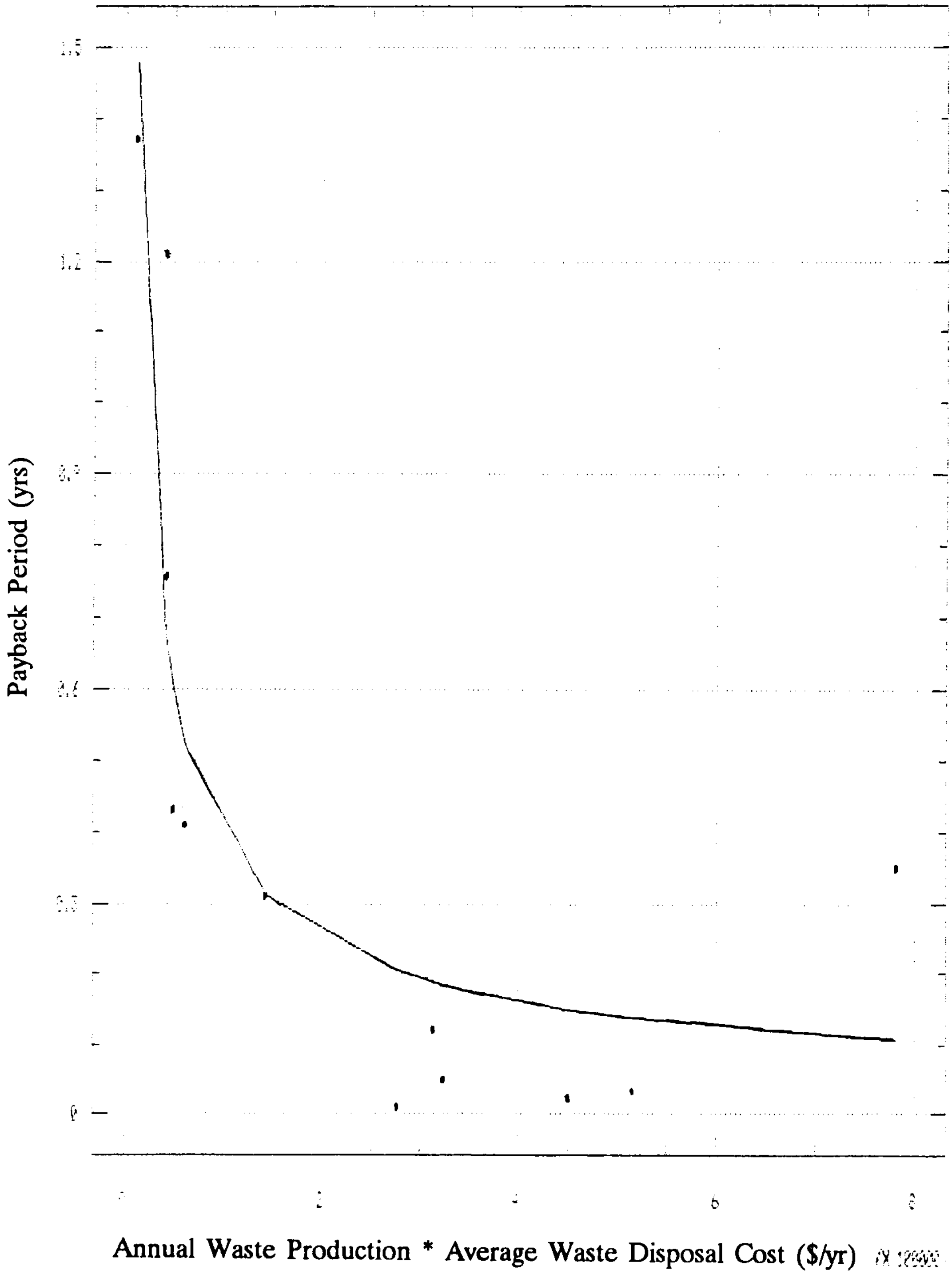

Figure 4.11. Non-linear curve fit of payback period on the product of annual waste production and average waste disposal cost (total annual waste disposal cost).
PBP = 530 * (AWP * AWDC)$^{-0.627}$, r = 0.887.

investment to be recovered (by the annual cost savings). The relationship that resulted for the curve fit is:

$$PBP = 530 * (AWP * AWDC)^{-0.627} \qquad (4\text{-}11)$$

The correlation coefficient was only 0.887 for the fit. Since this value is near +1, the equation can be used in the predictive model but the confidence in the accuracy of the results will not be as great as that for potential annual waste reduction and cost savings. Using equation (4-5), the standard deviation using this equation is $\pm$ 0.224 yrs. Study of Figure 4.11 shows that, due to the steep slope of the line, payback period estimates corresponding to total annual waste disposal costs (annual waste production * average waste disposal cost) less than $100,000/yr could contain a large amount of error. For total annual waste disposal costs greater than $100,000/yr, much of the estimation line would produce payback period estimates less than the standard error. Therefore, a more conservative rule to follow is that if the total annual waste disposal cost is less than $100,000/yr, the payback period will be less than 1.5 yrs. For total annual waste disposal costs greater than $100,000/yr the payback period will be 0.5 yrs. STATGRAPHICS calculated standard errors on C_0 and C_1 of $\pm$ 688 and $\pm$ 0.133, respectively.

Table 4.3 shows the total investment for the 12 bases (capital investment + cost of the waste reduction study) and the corresponding payback periods (calculated using the procedure presented in Example 1). Note that the study costs for the 3 ATC bases are estimates (see Table 3.1).

Table 4.3. Payback periods for the 12 bases for the capital investment and the cost of the waste reduction study combined.

COMMAND	BASE	TOTAL INVESTMENT ($)	PAYBACK PERIOD (YR)
Strategic Air Command	Barksdale	$132,956	1.5620
	Beale	$102,891	0.1654
	Carswell	$126,000	0.2584
	Castle	$125,929	2.9574
	K.I.Sawyer	$77,467	0.3763
	Loring	$146,530	0.4842
	Plattsburgh	$73,203	1.2508
Air Training Command	Keesler	$137,200	4.4432
	Lowry	$154,751	0.5675
	Randolph	$256,676	1.5675
Military Airlift Command	Charleston	$94,200	0.4249
	Hurlburt	$115,745	6.2084

Again, a non-linear regression was performed (payback period on the total annual waste disposal cost) to obtain the relationship (in the form of equation 4-10) of :

$$\boxed{PBP = 777 * (AWP * AWDC)^{-0.533} \qquad (4\text{-}12)}$$

The correlation coefficient for this curve fit was 0.775. Since this value is rather far from +1.0, the method of prediction of the payback period for the combination of the capital investment and the cost of the waste reduction study should be similar to that described for the payback period for the capital investment alone. Study of Figure 4.12 shows that, due to the steep slope of the line, payback period estimates corresponding to total annual waste disposal costs (annual waste production * average waste disposal cost) less than $100,000/yr could contain a large amount of error. For total annual waste disposal costs greater than \$100,000/yr, much of the estimation line would produce payback period estimates less than the standard error of $\pm$ 2.200 yrs. Therefore, a more conservative rule to follow is that if the total annual waste disposal cost is less than \$100,000/yr, the payback period will be approximately equal to or less than 6.0 yrs. For total annual waste disposal costs greater than \$100,000/yr the payback period will be approximately 1.5 yrs or less.

4.2.5. Computerization of Mathematical Model: The predictive equations for potential annual waste reduction, specific annual cost savings, and payback period (equations 4-2, 4-7, and 4-11 respectively) were entered into a spreadsheet in such a way that the user need only to enter the annual waste production and the average waste disposal cost in the indicated cells and the computer will calculate values for potential annual waste reduction, annual cost savings and approximate payback period. This computer model computes a payback period using equation 4-11 regardless of the value for total annual waste disposal cost. Therefore, the user should be aware that a more conservative estimate of the payback period is if the total annual waste disposal cost is less than \$100,000/yr, the payback period will be less than 1.5 yrs, and if the total annual waste disposal cost is greater than \$100,000/yr, the payback period will be less than 0.5 yrs.

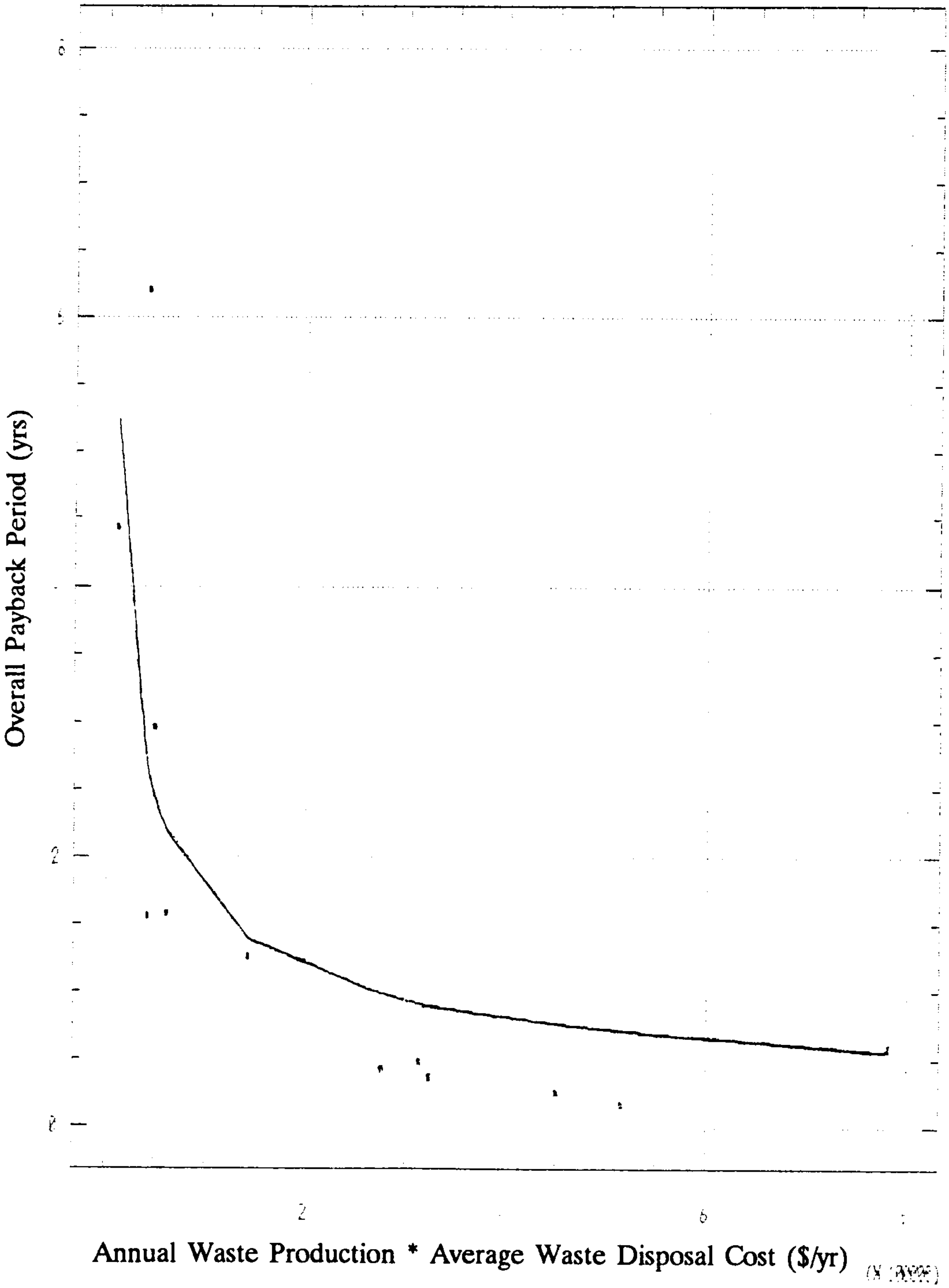

Figure 4.12. Non-linear regression of total payback period (on capital investment + cost of waste reduction study) on the product of annual waste production and average waste disposal cost (total annual waste disposal cost).
PBP = 777 * $(AWP * AWDC)^{-0.533}$, r = 0.775.

CHAPTER 5

TEST CASE EVALUATION

The relationships discussed above were tested by collecting data from a SAC base named Offutt that was not used in the model development. The waste reduction report from which the data were taken was completed in November of 1990 [38] and the study cost $97489 [7]. The base totals of its waste reduction parameters are: annual waste production = 52278 gal/yr, potential annual waste reduction = 35384 gal/yr, potential annual cost savings = $93925/yr, and capital investment = $29600.[38] Using the method illustrated in the Example 1 in Chapter 3, the payback period was calculated as 0.3467 yrs (USDF = 0.3151). A complete listing of the data for this base is located in Appendix B. Only one waste entry for Offutt Air Force Base had to be left in units of pounds because there was no conversion factor available. This entry was for 20 pounds of spill residue in the fuels management shop. Since the 20 pound production could not be reduced (and therefore produced no cost savings) and did not require any investment, only the value for production was affected by the exemption of this waste stream.

The distribution of the percentages of waste produced by various processes contributing to the base's overall waste production rate are shown in Figure 5.1. As described in the first section of Chapter 4, the corrosion control, fuels management, and vehicle maintenance shops contribute a considerable percentage to the annual waste production and reduction and cost savings. Processes unique to the base (e.g global weather and aerorepair), though, are also responsible for a large percentage of the

SHOP	% CONTRIB. TO TOTAL PRODUCTION	% CONTRIB. TO TOTAL REDUCTION	% CONTRIB. TO TOTAL SAVINGS	% CONTRIB. TO TOTAL INVESTMENT	% REDUCTION (PROD/RED)
AEROREPAIR	5.36%	1.13%	0.13%	0.00%	14.29%
AGE	18.20%	26.89%	27.37%	0.00%	100.00%
AUTO HOBBY SHOP	19.05%	1.02%	0.57%	0.00%	3.61%
CE PAINT SHOP	0.32%	0.31%	0.13%	0.00%	66.67%
CORROSION CONTROL	6.59%	7.21%	17.97%	84.46%	74.02%
FUEL SYSTEMS REPAIR	2.30%	3.39%	3.58%	0.00%	100.00%
FUELS MANAGEMENT	11.69%	15.54%	5.86%	0.00%	90.02%
GLOBAL WEATHER	6.89%	10.17%	9.58%	10.14%	100.00%
JET ENGINE	3.12%	4.59%	4.18%	0.00%	99.63%
LIQUID FUELS MAINT	1.10%	0.07%	0.06%	0.00%	4.35%
MEDICAL FACILITY	0.67%	0.72%	0.82%	0.00%	71.88%
NDI	0.45%	0.51%	0.46%	0.00%	76.60%
PHASE INSPECTION	1.15%	1.13%	1.22%	0.00%	66.67%
PNEUDRAULICS	2.52%	3.73%	3.61%	0.00%	100.00%
POWER PRODUCTION	0.61%	0.90%	0.69%	5.41%	100.00%
REFUELING MAINT	10.59%	12.61%	13.04%	0.00%	80.61%
VEHICLE MAINT	7.72%	7.80%	8.68%	0.00%	68.38%
WHEEL & TIRE	1.37%	2.02%	1.71%	0.00%	100.00%
ALL OTHER	0.32%	0.26%	0.35%	0.00%	54.82%
TOTAL	100.0%	100.0%	100.0%	100.0%	

Figure 5.1. Distribution showing which processes produce the most waste, allow for the most potential waste reduction and cost savings, and require the most investment.[37]

annual waste production and reduction and cost savings. Also notice that, as previously noted for 9 of the 12 bases in the study, the corrosion control shop is responsible for the majority of the required capital investment (84.5%).

To test the mathematical model developed in Chapter 4, the annual waste production and average waste disposal cost for Offutt Air Force Base were entered into equations 4-2, 4-7, and 4-11 by using the spreadsheet described in the last section of Chapter 4. The results of this test are shown in Figure 5.2. Note that the differences between the actual data and the predictions are all within the respective standard errors. Note also that the investment for Offutt is $29600, which is within the mode range of $0 to $40000 discussed in Chapter 4.

Although only time and frequent use will prove the validity of this model, this one test case implies that the model is a good predictor. One drawback of the model is that, although the test case results fell within the sample standard deviations, the sample standard deviations are a large percentage of the prediction. These relatively large values for sample standard deviation are acceptable, though, since the goal of this project is to develop a way to make rough estimates of potential annual waste reduction, annual cost savings, capital investment, and payback period with a small investment of time.

Assuming that this mathematical model is as valid for all Air Force commands as it is for the three commands used in the study, it can be used to estimate the waste reduction results that the United States would enjoy if the entire Air Force were to implement a waste reduction program.

WASTE REDUCTION COMPUTER MODEL

INPUT

ANNUAL WASTE PRODUCTION:	52278 (GAL/YR)
AVERAGE DISPOSAL COST:	1.659 ($/GAL)

OUTPUT

ANNUAL WASTE REDUCTION =	38715 (GAL/YR)
ANNUAL COST SAVINGS =	105939 ($/YR)
PAYBACK PERIOD =	0.4238 (YRS)

ANALYSIS

PARAMETER	ACTUAL	DIFFERENCE	STANDARD DEVIATION
PAWR	35384	3331	9653
PACS	93925	12014	53863
PBP	0.315	0.109	0.224
INVESTMENT	29600		0 TO 40000

Figure 5.2. Comparison of actual data and computer model results from the use of test data.

Example 2: Data collected for hazardous waste production at United States Air Force Installations showed that the annual waste production values for 1985, 1986, and 1987 were 60,485.52, 95,986.30, and 1,146,640.80 tons, respectively.[1] The data for 1987, though, is misleading in that it includes that waste which is reclaimed, recycled or reused or treated prior to disposal. Therefore, the estimate for hazardous waste production by the United States Air Force in 1986 will be used in this example. Since this is a mixture of various types of waste, an average conversion factor must be used to convert the production rate into gal/yr. The conversion factor used is the average 8.80, 8.34, and 7.80 lbs/gal, which are three values that Air Force bases Langley, Randolph, and Scott (respectively) use.[1] Using this average (8.31333 lb/gal) the annual production rate for 1986 is 23,092,142 gal/yr. Assuming that the average waste disposal cost for hazardous waste for the entire Air Force is the average value for the 13 bases in this study (12 from which data was collected and the 1 used for a test case) results in an estimated average waste disposal cost (from equation 4-4) of $3.9154/gal. Since there are approximately 100 U.S. AFB's, the total waste production can be divided by 100 to calculate an average waste production rate of 230,921 gal/yr for any U.S. AFB in 1986. Note that the use of this average will introduces some error because some of the bases produce a great deal more than this average while others produce a great deal less. Substituting the average waste disposal cost of $3.9154/gal and the average waste production rate of 230,921 gal/yr into the mathematical model developed above gives waste reduction values of:

Potential Annual Waste Reduction = 203,380 gal/yr

Potential Annual Cost Savings = $658,269/yr

Potential Payback Period = 0.0974 yrs

for each of the 100 bases. Total waste reduction parameters can be estimated by multiplying values for potential annual waste reduction and cost savings by 100. Since the total annual waste disposal cost is high (greater than $100,000/yr) the payback period should be assumed to be less than 0.5 yrs on the capital investment and less than 1.5 yrs for the total cost of the capital investment and the cost of the study (see discussion in section 4.2.4 above). Therefore, the potential annual waste reduction and cost savings for performing a waste reduction study at all U.S. AFB's are:

Potential Annual Waste Reduction = 20,338,000 gal/yr

Potential Annual Cost Savings = $65,826,900/yr

Using the potential annual savings and the maximum potential payback period on the required capital investment (to find the USDF), the capital investment can be calculated by rearranging equation 3-4 as follows:

NPV (investment) = USDF * annual cost savings (5-1)

From the table in the _Economic Analysis Handbook_, the USDF corresponding to a payback period of 0.5 yrs is 0.4545.[29] Therefore, the estimated required capital investment is:

Investment = 100 * (0.4545 * 658,269) = $29,918,326.

This example uses several assumptions that probably make the results grossly erroneous.

However, it illustrates that the practice of waste reduction can be very beneficial for both our environment and our pocketbooks (after all, even half of the reduction and savings estimated above is enough incentive to make the waste reduction effort worth while).

CHAPTER 6

CONCLUSIONS

1. The majority of the annual hazardous waste production, reduction, and cost savings at USAF installations under SAC, ATC, and MAC that implement waste reduction programs is usually found at three processes; corrosion control, fuels management, and vehicle maintenance.
2. On average, the hazardous waste produced by any process can be reduced by 40% to 100%.
3. In general, the majority (about 80%) of the capital investment required to implement a waste reduction program at one of these installations is required to reduce the waste produced by corrosion control.
4. Waste disposal costs are different for different waste streams and different bases (generators).
5. A waste reduction study at a SAC, ATC, or MAC base costs approximately $100,000.
6. The Waste Reduction Mathematical Model can be used to predict potential annual waste reduction and potential annual cost savings with a good degree of confidence using the following equations:

$$\boxed{PAWR = -9473 + 0.9218 * AWP \qquad (4\text{-}2)}$$

and

$$\boxed{PACS = 47336 + 0.6757 * AWP * AWDC \qquad (4\text{-}7)}$$

The standard errors on these equations are $\pm$ 9653 gal/yr and $\pm$ \$53863/yr, respectively.

7. In general, the capital investment required for a base to implement a waste reduction program is between \$20,000 and \$40,000.
8. Although equation 4-12 can be used to estimate the payback period on the required capital investment, a more conservative estimate is:

   for total annual waste disposal cost < \$100,000/yr, payback period < 1.5 yrs.

   for total annual waste disposal cost > \$100,000/yr, payback period < 0.5 yrs.
9. The Waste Reduction Mathematical Model should be used only for Air Force bases at which no full scale waste reduction program has previously been implemented.
10. If the U.S. Air Force had implemented waste reduction programs at all of the USAF installations in 1986, the United States could probably have reduced its hazardous waste production rate by approximately 20 million gal/yr and saved approximately a \$65 million/yr. Since the waste production rate is much higher today than it was in 1986, the waste reduction and cost saving resulting from the implementation of a waste reduction program at all U.S.A.F installations now would result in even higher values of potential annual waste reduction and cost savings.

CHAPTER 7

RECOMMENDATIONS

1. Since all of the data collected on results of a waste reduction study are "potential" results that would occur if all waste reduction recommendations were properly implemented, it would be very enlightening to find out how much of the potential annual waste reduction and cost savings has actually been realized through the implementation of waste reduction recommendations.
2. Research should be performed on the possibility of standardizing the types of recommendations made for situations common to all Air Force bases.
3. Data from waste reduction studies presently being performed and those performed in the future should collected and used to further test the validity of the Waste Reduction Mathematical Model developed in this paper.
4. Research should be performed to evaluate the possibility that a minimum annual waste production rate of 10,000 gal/yr is necessary to make the implementation of a waste reduction program profitable.

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APPENDICES

APPENDIX A. ANALYZED DATA

COMMAND: SAC/BASE: BARKSDALE

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	600	0	300	0	1,200	TREATMENT	4.26	4,000	3.700	.00	1. FILTER STRIPPER TO EXTEND ITS USEFUL LIFE. THIS COULD REDUCE STRIPPER USE BY UP TO 50%.
CORROSION CONTROL	RINSEWATER/STRIPPER	1,000	0	0	0	0	EQUIPMENT	.00	0	3.500	.00	1. MAXIMIZING THE USE OF THE PMB SYSTEM ALREADY IN OPERATION ON BASE WOULD REDUCE THE RINSEWATER RESULTING FROM CHEMICAL STRIPPING.
CORROSION CONTROL	MEK	1,100	0	610	0	20,515	SUBST/EQUIPMENT	.65	12,100	2.250	.00	CORROSION CONTROL DONE IN THREE BUILDINGS 1. BUILDING #6626 - PAINTS ENTIRE AIRCRAFT A. SPRAY GUN CLEANER - PRODUCED 300 GALLONS; REDUCED BY 220 GALLONS; SAVINGS OF $0; NO INVESTMENT INVOLVED - REDUCTION ACHEIVED BY USE OF SAFETY KLEEN GUN-CLEANING SERVICE. B. CLEAN-UP SOLVENT - PRODUCED 350 GAL; REDUCED BY 210 GAL; SAVINGS OF $892 FOR SOLVENT REPLACEMENT AND DISPOSAL, AND $13000 FOR PAINT REPLACEMENT; INVESTMENT OF $3500 - REDUCTION ACHEIVED BY REPLACING EXISTING SPRAY PAINT EQUIPMENT WITH AIRLESS SPRAY EQUIP. (ELECTROSTATIC EQUIP. NOT PRACTICAL BECAUSE OF FUEL PURGING REQUIREMENTS) 2. BUILDING #5755 - PAINTS AIRCRAFT PARTS CLEAN-UP SOLVENT - PRODUCED 250 GAL; REDUCED BY 100 GAL; SAVINGS OF $425 FOR SOLVENT REPLACEMENT AND DISPOSAL, AND $3700 FOR PAINT REPLACEMENT; INVESTMENT OF $4300 - REPLACE EXISTING SPRAY PAINT EQUIP. WITH ELECTROSTATIC EQUIP. 3. BUILDING #6824 - AGE AND A-10 AIRCRAFT CLEAN-UP SOLVENT - PRODUCED 200 GAL; REDUCED BY 80 GAL; SAVINGS OF $340 FOR SOLVENT REPLACEMENT AND DISPOSAL, AND $2158 FOR PAINT REPLACEMENT; INVESTMENT OF $4300 - SAME RECOMMENDATION AS #2 ABOVE.
CORROSION CONTROL	ALODINE/WATER	25	0	25	0	50	PROCEDURE	.00	0	2.000	.00	1. COLLECT ALODINE RINSEWATER AND USE IT TO MAKE UP FRESH SOLUTIONS WITH POWDERED ALODINE.
CORROSION CONTROL	ABRASIVE WASTE (PMB)	110	0	0	0	0	PROCEDURE	.00	0	.680	.00	1. TEST FOR EP TOXICITY - IF HAZARDOUS, USE I.E.DUPONT CORP. SERVICE TO RECYCLE WASTE.(110 GAL = 500 LBS)

CORROSION CONTROL	WATERFALL DISCHARGE	0	0	0	0	0	TREATMENT	.00	0	.250	.00	1. IF CURRENT DISPOSAL PRACTICE OF DISCHARGING WATER TO A SANITARY SEWER WERE DISCONTINUED DUE TO LACK OF COMPLIANCE, 100,000 GALLONS OF HAZARDOUS WASTE WOULD HAVE TO BE DISPOSED OF. A RECIRCULATING FILTER SYSTEM COULD ALLOW WATER IN TANK TO BE DISCHARGED TO SEWER (AS NON-HAZARDOUS WASTE). IF THE SYSTEM DOES NOT MAKE THE WATER NON-HAZARDOUS, IT WILL AT LEAST REDUCE DISPOSAL TO ONE CHANGE-OUT PER YEAR. (SAVINGS WOULD BE $25,000 IN DISPOSAL COST.)
CORROSION CONTROL	SHOP RAGS	800	0	800	0	120	SUBSTITUTION	.00	0	.150	.00	1. REPLACE SHOP RAGS WITH SHOP TOWELS WHICH CAN BE WASHED AND REUSED.
CORROSION CONTROL	SOLVENT (PD-680)	0	0	0	0	0	SUBSTITUTION	.00	0	1.750	.00	1. USE DETERGENT (SUCH AS AIRCRAFT CLEANER II) FOR ALL AIRCRAFT CLEANING. (CLEANER BASED ON GLYCOL ETHER SOLVENTS). THE USE OF PD-680 PRESENTS POSSIBLE FUTURE COMPLIANCE PROBLEMS. PRESENTLY, THE AIRCRAFT RINSEWATER CONTAINS 4125 GALLONS OF PD-680 PER YEAR. IT GOES TO THE OIL/WATER SEPERATOR WHERE IT EITHER EVAPORATES OR IS DISPERSED BY DETERGENT.
VEHICLE MAINT.	BATTERIES	5	0	0	0	0	CONTRACTOR	.00	0	30.000	.00	1. ELIMINATE BATTERY ACID WASTE (BOTH LEAD ACID AND NEUTRALIZED ACID) BY TURNING THE BATTERIES IN TO THE CONTRACT AUTOMOTIVE PARTS STORE WET INSTEAD OF DRY. 30 LB = 1 GAL
VEHICLE MAINT.	BATTERY ACID	90	0	90	0	27	CONTRACTOR	.00	0	.300	.00	1. ELIMINATE BATTERY ACID WASTE (BOTH LEAD ACID AND NEUTRALIZED ACID) BY TURNING THE BATTERIES IN TO THE CONTRACT AUTOMOTIVE PARTS STORE WET INSTEAD OF DRY.
VEHICLE MAINT.	WASTE OIL (SYNTHETIC)	380	0	0	0	0	SELL	.00	0	-.010	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON.
VEHICLE MAINT.	WASTE OIL (LUBE OIL)	1,600	0	0	0	0	SELL	.00	0	-.010	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON.
VEHICLE MAINT.	HYDRAULIC FLUID	150	0	0	0	0	SELL	.00	0	.300	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON.

VEHICLE MAINT.	PAINT THINNER/PAINT	45	0	18	0	76	PROCEDURE/EQUIP	.00	0	4.220	.00	1. A. PROHIBIT THE USE OF COMMERCIAL THINNERS. B. USE ONLY THE FOLLOWING CLEAN-UP SOLVENTS AND THINNERS: LACQUERS - MIBK, ACETONE, BUTANOL, OR BUTYL CELLOSE. ENAMELS - PURE NAPHTHA URETHANES - MIBK OR XYLENE C. SOLVENTS USED FOR LACQUIER AND ENAMEL CLEAN-UP SHOULD BE SEGREGATED BY COLOR AND REUSED AS THINNER. D. CLEAN-UP SOLVENTS USED FOR URETHANES CAN BE RECOVERED BY FILTRATION. (AMOUNTS FOR VOLUME REDUCTION AND COST SAVINGS ARE UNKNOWN) E. INSTALLATION OF ELECTROSTATIC SPRAY EQUIP. CAN REDUCE CLEAN-UP REQUIREMENTS BY 40%.
VEHICLE MAINT.	ANTIFREEZE	350	0	0	0	0	RECYCLE	.00	0	.300	.00	1. BASE PERSONNEL SHOULD FURTHER RESEARCH THE OPTION OF RECYCLING ANTIFREEZE.
VEHICLE MAINT.	FILTERS	500	0	250	0	3,500	EQUIPMENT	1.08	3,400	1.000	.00	1. THE USE OF IMPROVED SPRAY EQUIPMENT REDUCES OVERSPRAY. THIS RESULTS IN FEWER FILTER CHANGE-OUTS AND LESS PAINT USAGE.
VEHICLE MAINT.	PAINT	20	0	0	0	0	NONE	.00	0	4.000	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	STRIPPER	30	0	0	0	0	NONE	.00	0	4.000	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	DRUMS	0	0	0	0	0	NONE	.00	0	.350	.00	1. (ACTUAL VOLUMES UNKNOWN) NO OPTIONS FOR REDUCTION SUGGESTED.
PHASE INSPECTION	HYDRAULIC OIL	300	0	0	0	0	SELL	.00	0	.300	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISPOSAL COST ESTIMATED FROM HYDRAULIC FLUID DISPOSAL COST IN VEHICLE MAINTENANCE SHOP.
PHASE INSPECTION	WASTE OIL (JET ENGINE)	800	0	0	0	0	SELL	.00	0	.250	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISPOSAL COST ESTIMATED FROM WASTE OIL DISPOSAL COST IN VEHICLE MAINTENANCE SHOP.
PHASE INSPECTION	WASTE FUEL (JP-4)	0	0	0	0	0	RECYCLE	.00	0	.000	.00	

												1. CONTINUE TO RECYCLE ON BASE. (ALTHOUGH 800 GALLONS OF WASTE IS PRODUCED, IT IS ALREADY BEING RECYCLED ON BASE AND, THEREFORE, AVOIDS MANIFESTATION.)
JET ENGINE	SOLVENT (PD-680)	360	0	180	0	600	PROCEDURE	.00	0	1.750	.00	1. EXAMINE CHANGE-OUT SCHEDULE. IF POSSIBLE, CHANGE-OUT LESS OFTEN.(COULD PRODUCE A 50% SAVINGS) DISPOSAL COST ESTIMATED FROM SOLVENT DISPOSAL COST IN CORROSION CONTROL SHOP.
JET ENGINE	WASTE FUEL (JP-4)	300	0	300	0	150	REUSE	.00	0	-.010	.00	1. TEST FOR SPECIFICATIONS. IF IT MEETS SPECS, RETURN TO FUELS STORAGE. ELSE, USE FOR FIRE TRAINING OR DESTRUCTION OF EXPLOSIVE ORDINANCED BY OPEN PIT.
JET ENGINE	WASTE OIL (JET ENGINE)	500	0	0	0	0	SELL	.00	0	-.010	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISPOSAL COST ESTIMATED FROM WASTE OIL IN VEHICLE MAINT. SHOP.
JET ENGINE	HYDRAULIC FLUID	10	0	0	0	0	SELL	.00	0	.300	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISPOSAL COST ESTIMATED FROM HYD. FLUID IN VEHICLE MAINT. SHOP.
JET ENGINE	CARBON REMOVER	400	0	400	0	4,000	SUBSTITUTION	.00	0	10.000	.00	1. USE A CARBON REMOVER BASED ON ETHANOLAMINE, SODIUM PYROPHOSPHATE, TRISODIUM PHOSPHATE, OR GLYCOL ETHERS AND DISCHARGE TO A SANITARY SEWER (AFTER TESTING FOR HAZARDOUSNESS).
JET ENGINE	CLEANING CMPD.	300	0	300	0	1,200	SUBSTITUTION	.00	0	4.000	.00	1. (MADE OF HYDROCARBONS, DIETHYLENE GLYCOL, AND BUTYL CARBATHYL) SUBSTITUTE A CLEANER WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE CLEANER DESCRIBED ABOVE.
AGE (POWERED)	SOLVENT (PD-680)	0	0	0	0	0	PROCEDURE	.00	0	1.750	.00	1. EXAMINE CHANGE-OUT SCHEDULE. IF POSSIBLE, CHANGE-OUT SOLVENT VAT EVERY 12 WEEKS INSTEAD OF EVERY 8 WEEKS (50%LESS WASTE WOULD BE PRODUCED). (ACTUAL VOLUMES NOT AVAILABLE)
AGE (NON-POWERED)	SOLVENT (PD-680)	240	0	120	0	400	PROCEDURE	.00	0	3.330	.00	1. EXAMINE CHANGE-OUT SCHEDULE AND, IF POSSIBLE, CHANGE VAT OUT LESS OFTEN. (POSSIBLE 50% SAVINGS)

PNEUDRAULICS	SOLVENT	1,320	0	660	0	2,000	PROCEDURE	.00	0	3.000	.00	1. EXAMINE CHANGE-OUT SCHEDULE AND, IF POSSIBLE, CHANGE VAT OUT LESS OFTEN. (POSSIBLE 50% SAVINGS)
PNEUDRAULICS	HYDRAULIC FLUID	300	0	0	0	0	SELL	.00	0	.300	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON.
WHEEL & TIRE	SOLVENT (PD-680)	4,000	0	2,000	0	4,400	PROCEDURE	.00	0	2.200	.00	1. EXAMINE CHANGE-OUT SCHEDULE AND, IF POSSIBLE, CHANGE VAT OUT LESS OFTEN. (POSSIBLE 50% SAVINGS)
WHEEL & TIRE	SHOP RAGS	0	0	0	0	0	SUBSTITUTION	.00	0	.000	.00	ACTUAL VOLUME DATA NOT AVAILABLE. 1. REPLACE SHOP RAGS WITH SHOP TOWELS THAT CAN BE WASHED AND REUSED.
MUNITIONS MAINT.	SOLVENT (PD-680)	420	0	210	0	700	PROCEDURE	.00	0	3.330	.00	1. EXAMINE CHANGE-OUT SCHEDULE AND, IF POSSIBLE, CHANGE VAT OUT LESS OFTEN. (POSSIBLE 50% SAVINGS)
MUNITIONS MAINT.	HYDRAULIC FLUID	100	0	0	0	0	SELL	.00	0	.300	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON.
BATTERY	BATTERY ACID	250	0	125	0	75	CONTR/EQUIPMENT	.00	0	.300	.00	1. A. ESTABLISH A CONTRACT FOR BATTERY SERVICE. THE SERVICE ORGANIZATION ACCEPTS WET BATTERIES AND THE RESPNSIBILITY FOR THE DISPOSAL OF THE BATTERIES AND THE ACID. B. INSTALL A WATER CONSERVATION NOZZLE FOR SPRAYING BATTERIES. (COST IS NEGLIGIBLE)
BATTERY	BATTERIES (LEAD)	223	0	223	0	6,700	CONTRACTOR	.00	0	30.000	.00	1. ESTABLISH CONTRACT FOR BATTERY SERVICE. SERVICE ORGANIZATION ACCEPTS WET BATTERIES AND THE RESPONSIBILITY FOR THEIR DISPOSAL. 30 LB = 1 GAL
BATTERY	BATTERIES (NICd)	92	0	92	0	5,500	CONTRACTOR	.00	0	60.000	.00	1. ESTABLISH CONTRACT FOR BATTERY SERVICE. SERVICE ORGANIZATION ACCEPTS WET BATTERIES AND THE RESPONSIBILITY FOR THEIR DISPOSAL. 30 LB = 1 GAL
NDI	INSP PENETRANT	55	0	0	0	1	SELL	.00	0	.250	.00	1. SELL TO CONTRACTOR THROUGH USED OIL PROGRAM FOR $0.015/GALLON.
NDI	EMULSIFIER	0	0	0	0	0	SEWER	.00	0	.000	.00	

1. 110 GALLONS ARE CURRENTLY BEING DISCHARGED TO SANITARY SEWER. THIS PRACTICE SHOULD BE INVESTIGATED TO VALIDATE ITS SAFETY.

NDI	MAGNETIC PARTICLE SOLN.	110	0	110	0	0 TREATMENT	.00	0	.250	.00	1. (POTENTIAL COST SAVINGS UNKNOWN) FILTER AND REUSE. IF THIS PRACTICE PROVES UNACCEPTABLE, THE SOLUTION COULD BE SOLD THROUGH THE USED OIL PROGRAM FOR $0.015/GALLON.
NDI	DEVELOPER	0	0	0	0	0 SEWER	.00	0	.000	.00	1. 55 GALLONS ARE CURRENTLY BEING DISCHARGED TO SANITARY SEWER. THIS PRACTICE SHOULD BE INVESTIGATED TO VALIDATE ITS SAFETY.
NDI	WASTE OIL (ENGINE OIL)	160	0	0	0	0 SELL	.00	0	-.010	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISP. COST ESTIMATED FROM WASTE OIL IN VEHICLE MAINT. SHOP.
NDI	1,1,1 TRICHLOROETHANE	180	0	0	0	300 SUBSTITUTION	.00	0	2.200	.00	1. USE OF A PD-680 TANK REDUCES TCA USAGE BY 150 GAL/YR AND SAVES $300 ON FEEDSTOCK.
FUELS MANAGEMENT	WASTE FUEL (JP-4)	350	0	350	0	193 REUSE	.00	0	.200	.00	1. TEST FOR SPECIFICATIONS. IF IT MEETS SPECS, RETURN TO FUELS STORAGE. ELSE, USE FOR FIRE TRAINING OR DESTRUCTION OF EXPLOSIVE ORDINANCE BY OPEN PIT.
FUELS MANAGEMENT	WASTE FUEL (MOGAS/DIESEL)	700	0	700	0	385 REUSE	.00	0	.200	.00	1. TEST FOR SPECIFICATIONS. IF IT MEETS SPECS, RETURN TO FUELS STORAGE. ELSE, USE FOR FIRE TRAINING OR DESTRUCTION OF EXPLOSIVE ORDINANCED BY OPEN PIT.
FUELS MANAGEMENT	WASTE FUEL/OIL/SOLVENT	1,000	0	1,000	0	800 REUSE	.96	700	.200	.00	1. CONSTRUCT A JP-4 RECOVERY SYSTEM TO PREVENT JP-4 FROM MIXING WITH OIL IN THE OIL WATER SEPARATOR.
FUELS MANAGEMENT	WASTE OIL	8,200	0	0	0	0 SELL	.00	0	-.010	.00	1. CONTINUE TO SELL.
FUELS MANAGEMENT	HYDRAULIC FLUID	1,800	0	0	0	0 SELL	.00	0	-.010	.00	1. CONTINUE TO SELL.
FUELS MANAGEMENT	ANTIFREEZE	285	0	285	0	713 RECYCLE	1.73	1,077	.300	.00	1. RECYCLE THROUGH A FILTRATION SYSTEM.

CE PAINT SHOP	PAINT THINNER	50	0	0	0	0	NONE	.00	0	2.2[illegible]	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISP. COST ESTIMATED FROM MEK DISP. COST IN CORROSION CONTROL SHOP.
REPROGRAPHICS	BLANKET WASH	65	0	65	0	0	SUBSTITUTION	.00	0	.000	.00	1. SUBSTITUTE A NAPHTHA-BASED PRODUCT FOR THE BLANKET WASH NOW IN USE.
REPROGRAPHICS	ELECTROSTATIC SOLN	52	0	0	0	0	NONE		0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. (MADE OF POTASSIUM FERROCYANIDE)
AUTO HOBBY SHOP	SOLVENT (SAFETY KLEEN)	240	0	240	0	0	SUBSTITUTION	.00	0	2.850	.00	1. CHANGE CONTRACTOR FROM SAFETY-KLEEN TO ZEP, WHO CAN PROVIDE A SOLVENT THAT HAS A FLASH POINT GREATER THAN 143 DEGREES F AND THE EQUIP. FOR PARTS CLEANING AT THE SAME COST AS THE SAFETY-KLEEN SERVICE. (REDUCES WASTE FROM 240 GAL. TO 0 GAL)
AUTO HOBBY SHOP	PAINT RELATED WASTE	50	0	26	0	52	SUBSTITUTION	.00	0	4.000	.00	1. USE THE SAFETY KLEEN GUN CLEANING SERVICE.
AUTO HOBBY SHOP	WASTE OIL	10,000	0	0	0	0	SELL	.00	0	.250	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISP. COST ESTIMATED FROM WASTE OIL DISPOSAL IN OTHER SHOPS.
FIRE CONTROL	SOLVENT (PD-680)	600	0	300	0	500	PROCEDURE	.00	0	1.670	.00	1. CHANGE OUT VATS HALF AS OFTEN (THERFORE, PRODUCING HALF AS MUCH WASTE.)
FIRE CONTROL	WASTE OIL (LUBE)	100	0	0	0	0	SELL	.00	0	-.010	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISP. COST ESTIMATED FROM WASTE OIL DISP. IN OTHER SHOPS.
MEDICAL FACILITY	SILVER	0	0	0	0	0	EQUIPMENT	.00	0	.000	.00	VOLUME OF WASTE UNKNOWN. 1. COULD ADD A SILVER RECOVERY CARTRIDGE DOWNSTREAM FROM THE HOSPITAL ELECTROLYTIC SILVER RECOVERY UNIT AND TEST DISCHARGE FOR SILVER CONTENT.
PMEL	HYDRAULIC FLUID	5	0	0	0	0	SELL	.00	0	.300	.00	1. CONTINUE TO SELL TO CONTRACTOR FOR $0.015/GALLON. DISP. COST ESTIMATED FROM HYDRAULIC FLUID DISP. IN OTHER SHOPS.
PMEL	MERCURY	0	0	0	0	0	NONE	.00	0	.000	.00	

											1. NO OPTION FOR REDUCTION SUGGESTED. NO DISPOSAL COST FOUND. 113.1 LB = 1 GAL
PMEL	FREON 113	10	0	10	0	0 REUSE	.00	0	.000	.00	
											POTENTIAL COST SAVINGS UNKNOWN. 1. REUSE FOR LESS STRINGENT CLEANING REQUIREMENTS IN PMEL OR BATTERY AND ELECTRONICS SHOP. NO DISPOSAL COST FOUND.
ENTOMOLOGY & GOLF COURSE	PESTICIDES	0	0	0	0	0 PROCEDURE	.00	0	.000	.00	
											1. PROCEDURAL ALTERATIONS SUCH AS THE ALTERNATE USE OF TYPES OF PESTICIDES AND FERTILIZER MIXTURES, WHICH PREVENTS TOLERANCE BUILD-UP AND PROMOTES GOOD TURF, WILL RESULT IN LESS USE OF PESTICIDES.

COMMAND: SAC/BASE: BEALE

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	RINSEWATER/STRIPPER	60	0	0	0	0	NONE	.00	0	11.690	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
CORROSION CONTROL	MEK	55	0	0	0	0	NONE	.00	0	5.030	.00	1. THIS WASTE IS MADE UP OF THE STILL BOTTOMS THAT RESULT FROM THE DISTILLATION OF MEK.
CORROSION CONTROL	ALODINE/ACID	660	0	500	0	4,125	PROCEDURE/TREAT	.00	0	8.270	.00	1. A. SEGREGATE ACID AND ALODINE SOLUTION. B. NEUTRALIZE ACID WITH SODIUM BICARBONATE TO MAKE IT NON-HAZARDOUS.
CORROSION CONTROL	ABRASIVE WASTE (PMB)	1,980	0	1,980	0	0	RECYCLE	.00	0	.950	.00	1. RECYCLE THROUGH DUPONT.(NO SAVINGS DUE TO INCREASED COST OF PLASTIC MEDIA)
CORROSION CONTROL	WATERFALL DISCHARGE	50,000	0	50,000	0	131,500	PROCEDURE	.00	0	2.630	.00	1. DISCONTINUE PRACTICE OF DISCHARGING MEK INTO WATERFALL.
CORROSION CONTROL	PAINT RELATED WASTE	1,250	0	1,250	0	6,562	SUBSTITUTION	.00	0	5.250	.00	1. SUBSTITUTE WATER-BASED AND HIGH-SOLID URETHANE PAINTS FOR THE PAINTS CURRENTLY IN USE.
VEHICLE MAINT.	PAINT RELATED WASTE	40	0	20	0	64	SUBST/RECYCLE	.00	0	4.750	.00	1. A. SUBSTITUTE MEK FOR THE PAINT GUN CLEANER NOW IN USE. B. DISTILL MEK IN CORROSION CONTROL SHOP AND REUSE FOR CLEANING PURPOSES ONLY.
VEHICLE MAINT.	WATERFALL DISCHARGE	45,000	0	45,000	0	118,350	PROCEDURE	.00	0	2.630	.00	1. DISCONTIUE PRACTICE OF DISCHARGING SOLVENT INTO WATERFALL.
VEHICLE MAINT.	SOLVENT (PD-680)	45	0	23	0	65	PROCEDURE	.00	0	2.990	.00	1. USE TESTING KIT TO TEST PD-680 FOR USEFULNESS BEFORE DISPOSING OF IT.
VEHICLE MAINT.	WASTE OIL	840	0	0	0	0	SELL	.00	0	2.400	.00	1. CONTINUE TO SELL WASTE OIL. IF PRICE FOR WASTE OIL DROPS CONSIDER IMPLIMENTATION OF AN OIL ANALYSIS PROGRAM.

VEHICLE MAINT.	ANTIFREEZE	660	0	660	0	4,349	RECYCLE	1.29	5,000	2.500	.00	1. USE KLEERFLO FILTRATION UNIT TO RECYCLE ON BASE. 2. RECYCLE THROUGH ANTIFREEZE ENVIRONMENTAL SERVICES CORP.-CALIF.
PHASE INSPECTION	SPEEDY DRY/HYD FLUID	220	0	165	0	277	PROC/REUSE	.00	0	.870	.00	1. REUSE UNTIL SATURATED AND THEN USE AS PACKING FOR FUEL FILTERS. LESS IS USED BY USING PLASTIC BAGGIES TO CATCH THE DRAINING FLUID RATHER THAN DRAINING THE FLUID INTO A BED OF SPEEDY DRY. DISP. COST ESTIMATED FROM SPEEDY DRY DISPOSAL IN THE LIQUID FUELS MAINTENANCE SHOP.
JET ENGINE	SOLVENT (PD-680)/OIL	50	0	30	0	130	REUSE	.00	0	4.340	.00	1. REUSE THE PD-680 USED FOR BEARING CLEANING FOR GENERAL PARTS CLEANING.
JET ENGINE	WASTE FUEL	1,320	0	1,000	0	6,600	FRP	.00	0	6.600	.00	1. REMOVE WATER, FILTER AND BLEND WITH FRESH FUEL FOR REUSE IN THE FUEL RECOVERY PROGRAM. (JP-7 & JP-4)
JET ENGINE	CARBON REMOVER	15	0	15	0	178	SUBSTITUTION	.00	0	11.880	.00	1. SUBSTITUTE A MONOETHANOLAMINE BASED REMOVER FOR THE CARBON REMOVER NO IN USE. THE ETHANOLAMINE-BASED CARBON REMOVER CAN BE DISCHARGED TO A SANITARY SEWER AFTER A CHECK FOR CADMIUM. SUCH A DISCHARGE MUST BE COORDINATED WITH THE WATER TREATMENT FACILITY. SUBSTITUTION WOULD REQUIRE A CHANGE IN THE TECHNICAL ORDER.
JET ENGINE	FINGERPRINT REMOVER	2	0	0	0	0	NONE	.00	0	12.450	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
JET ENGINE	HYDRAULIC FLUID	12	0	0	0	0	RECYCLE	.00	0	10.670	.00	1. CONSIDER RECLAIMING THE USED HYDRAULIC FLUID.
JET ENGINE	WASTE OIL	830	0	0	0	0	SELL	.00	0	-.100	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH USED OIL PROGRAM.
JET ENGINE	WASTE FLUID (CALIBRATION)	50	0	0	0	0	NONE	.00	0	5.340	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
JET ENGINE	AEROSOL CANS	60	0	0	0	0	NONE	.00	0	3.640	.00	1. NO OPTION FOR REDUCTION SUGGESTED. (110 CANS = 60 GALLONS)

JET ENGINE	WASTE OIL (MINERAL)	2	0	0	0	0	NONE	.00	0	4.340	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
AGE	WASTE OIL (LUBE)	5,500	0	0	0	0	SELL	.00	0	-.100	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH USED OIL PROGRAM.
AGE	WASTE OIL/FLUIDS (SYNTH)	660	0	0	0	0	SELL	.00	0	-.100	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH USED OIL PROGRAM.
AGE	HYDRAULIC FLUID (PETRO)	220	0	0	0	0	NONE	.00	0	-.100	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
AGE	DETERGENT (DISS.-N-CLEAN)	315	0	315	0	1,008	SEWER	.00	0	3.200	.00	1. THIS MATERIAL IS COMPOSED OF SODIUM HYDROXIDE, ISOPROPANOL, AND ETHYLENE GLYCOL MONOBUTYLETHER. TEST FOR EP TOXICITY AND CORROSIVITY. IF BELOW REQUIRED LIMITS, DISCHARGE TO SANITARY SEWER.
AGE	REFRIGERANT (FREON)	0	0	0	0	0	RECYCLE	.00	0	.000	.00	1. INVESTIGATE PURCHASE OF A RECOVERY UNIT FOR FREON. SUCH A UNIT WOULD COST APPROXIMATELY $3800.00. THIS UNIT WOULD ELIMINATE THE RELEASE OF 250 LB/YR OF FREON TO THE ATMOSPHERE. ALTHOUGH THIS OPTIONS OFFERS NO SAVINGS OVER THE PRESENT PRACTICE, IT MAY PREVENT THE VIOLATION OF AIR EMISSION STANDARDS. OPERATION WOULD COST $240/YR MORE THAN THE PRESENT OPERATION.
AGE	AEROSOL CANS	550	0	275	0	1,000	SUBST/EQUIP	.03	24	3.640	.00	1. SUBSTITUTE NON-HAZARDOUS AEROSOL PRODUCTS OR SPRAY-PUMP CONTAINERS FOR THE AEROSOL PRODUCTS NOW IN USE WHENEVER POSSIBLE. (1000 CANS EQUALS 550 GALLONS)
PNEUDRALICS	HYDRAULIC FLUID	250	0	0	0	0	SELL	.00	0	2.400	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH USED OIL PROGRAM.
PNEUDRAULICS	SOLVENT (SAFETY KLEEN)	800	0	600	0	60	SUBSTITUTION	.00	0	2.400	.00	1. SUBSTITUTE MIRACHEM 100 FOR THE PD-680 NOW IN USE. THE MIRACHEM 100 CAN BE DISCHARGED TO A SANITARY SEWER AFTER USE. OTHER POSSIBLE SUBSTITUTIONS INCLUDE SIMPLE GREEN, & PENETONE'S FORMULA 724.
PNEUDRAULICS	MISC. SOLID WASTES	0	0	0	0	0	NONE	.00	0	.000	.00	1. VOLUMES OF SOLID WASTES PRODUCED IS UNKNOWN. THERE ARE NO

												OPTIONS FOR REDUCTION SUGGESTED FOR WHAT IS PRODUCED.
WHEEL & TIRE	SOLVENT (SAFETY KLEEN)	1,200	0	0	0	0	NONE	.00	0	2.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
WHEEL & TIRE	SOLVENT (SE 377c SOLN)	110	0	0	0	0	NONE	.00	0	4.430	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
WHEEL & TIRE	AEROSOL CANS	33	0	17	0	60	SUBST/EQUIP	.00	0	3.640	.00	1. CONSIDER THE USE OF BRUSH-ON PAINT FOR WHEELS AND REUSABLE PLASTIC TRIGGER-PUMP CONTAINERS FOR SOLVENTS AND LIGHT LUBRICANTS IN PLACE OF THE AEROSOL PRODUCTS NOW IN USE.(60 CANS EQUALS 33 GALLONS)
NDI	INSP PENETRANT	110	0	0	0	0	NONE	.00	0	8.320	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
NDI	EMULSIFIER	110	0	110	0	852	SEWER	.00	0	7.750	.00	1. DISCHARGE TO SANITARY SEWER.
NDI	MAGNETIC PARTICLE SOLN.	30	0	0	0	196	SELL	.00	0	6.420	.00	1. SHOULD SELL THROUGH THE USED OIL PROGRAM.
NDI	DEVELOPER	110	0	110	0	570	SUBSTITUTION	.00	0	5.180	.00	1. SUBSTITUTE MAGNAFLUX ZP58 FOR THE DEVELOPER NOW IN USE.
NDI	ISOPROPANOL	60	0	30	0	144	PROCEDURAL	.00	0	4.790	.00	1. BE MORE CAREFUL WHEN USING THE ISOPROPANOL AND CHANGE IT OUT ONLY WHEN NECESSARY.
NDI	AEROSOL CANS	83	0	55	0	200	EQUIPMENT	.00	0	3.640	.00	1. SUBSTITUTE TRIGGER-PUMP CONTAINERS FOR THE AEROSOL CANS NOW IN USE WHENEVER POSSIBLE. (150 CANS EQUALS 83 GALLONS)
CE PAINT SHOP	PAINT SLUDGE	20	0	20	0	153	SUBSTITUTION	.00	0	7.670	.00	1. SUBSTITUTE LATEX PAINT FOR THE ENAMELS AND ALKYDS CURRENTLY IN USE.
REPROGRAPHICS	DISPERSANT/DEVELOPER	12	0	0	0	0	EQUIP/PROC	.00	0	.000	.00	(VOLUMES OF REDUCTION ARE UNKNOWN) 1. REPLACE THE OFFSET PRINTING PROCESS CAPACITY WITH EQUIVALENT XEROGRAPHIC PROCESS CAPACITY-HAZARDOUS WASTE PRODUCTION COULD GO TO ZERO. (PRESENTLY NOT ECONOMICAL) 2. IF YOU RETAIN THE OFFSET PROCESS, USE 875 PLATEMAKER ONLY WHEN ABSOLUTELY NECESSARY AND CHANGE DISPERSANT/DEVELOPER

PNEUDRAULIC	HYDRAULIC FLUID	100	0	100	0	1,075	FRP	.00	0	10.000	.00	1. BURN FOR ENERGY RECOVERY.
WHEEL & TIRE	SOLVENT (PD-680)	660	0	594	0	4,742	RECYCLE	.44	1,878	10.000	.00	1. RECYCLE ON BASE.
EQUIPMENT MAINT.	SOLVENT (PD-680)	240	0	216	0	1,724	SUBSTITUTION	.44	683	10.000	.00	1. SUBSTITUE A NON-HAZARDOUS PRODUCT FOR THAT CURRENTLY BEING USED.
NDI	INSP PENETRANT	220	0	220	0	2,200	SUBSTITUTION	.00	0	10.000	.00	1. SUBSTITUE A NON-HAZARDOUS PRODUCT FOR THAT CURRENTLY BEING USED.
NDI	EMULSIFIER	220	0	220	0	2,200	SUBSTITUTION	.00	0	10.000	.00	1. SUBSTITUE A NON-HAZARDOUS PRODUCT FOR THAT CURRENTLY BEING USED.
NDI	MAGNETIC PARTICLE SOLN.	50	0	50	0	500	FRP	.00	0	10.000	.00	1. FILTER AND BURN FOR ENERGY RECOVERY.
CE PAINT SHOP	PAINT THINNER	300	0	210	0	956	RECYCLE	.98	854	10.000	.00	1. RECYCLE ON BASE.
REPROGRAPHICS	ELECTROSTATIC SOLN.	0	0	0	0	0	SUBSTITUTION	.00	0	10.000	.00	1. SUBSTITUTE NON-HAZARDOUS PRODUCT FOR THAT CURRENTLY BEING USED. ACTUAL AMOUNTS OF PRODUCTION AND SAVINGS ARE UNKNOWN.
REPROGRAPHICS	BLANKET WASH	0	0	0	0	0	SUBSTITUTION	.00	0	10.000	.00	1. SUBSTITUTE NON-HAZARDOUS PRODUCT FOR THAT CURRENTLY BEING USED. ACTUAL AMOUNTS OF PRODUCTION AND SAVINGS ARE UNKNOWN.
REPROGRAPHICS	DEGLAZING SOLN.	0	0	0	0	0	SUBSTITUTION	.00	0	10.000	.00	1. SUBSTITUTE NON-HAZARDOUS PRODUCT FOR THAT CURRENTLY BEING USED. ACTUAL AMOUNTS OF PRODUCTION AND SAVINGS ARE UNKNOWN.
AUTO HOBBY SHOP	WASTE OIL (MOTOR)	3,000	0	3,000	0	33,000	FRP	.00	0	10.000	.00	1. BURN FOR ENERGY RECOVERY.
AUTO HOBBY SHOP	SOLVENT (PD-680/SAFE KLN)	1,180	0	1,062	0	8,478	RECYCLE	.44	3,358	10.000	.00	1. RECYCLE ON BASE.

FIRE CONTROL	SOLVENT (PD-680)	110	0	99	0	790	RECYCLE	.44	313	10.000	.00	1. RECYCLE ON BASE.
REFUELING MAINT.	SOLVENT (PD-680/SAFE.KLN)	355	0	320	0	2,550	SUBST/RECYCLE	.44	1,010	10.000	.00	1. SUBSTITUTE PD-680 FOR THE 300 GALLONS OF SAFETY KLEEN SOLVENT AND RECYCLE ON BASE.
REFUELING MAINT.	WASTE FUEL (JP-4)	5,000	0	5,000	0	53,600	RECYCLE/FT	.00	0	10.000	.00	1. A. RECLAIM AND REUSE 90%. B. BURN OTHER 10% FOR FIRE TRAINING.
REFUELING MAINT.	ANTIFREEZE	70	0	70	0	700	SEWER	.00	0	10.000	.00	1. DISCHARGE TO SANITARY SEWER.
REFUELING MAINT.	WASTE OIL (MOTOR)	240	0	240	0	2,640	FRP	.00	0	10.000	.00	1. BURN FOR ENERGY RECOVERY.
REFUELING MAINT.	WASTE FLUID (TRANSMISS.)	24	0	24	0	240	FRP	.00	0	10.000	.00	1. BURN FOR ENERGY RECOVERY.
REFUELING MAINT.	DETERGENT (AIRCRAFT)	120	0	0	0	0	NONE	.00	0	10.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
POWER PRODUCTION	WASTE OIL (SYNTHETIC)	156	0	0	0	1,881	RECYCLE	.00	0	10.000	.00	1. RECYCLE OFF BASE.
POWER PRODUCTION	WASTE FUEL (MOGAS)	108	0	108	0	829	FRP/FT	.00	0	10.000	.00	1. A. BURN GASOLINE FOR FIRE TRAINING. B. BURN DIESEL FOR ENERGY RECOVERY IN HOSPITAL BOILER.
POWER PRODUCTION	SOLVENT	108	0	97	0	773	RECYCLE	.44	307	10.000	.00	1. RECYCLE ON BASE.
301 RESERVES	ANTIFREEZE	60	0	60	0	600	SEWER	.00	0	10.000	.00	1. DISCHARGE TO SANITARY SEWER.
301 RESERVES	WASTE FLUIDS	312	0	312	0	3,432	FRP	.00	0	10.000	.00	1. BURN FOR ENERGY RECOVERY.
AEROREPAIR	SOLVENT (PD-680)	640	0	576	0	4,598	RECYCLE	.44	1,821	10.000	.00	1. RECYCLE ON BASE. (301ST RESERVES)
AEROREPAIR	STRIPPER	100	0	90	0	539	RECYCLE	.58	285	10.000	.00	1. RECYCLE ON BASE. (301ST RESERVES)

PHASE DOCK	SOLVENT (PD-680)	480	0	432	0	3,449	RECYCLE	.44	1,366	10.000	.00
	1. RECYCLE ON BASE. (301ST RESERVES)										
PHASE DOCK	CARBON REMOVER	8	0	7	0	55	RECYCLE	.44	23	10.000	.00
	1. RECYCLE ON BASE. (301ST RESERVES)										
PHASE DOCK	WASTE FUEL (JP-4)	600	0	600	0	6,432	RECYCLE/FT	.00	0	10.000	.00
	1. A. RECLAIM AND REUSE 90%. B. BURN 10% FOR FIRE TRAINING.(301ST RESERVES ONLY)										
TEST CELL	WASTE OIL (SYNTHETIC)	60	0	0	0	724	RECYCLE	.00	0	10.000	.00
	1. RECYCLE OFF BASE.										
TEST CELL	WASTE FUEL (JP-4)	240	0	240	0	2,573	RECYCLE/FT	.00	0	10.000	.00
	1. A. RECLAIM AND REUSE 90%. B. BURN 10% FOR FIRE TRAINING.										
TEST CELL	SOLVENT	24	0	22	0	178	RECYCLE	.44	68	10.000	.00
	1. RECYCLE ON BASE.										

COMMAND: SAC/BASE: CARSWELL

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	822	0	740	0	4,429	RECYCLE	.58	2,339	10.000	.00	1. IMPLEMENT AN ON-BASE RECYCLING PROGRAM.
CORROSION CONTROL	FILTERS	1,200	0	1,200	0	9,600	VARIANCE	.00	0	10.000	.00	1. CAN BE PROVEN TO BE NON-HAZARDOUS (CURING PROCESS REDUCES SOLVENT TO LOW LEVELS, AND PAINT HAZARDS ARE BOUND IN PAINT MATRIX).
CORROSION CONTROL	ABRASIVE WASTE (PMB)	510	0	510	0	4,800	VARIANCE	.00	0	10.000	.00	1. CAN BE PROVEN TO BE NON-HAZARDOUS.
CORROSION CONTROL	MEK	240	0	216	0	1,724	RECYCLE	.44	683	10.000	.00	1. RECYCLE ON BASE.
CORROSION CONTROL	PAINT THINNER/PAINT	720	0	504	0	2,293	RECYCLE	.98	2,049	10.000	.00	1. RECYCLE ON BASE.
CORROSION CONTROL	ALODINE	120	0	0	0	0	NONE	.00	0	10.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	WASTE OIL (MOTOR)	2,280	0	2,280	0	19,350	FRP	.00	0	10.000	.00	1. BURN FOR ENERGY RECOVERY IN HOSPITAL BOILER.
VEHICLE MAINT.	WASTE FLUIDS	384	0	384	0	4,125	FRP	.00	0	10.000	.00	1. BURN FOR ENERGY RECOVERY IN HOSPITAL BOILER.
VEHICLE MAINT.	SOLVENT (SAFETY KLEEN)	584	0	526	0	4,201	RECYCLE	.44	1,662	10.000	.00	1. RECYCLE ON BASE.
VEHICLE MAINT.	WASTE FUEL (MOGAS)	240	0	240	0	4,800	RECYCLE	.00	0	10.000	.00	1. RECYCLE ON BASE.
VEHICLE MAINT.	PAINT THINNER	120	0	84	0	382	RECYCLE	.98	341	10.000	.00	1. RECYCLE ON BASE.
VEHICLE MAINT.	ANTIFREEZE	600	0	600	0	6,000	SEWER	.00	0	.000	.00	1. DISCHARGE TO SANITARY SEWER.
VEHICLE MAINT.	STRIPPER	60	0	54	0	323	RECYCLE	.58	171	10.000	.00	

												B. LIMIT PAINTING WITH AEROSOL CANS.
VEHICLE MAINT.	FILTERS (PAINT)	110	0	110	0	237	SUBSTITUTION	.00	0	5.790	.00	1. THE USE OF WATERBORNE COATINGS (WHICH WOULD REQUIRE A CHANGE IN THE TECHNICAL ORDER) WOULD MAKE THIS WASTE NON-HAZARDOUS.
PHASE INSPECTION	SPEEDY DRY	11,550	0	10,725	0	28,030	REUSE/PROCEDURE	.00	0	2.760	.00	1. REUSE UNTIL SATURATED AND THEN USE AS PACKING FOR FUEL FILTERS. LESS IS USED BY USING PLASTIC BAGGIES TO CATCH THE DRAINING FLUID RATHER THAN DRAINING THE FLUID INTO A BED OF SPEEDY DRY. (200 LBS PER 55 GALLONS)
JET ENGINE	SOLVENT (SAFETY KLEEN)	455	0	174	0	812	SUBSTITUTION	.00	0	3.750	.00	1. USE SOLVENT WITH FLASH POINT AT LEAST 143 DEGREES F.
JET ENGINE	CARBON REMOVER	550	0	288	0	6,266	PROCEDURE	.00	0	7.310	.00	1. CHANGE CARBON REMOVER LESS FREQUENTLY. CARBON REMOVER CONTAINS CHRESYLIC ACID, ORTHODICHLOROBENZENE, AND METHYLENE CHLORIDE.
JET ENGINE	SPEEDY DRY	550	0	330	0	275	REUSE/PROCEDURE	.00	0	2.760	.00	1. REUSE UNTIL SATURATED AND THEN USE AS PACKING FOR FILTERS. (550 GALLONS = 2000 POUNDS)
AGE	SOLVENT (SAFETY KLEEN)	520	0	520	0	784	SUBST/EQUIP/TRE	1.90	1,298	3.750	.00	1. INSTALL A PARTS WASHER, USE HIGH FLASH POINT SOLVENT, AND FILTER AND REUSE SOLVENT.
AGE	REFRIGERANT (FREON)	454	0	113	0	0	PROCEDURE/REUSE	.00	0	.000	.00	1. RECOVER 50% OF THE FREON RELEASED DURING A/C MAINTENANCE. (THIS ACTION WILL COST $592 MORE THAN THE CURRENT PRACTICE, BUT IT WILL ALLOW COMPLIANCE WITH INEVITABLE REGULATIONS ON FREON RELEASE.) 11 LB = 1 GAL
AGE	AEROSOL CANS	660	0	660	0	575	SUBST EQUIPMENT	.00	0	.380	.00	1. USE A NON-HAZARDOUS SOLVENT IN A REFILLABLE SPRAY-PUMP CAN. (660 GAL = 1200 CANS)
AGE	FREON GAS TANKS	0	200	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
PNEUDRAULICS	SOLVENT (SAFETY KLEEN)	680	0	600	0	1,248	SUBSTITUTION	.00	0	2.080	.00	1. SUBSTITUTE EITHER MIRACHEM 100, SIMPLY GREEN, OR FORMULA

724
(IN THAT ORDER) FOR PD-680.

PNEUDRAULICS	HYDRAULIC FLUID	250	0	50	0	122 TREATMENT	.00	0	2.440	.00	1. FILTER HYDRAULIC FLUID TO EXTEND ITS LIFE.
WHEEL & TIRE	SOLVENT	160	0	0	0	0 NONE	.00	0	4.810	.00	1. NO BETTER OPTIONS AVAILABLE AT THIS TIME.
WHEEL & TIRE	SLUDGE/SPEEDY DRY	110	0	60	0	300 PROCEDURE	.00	0	3.610	.00	1. DISPOSE OF SLUDGE AS A LIQUID RATHER THAN MIXING IT WITH SPEEDY DRY.
WHEEL & TIRE	AEROSOL CANS	55	0	55	0	0 EQUIPMENT	.00	0	1.100	.00	1. USE BRUSH-ON PAINT AND TRIGGER-PUMP CONTAINERS RATHER THAN AEROSOL CANS.
MUNITIONS MAINT.	SOLVENT (PD-680)	34	0	0	0	99 SUBSTITUTION	.00	0	3.810	.00	1. SUBSTITUTE SOLVENT WITH FLASH POINT OF AT LEAST 143 DEGRRES FFOR PD-680. THIS WASTE WOULD BE A CALIFORNIA RECYCLABLE HAZARDOUS WASTE WITH A LOWER DISPOSAL COST.
MUNITIONS MAINT.	ALODINE/WATER	20	0	14	0	168 SUBST/RECYCLE	.00	0	5.900	.00	1. STANDARDIZE SOLVENT USAGE TO MEK, DISTILL IN CORR. CONTROL SHOP AND REUSE.
MUNITIONS MAINT.	PAINT RELATED WASTE	10	0	7	0	84 SUBST/RECYCLE	.00	0	5.060	.00	1. STANDARDIZE SOLVENT USAGE TO MEK, DISTILL IN CORR. CONTROL SHOP AND REUSE.
MUNITIONS MAINT.	AEROSOL CANS	220	0	0	0	0 NONE	.00	0	1.100	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
NDI	INSP PENETRANT	440	0	0	0	0 PROCEDURE	.00	0	8.270	.00	1. POSSIBLE REDUCTIN MIGHT BE OBTAINED BY EXTENDING THE PENETRANT CHANGE-OUT PERIOD.
NDI	EMULSIFIER	440	0	440	0	3,810 SUBSTITUTION	.00	0	8.270	.00	1. SUBSTITUTE HYDROPHILIC EMULSIFIER FOR THAT CURRENTLY IN USE.
NDI	MAGNETIC PARTICLE SOLN.	100	0	0	0	828 SELL	.00	0	8.270	.00	1. SELL AS USED OIL TO BE BURNED.

NDI	DEVELOPER	440	0	440	0	0	SUBSTITUTION	.00	0	.000	.00	1. SUBSTITUTE A NON-CHROMATE BASED DEVELOPER FOR THAT CURRENTLY IN USE. NO SAVINGS ARE REALIZED BECAUSE THE DEVELOPER IS NOT CURRENTLY BEING DISPOSED OF AS HAZARDOUS WASTE.
NDI	1,1,1-TRICHLOROETHANE	56	0	28	0	382	SUBSTITUTION	.00	0	10.370	.00	1. SUBSTITUTE ISOPROPANOL FOR TCA.
NDI	AEROSOL CANS	83	0	28	0	50	EQUIPMENT	.00	0	2.910	.00	1. SUBSTITUTE NON-AEROSOL CONTAINERS FOR AEROSOL CANS WHEN POSSIBLE (150 CANS EQUALS 83 GALLONS)
FUELS MANAGEMENT	WASTE FUEL	350	0	0	0	0	NONE	.00	0	4.250	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISP. COST ESTIMATED FROM WASTE FUEL IN VEHICLE MAINT. SHOP.
FUELS MANAGEMENT	WASTE OIL	6,000	0	0	0	2,200	SELL	.00	0	2.440	.00	1. SELL TO OUTSIDE CONTRACTOR.
REPROGRAPHICS	FIXER	480	0	480	0	1,272	SEWER	.00	0	2.650	.00	1. CAREFUL RECOVERY OF SILVER FROM THE FIXER SHOULD PRODUCE OF WASTE WITH A SILVER CONTENT LOW ENOUGH THAT THE FIXER CAN BE DISCHARGED INTO THE SEWER. (ALREADY HAVE RECOVERY EQUIPMENT)
AUTO HOBBY SHOP	SOLVENT (PD-680)	70	0	0	0	197	SUBSTITUTION	.00	0	2.810	.00	1. SUBSTITUTE SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR PD-680 (IE. PENETONE'S FORMULA 724). THIS WOULD MAKE THE WASTE A CALIFORNIA RECYCLABLE HAZARDOUS WASTE (LOWERING THE COST OF DISPOSAL).
AUTO HOBBY SHOP	CARBON REMOVER	24	0	0	0	0	NONE	.00	0	10.250	.00	1. NO AVAILABLE OPTIONS ARE PRESENTLY ECONOMICAL. CONTAINS CRESYLIC ACID, ORTHODICHLOROBENZENE, AND METHYLENE CHLORIDE. TOTAL SERVICE COST OF $372 FOR 24 GALLONS ($15.50/GAL) MINUS FEEDSTOCK COST ($5.25/GAL) MAKES DISP. COST OF $10.25/GAL)
AUTO HOBBY SHOP	PAINT RELATED WASTE	60	0	0	0	0	PROCEDURE	.00	0	6.060	.00	1. REDUCTIONS COULD BE REALIZED BY TRAINING PAINT BOOTH USERS TO MINIMIZE OVERSPRAY AND BY ENCOURAGING THE USE OF WATERBORNE ACRYLICS. DISP. COST ESTIMATED FROM PAINT RELATED WASTE IN VEHICLE MAINT. SHOP.

AIRCRAFT WASH RACK	SOLVENT (PD-680)	6,250	0	6,250	0	22,860	SUBSTITUTION	.00	0	3.810	.00	1. SUBSTITUTE A BIODEGRADABLE SOLVENT (D-LIMONENE BASED)FOR THE PD-680.
FIRE CONTROL	SOLVENT (PD-680)	520	0	520	0	784	SUBSTITUTION	.91	649	2.410	.00	1. USE GOVERNMENT OWNED EQUIPMENT AND A HIGH FLASH POINT SOLVENT INSTEAD OF CONTRACTOR SERVICE. USED SOLVENT CAN BE HANDLED AS WASTE OIL.
REFUELING MAINT	SOLVENT (PD-680)	240	0	240	0	161	SUBSTITUTION	1.40	200	1.600	.00	1. SUBSTITUTE A D-LIMONENE BASED SOLVENT FOR THE PD-680 (MAY REQUIRE THE PURCHASE OF A VAT.)
REFUELING MAINT	FILTERS (FUEL)/SPEEDY DRY	1,605	0	1,600	0	6,488	REUSE	.00	0	3.500	.00	1. DRY FILTERS AND DISPOSE OF THEM AS A SOLID WASTE.
REFUELING MAINT	AEROSOL CANS	13	0	13	0	48	SUBSTITUTION	.00	0	1.100	.00	1. SUBTITUTION OF CITRIKLEEN FOR FREON 113 MAKES CANS NON-HAZARDOUS. (24 CANS EQUALS 13 GALLONS)
LIQUID FUEL MAINT	SLUDGE	25	0	0	0	0	NONE	.00	0	.890	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
LIQUID FUEL MAINT	SPEEDY DRY	30	0	30	0	150	REUSE	.00	0	.890	.00	1. FILL SLUDGE DRUMS WITH USED SPEEDY DRY RATHER THAN NEW SPEEDY DRY.
MACHINE SHOP	ABRASIVE WASTE	22	0	0	0	0	PROCEDURE	.00	0	.000	.00	1. TEST - IF NOT HAZARDOUS CAN BE DISPOSED OF AS SOLID WASTE. (22 GAL = 100 LBS)
MACHINE SHOP	AEROSOL CANS	28	0	0	0	0	NONE	.00	0	1.100	.00	1. (50 CANS EQUALS 28 GALLONS) NO OPTION FOR REDUCTION SUGGESTED. DISP. COST ESTIMATED FROM AEROSOL CANS IN WHEEL & TIRE SHOP.
MACHINE SHOP	SHOP RAGS	150	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
POWER PRODUCTION	ANTIFREEZE	55	0	0	0	0	NONE	.00	0	.000	.00	1. SENT TO VEHICLE MAINTENANCE SHOP FOR DISPOSAL.
POWER PRODUCTION	BATTERIES	20	0	0	0	630	CONTRACTOR	.00	0	31.500	.00	1. EXCHANGE PROGRAM WITH AN COPARS - COPARS HANDLES USED BATTERIES AND SELLS NEW ONES TO THE BASE.(600 LBS = 20

BATTERIE AND 1 BATTERY = 1 GAL)

POWER PRODUCTION	BATTERY ACID	10	0	0	0	26	CONTRACTOR	.00	0	2.650	.00	1. EXCHANGE PROGRAM WITH AN COPARS - COPARS HANDLES BATTERYACID.
HEAT SHOP	REFRIGERANT (FREON)	177	0	89	0	184	REUSE	13.50	1,331	.000	.00	1. REUSE OF 50% OF THE FREON REMOVED FOR MAINTENANCE. (WOULD REQUIRE THE PURCHASE OF NEW EQUIPMENT AND ADDITIONAL MAN-HOURS). 11 LB = 1 GAL
TRAINER MAINT.	HYDRAULIC FLUID	100	0	0	0	425	SELL	.00	0	1.750	.00	1. SELL TO RECYCLERS.
TRAINER MAINT.	SPEEDY DRY/FILTERS	1	0	0	0	0	NONE	.00	0	3.500	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED. (1 GALLON = 3 POUNDS) DISP. COST ESTIMATED FROM SPEEDY DRY IN REFUELING MAINT.

COMMAND: SAC/BASE: CASTLE

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	684	0	616	0	3,325	EQUIPMENT	20.23	28,411	5.400	.00	1. REPLACE CHEMICAL STRIPPING PROCESS WITH A PMB SYSTEM.
CORROSION CONTROL	RINSEWATER/STRIPPER	5,000	0	4,500	0	20,550	EQUIPMENT	.00	0	4.110	.00	1. REPLACE CHEMICAL STRIPPING PROCESS WITH A PMB SYSTEM.
CORROSION CONTROL	MEK	1,300	0	1,000	0	5,310	TREATMENT	.00	0	5.310	.00	1. FILTER AND REUSE.
CORROSION CONTROL	ABRASIVE WASTE (PMB)	90	0	90	0	418	VARIANCE	.00	0	4.650	.00	1. MIX PAINT CHIPS WITH OTHER ABRASIVE WASTES TO DILUTE TOXICITY, AND TEST MIXURE FOR TOXICITY LEVEL.
CORROSION CONTROL	ALODINE	50	0	0	0	0	NONE	.00	0	5.150	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	SOLVENT (SAFETY KLEEN)	320	0	0	0	0	NONE	.00	0	2.680	.00	1. SHOP PERSONEL PREFER TO CONTINUE USE OF SAFETY-KLEEN SOLVENT.
VEHICLE MAINT.	PAINT RELATED WASTE	55	0	55	0	333	SUBSTITUTION	.00	0	6.060	.00	1. USE WATERBORN ACRYLICS (HAS DEMONSTRATED SUPERIOR QUALITY BUT REQUIRES A TECHNICAL ORDER CHANGE.)
VEHICLE MAINT.	CARBON REMOVER	64	0	64	0	220	DISCONTINUE	.00	0	3.440	.00	1. DISCONTINUE USE. (ALSO REFERRED TO AS CARBURETOR CLEANER)
VEHICLE MAINT.	MEK (SPRAY GUN CLEANER)	72	0	72	0	360	DISCONTINUE	.00	0	5.000	.00	1. DISCONTINUE USE.
VEHICLE MAINT.	STRIPPER (CAUSTIC SOLN.)	20	0	20	0	103	DISCONTINUE	.00	0	5.150	.00	1. DISCONTINUE USE. (SOLUTION USED TO CLEAN RADIATORS)
VEHICLE MAINT.	WASTE FUEL	720	0	300	0	2,685	PROCEDURE	.00	0	4.250	.00	1. MANAGEMENT SHOULD PROMOTE MORE CAREFUL HANDLING OF FUEL.
VEHICLE MAINT.	AEROSOL CANS	110	0	0	0	0	EQUIP/PROCEDURE	.00	0	2.500	.00	1. A. PURCHASE PRODUCTS IN NON-AEROSOL CONTAINERS AND APPLY WITH RAG.

1. RECYCLE ON BASE.

JET ENGINE	SOLVENT (PD-680)	360	0	324	0	587	RECYCLE	2.01	1,024	10.000	.00
	1. RECYCLE ON BASE.										
JET ENGINE	CARBON REMOVER	120	0	108	0	862	RECYCLE	.44	341	10.000	.00
	1. RECYCLE ON BASE.										
JET ENGINE	WASTE FUEL (JP-4)	180	0	180	0	1,930	RECYCLE/FT	.00	0	10.000	.00
	1. A. RECLAIM AND REUSE 90%. B. BURN 10% FOR FIRE TRAINING.(7TH FMS + 301ST)										
JET ENGINE	WASTE OIL (SYNTHETIC)	324	0	0	0	3,907	RECYCLE	.00	0	10.000	.00
	1. RECYCLE OFF BASE. (301ST CAMS + 7TH FMS)										
AGE	SOLVENT (PD-680)	1,920	0	1,728	0	13,795	RECYCLE	.44	5,463	10.000	.00
	1. RECYCLE ON BASE.										
AGE	HYDRAULIC FLUID	660	0	660	0	4,380	FRP	.00	0	.000	.00
	1. BURN FOR ENERGY RECOVERY IN HOSPITAL BOILER.										
AGE	SOLVENT (CITROKLEEN)	660	0	594	0	4,742	RECYCLE	.44	1,878	10.000	.00
	1. RECYCLE ON BASE.										
AGE	MEK	12	0	11	0	89	RECYCLE	.44	34	10.000	.00
	1. RECYCLE ON BASE.										
AGE	WASTE FUEL (JP-4)	1,386	0	1,386	0	14,858	RECYCLE/FT	.00	0	10.000	.00
	1. A. RECLAIM AND REUSE 90%. B. BURN 10% FOR FIRE TRAINING.										
AGE	WASTE FUEL (MOGAS)	594	0	594	0	4,558	FRP/FT	.00	0	10.000	.00
	1. A. BURN GASOLINE FOR FIRE TRAINING. B. BURN DIESEL FOR ENERGY RECOVERY IN HOSPITAL BOILER.										
AGE	WASTE OIL (PETROLEUM)	1,960	0	1,960	0	15,880	FRP	.00	0	10.000	.00
	1. BURN FOR ENERGY RECOVERY IN HOSPITAL BOILER. (OIL FROM 301ST CAMS +7TH FMS)										
AGE	WASTE OIL (SYNTHETIC)	1,000	0	0	0	12,060	RECYCLE	.00	0	10.000	.00
	1. RECYCLE OFF BASE. (301ST CAMS + 7TH FMS)										
PNEUDRAULIC	SOLVENT (PD-680)	720	0	648	0	5,173	RECYCLE	.44	2,049	10.000	.00
	1. RECYCLE ON BASE.										

												ONLY WHEN PERFORMANCE OF EQUIPMENT INDICATES A CHANGE.
REPROGRAPHICS	BLANKET WASH	12	0	0	0	0	SUBSTITUTION	.00	0	.000	.00	1. COULD SUBSTITUTE MULTILITH BLANKROLLA II (WHICH IS ONLY CHARACTERISTICALLY HAZARDOUS) FOR THE BLANKET WASH NOW IN USE.
REPROGRAPHICS	ELECTROSTATIC SOLN	12	0	0	0	0	SUBSTITUTION	.00	0	.000	.00	1. WHEN A CYANIDE FREE SOLUTION (WHICH IS IN DEVELOPMENT) BECOMES AVAILABLE, TRY IT. SUCH A SOLUTION COULD BE DISCHARGED TO A SANITARY SEWER.
REPROGRAPHICS	MISC. SOLID WASTES	0	0	0	0	0	VARIANCE	.00	0	.000	.00	(VOLUME PRODUCED IS UNKNOWN)1. A. RAGS SHOULD BE CLEANED AND REUSED. B. CONTAINERS CAN BE DISPOSED OF AS NON-HAZARDOUS IF THEY CONTAIN LESS THAN 3% OF THEIR ORIGINAL VOLUME. C. PADS CAN BE DISPOSED OF AS NON-HZARDOUS IF THE SOLVENT (OR OTHER LIQUID) IS PLACED ON THE PAD BEFORE USE.
AUTO HOBBY SHOP	WASTE OIL	250	0	0	0	0	SELL	.00	0	-.100	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH USED OIL PROGRAM.
AUTO HOBBY SHOP	SOLVENT	360	0	360	0	1,800	SUBSTITUTION	.00	0	5.000	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE SOLVENT NOW IN USE.
AUTO HOBBY SHOP	PAINT	50	0	0	0	0	PROCEDURE	.00	0	7.250	.00	1. INSTRUCT USERS OF THE PAINT BOOTH TO PAINT IN SUCH A WAY AS TO REDUCE OVERSPRAY (USING LESS PAINT). VOLUME SAVINGS CANNOT BE ESTIMATED FOR THIS SUGGESTION.
AUTO HOBBY SHOP	FILTERS	14	0	14	0	46	SUBSTITUTION	.00	0	3.260	.00	1. SUBSTITUTE WATERBORNE ACRYLICS FOR THE PAINT NOW IN USE. (14 GALLONS = 40 POUNDS)
PAVE PAWS	WASTE OIL	0	0	0	0	0	SELL	.00	0	2.400	.00	1. CONTINUE TO SELL FOR RECYLING THROUGH THE USE OIL PROGRAM. (VOLUMES PRODUCED BY THIS SHOP ARE UNKNOWN.)
PAVE PAWS	SOLVENT (DRY CLEANING)	120	0	0	0	0	NONE	.00	0	5.690	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
PAVE PAWS	BATTERY ACID	60	0	0	0	0	NONE	.00	0	8.280	.00	1. NO OPTION FOR REDUCTION SUGGESTED.

PAVE PAWS	ANTIFREEZE	330	0	0	0	0	NONE	.00	0	2.500	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
PAVE PAWS	AEROSOL CANS	127	0	0	0	0	NONE	.00	0	3.640	.00	1. (230 CANS = 127 GALLONS) NO OPTION FOR REDUCTION SUGGESTED.
AIRCRAFT WASH RACK	SOLVENT (PD-680)	1,680	0	1,680	0	7,009	SUBSTITUTION	.00	0	5.340	.00	1. SUBSTITUTE D-LIMONENE SOLVENT FOR PD-680. (D-LIMONENE HAS A LOWER DISPOSAL COST).
REFUELING MAINT. (TRUCK)	WASTE OIL	250	0	0	0	0	SELL	.00	0	1.410	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH THE USED OIL PROGRAM.
REFUELING MAINT. (TRUCK)	WASTE FUEL (DIESEL)	300	0	0	0	0	PROC/TREATMENT	.00	0	.000	.00	1. COULD REDUCE BY FILTERING, WATER REMOVAL, DOWNGRADING JP-7 AND JPTS TO JP-4 AND JP-4 TO DIESEL AND DIESEL TO NO.2 FUEL.
REFUELING MAINT. (TRUCK)	FILTERS	1,200	0	1,200	0	4,200	PROCEDURE	.00	0	.000	.00	1. PACK FUEL FILTERS WITH USED SPEEDY DRY TO MEET DISPOSAL REQUIREMENTS.
REFUELING MAINT. (TRUCK)	AEROSOL CANS	40	0	28	0	100	SUBSTITUTION	.00	0	3.640	.00	1. SUBSTITUTE CITRIKLEEN HD FOR THE SOLVENT NOW USED IN THE CANS. CANS ARE STILL USED BUT ARE NOT HAZARDOUS BECAUSE THE SOLVENT IS BIODEGRADABLE. (72 CANS EQUALS 40 GALLONS).
REFUELING MAINT. (TRUCK)	SOLVENT (SAFETY KLEEN)	240	0	0	0	0	NONE	.00	0	5.350	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
LIQUID FUEL MAINT	SLUDGE/SPEEDY DRY	55	0	25	0	42	PROCEDURE	.00	0	.870	.00	1. MIX SLUDGE WITH USED ABSORBENT RATHER THAN CLEAN ABSORBENT.
MACHINE SHOP	WASTE OIL	10	0	0	0	0	SELL	.00	0	.000	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH THE USED OIL PROGRAM.
MACHINE SHOP	WASTE FLUID	30	0	0	0	0	NONE	.00	0	2.500	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
MACHINE SHOP	WASTE OIL (QUENCHING)	15	0	15	0	52	PROCEDURE	.00	0	6.200	.00	

												1. TEST OIL - IF NOT HAZARDOUS, IT CAN BE DISPOSED OF AS A CALIFORNIA RECYCLABLE HAZARDOUS WASTE (SAVINGS OF $1.75/GALLON).
MACHINE SHOP	ABRASIVE WASTE	11	0	0	0	0	PROCEDURE	.00	0	4.550	.00	1. TEST - IF NOT HAZARDOUS, CONTINUE CURRENT DISPOSAL PRACTICES. - IF HAZARDOUS, COLLECT & DISPOSE OF AS HAZARDOUS WASTE.(11 GAL = 50 LBS)
POWER PRODUCTION	ANTIFREEZE	125	0	0	0	0	NONE	.00	0	2.500	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
POWER PRODUCTION	WASTE OIL/FLUIDS	150	0	0	0	0	SELL	.00	0	-.100	.00	1. CONTINUE TO SELL FOR RECYCLING THROUGH THE USED OIL PROGRAM.
POWER PRODUCTION	WASTE OIL	150	0	0	0	0	NONE	.00	0	2.400	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
POWER PRODUCTION	SPEEDY DRY	248	0	248	0	2,000	SUBSTITUTION	.00	0	4.220	.00	1. CLEAN-UP SPILLS WITH RAGS (WHICH CAN BE WASHED AND REUSED) INSTEAD OF SPEEDY DRY. (248 GAL = 900 POUNDS)
POWER PRODUCTION	SOLVENT	5	0	5	0	15	EQUIPMENT	16.89	120	3.000	.00	1. INSTALL COVERED DIP TANK.(IF PURCHASE IS NOT POSSIBLE, RETAIN SOLVENT IN A CLOSED CONTAINER, ALLOW SOLIDS TO SETTLE, AND REUSE SOLVENT.)
POWER PRODUCTION	BATTERIES	20	0	0	0	0	NONE	.00	0	30.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. 30 LB = 1 GAL
MUSEUM	SOLVENT	10	0	9	0	100	EQUIPMENT	1.71	150	11.190	.00	1. INSTALL A PARTS WASHING VAT CONTAINING CITRIKLEEN. WHEN NO LONGER USABLE, SKIM EXCESS OIL FROM TOP (PUT INTO USED OIL PROGRAM) AND COORDINATE WITH SEWAGE TREATMENT FACILITY THE DISCHARGE OF THE SOLVENT TO THE SEWER.
MUSEUM	MEK	10	0	7	0	30	RECYCLE	.00	0	4.250	.00	1. USE CORROSION CONTROL FACICLITIES TO RECYCLE MEK AND REUSE MEK FOR CLEAN-UP ONLY.
RAILROAD OPERATIONS	SOLVENT (DRY CLEANING)	55	0	55	0	275	EQUIPMENT	.60	150	4.990	.00	1. INSTALL A DIP TANK FOR PARTS CLEANING.(SO SOLVENT CAN BE REUSED)

RAILROAD OPERATIONS	USED OIL CANS	0	0	0	0	0	SELL	.00	0	.000	.00	1. (VOLUME OF OIL PRODUCED IS UNKNOWN) CONTINUE TO SELL FOR RECYCLING THROUGH USED OIL PROGRAM.
9TH RECONN TECH SQUADRON	SOLVENT	30	0	30	0	0	EQUIPMENT	.00	0	.000	.00	1. USE DIFFERENT SYSTEMS CLEANER IN 2 FILM PROCESSING UNITS - SOLUTION OF SODIUM PERSULPHATE AND PHOSPHORIC ACID CAN BE USED IN PLACE OF THE CHROMIUM CONTAINING CLEANER NOW IN USE.
9TH RECONN TECH SQUADRON	SLUDGE	1,800	0	900	0	5,571	TREATMENT	1.64	8,000	6.190	.00	1. ANALYZE SLUDGE ($3000). INSTALL A BAG FILTRATION SYSTEM AND A SILVER RECOVERY SYSTEM ($5000), AND RETURN FILTRATE TO VAPORIZATION UNIT FOR RECYCLING.
FUEL SYSTEM REPAIR	SEALANT	55	0	0	0	0	PROCEDURE	.00	0	4.220	.00	1. DISTRIBUTION OF MIXING CONTAINERS IN A LARGE VARIETY OF SIZES TO ENCOURAGE USERS TO MIX ONLY AS MUCH SEALANT AS THEY NEED FOR A GIVEN JOB COULD REDUCE THE AMOUNT OF WASTE SEALANT PRODUCED. DISPOSAL COST ESTIMATED TO BE EQUAL TO THAT FOR SPEEDY TRY (SINCE IT IS ALSO A SOLID WASTE.)
FUEL SYSTEMS REPAIR	SHOP RAGS	740	0	740	0	3,122	PROCEDURE	.00	0	4.220	.00	1. COULD USE THESE WASTE RAGS AS ABSORBENT PACKING MATERIAL. DISP. COST ESTIMATED TO BE EQUAL TO THAT OF SPEEDY DRY (SINCE IT IS ALSO A SOLIC WASTE.)
STRUCTURAL REPAIR	SEALANT	240	0	0	0	0	PROCEDURE	.00	0	4.220	.00	1. DISTRIBUTION OF MIXING CONTAINERS IN A LARGE VARIETY OF SIZES TO ENCOURAGE USERS TO MIX ONLY AS MUCH SEALANT AS THEY NEED FOR A GIVEN JOB COULD REDUCE THE AMOUNT OF WASTE SEALANT PRODUCED. DISPOSAL COST ESTIMATED TO BE EQUAL TO THAT OF SPEEDY DRY (SINCE IT IS ALSO A SOLID WASTE).

COMMAND: SAC/BASE: K.I. SAWYER

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	165	0	135	0	881	EQUIPMENT	6.36	4,000	6.250	.00	1. USE OF A PRESSURE-TYPE FILTRATION UNIT TO FILTER PAINT FROM STRIPPER WILL ELIMINATE STRIPPER DISPOSAL. (30 GAL OF FILTER WASTE PRODUCED AT $500/YEAR REPLACEMENT & $300/YR DISPOSAL)
CORROSION CONTROL	RINSEWATER/STRIPPER	54,720	0	54,690	0	340,750	EQUIPMENT	.01	3,000	6.250	.00	1. SAME OPTION AS STRIPPER PLUS ADD A HOT RINSE TANK - WASTE FROM PERIODIC CLEANING OF RINSE TANK WILL PRODUCE 1879 GAL/YR. THE RINSEWATER USED AFTER TANK CAN BE DISCHARGE TO SEWER. (COSTS $1500 PER TANK.)
CORROSION CONTROL	MEK	324	0	0	0	0	SUBST/RECYCLE	.00	0	6.250	.00	1. THE USE OF ONE SOLVENT WILL MAKE RECLAMATION/REUSE OF THE SOLVENT EASIER IF IT BECOMES POSSIBLE.
CORROSION CONTROL	MISC. SOLID WASTES	6,414	0	0	0	0	NONE	.00	0	2.000	.00	1. AIR-ATOMIZED EQUIPMENT COULD REDUCE AMOUNT OF PAPER AND FILTERS USED.
CORROSION CONTROL	SHOP RAGS	1,180	0	1,180	0	7,375	SUBSTITUTION	.00	0	6.250	.00	1. SUBSTITUTE MIBK/NAPHTHA FOR MEK/TOLUENE - ALLOWS SHOP RAGS TO BE WASHED AND DISPOSED OF AS NON-HAZARDOUS.
CORROSION CONTROL	ALODINE	40	0	0	0	0	NONE	.00	0	6.250	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
CORROSION CONTROL	PHOSPHORIC ACID	40	0	0	0	0	NONE	.00	0	6.250	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	PAINT RELATED WASTE	110	0	0	0	0	NONE	.00	0	6.360	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	WATERFALL DISCHARGE	24,000	0	24,000	0	138,000	SUBSTITUTION	.00	0	5.750	.00	1. USE WATERBORNE ACRYLIC COATING SYSTEMS TO ELIMINATE THE NEED FOR SOLVENTS. (THIS WILL REQUIRE A CHANGE IN THE TECHNICAL ORDER).
VEHICLE MAINT.	SOLVENT (SAFETY KLEEN)	420	0	420	0	950	SUBST/EQUIP	.46	400	1.670	.00	

												1. RETURN TO THE USE OF PD-680, FILTER VAT, AND BURN USED SOLVENT FOR ENERGY RECOVERY.
JET ENGINE	SOLVENT (PD-680)	132	0	50	0	156	REUSE/SELL	.00	0	-.070	.00	1. REUSE PD-680 USED IN BEARING CLEANING VATS FOR GENERAL PARTSCLEANING. THE REMAINING PD-680 IS CURRENTLY SOLD AND RECYCLED. ENERGY RECOVERY IS NOT PRESENTLY ECONOMICAL.
JET ENGINE	CARBON REMOVER	68	0	0	0	0	NONE	.00	0	6.250	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED. (CARBON REMOVER IS BASED ON ORTHODICHLOROBENZENE.)
JET ENGINE	FINGERPRINT REMOVER	12	0	0	0	0	NONE	.00	0	6.250	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
JET ENGINE	SODIUM HYDROXIDE (SOLN)	18	0	18	0	54	REUSE	.00	0	3.000	.00	1. USE FOR NEUTRALIZATION OF BATTERY ELECTROLYTE.
JET ENGINE	WASTE FLUID (CALIBRATION)	10	0	0	0	0	SELL	.00	0	-.070	.00	1. SOLD TO DRMO CONTRACTOR AS WASTE OIL.
AGE	SOLVENT (PD-680)	80	0	0	0	5	SELL	.00	0	-.070	.00	1. SOLD TO DRMO CONTRACTOR FOR REUSE.
AGE	HYD FLUID/LUBRICANT	300	0	0	0	21	SELL	.00	0	-.070	.00	1. SOLD TO DRMO CONTRACTOR FOR REUSE.
AGE	BATTERIES	100	0	0	0	0	CONTRACTOR	.00	0	13.500	.00	1. BATTERY EXCHANGE PROGRAM WITH OUTSIDE CONTRACTOR WOULD REDUCE LABOR & LIABILITY. 30 LB = 1 GAL
PNEUDRAULICS	HYDRAULIC FLUID	110	0	0	0	8	SELL	.00	0	6.250	.00	1. SOLD TO DRMO CONTRACTOR - ENERGY RECOVERY NOT PRESENTLY ECONOMICAL.
PNEUDRAULICS	SOLVENT (PD-680)	90	0	0	0	6	SELL	.00	0	6.250	.00	1. SOLD TO DRMO CONTRACTOR - COULD SUBSTITUTE FOR PD-680 IF IT BECAME NECESSARY.
WHEEL & TIRE	SOLVENT (PD-680)	980	0	980	0	1,000	TREATMENT/SUBST	1.17	1,050	-.070	.00	1. SUBSTITUTE A HIGH FLASH POINT SOLVENT TO MAKE WASTE NON-HAZARDOUS. FILTER AND REUSE.
WHEEL & TIRE	CARBON REMOVER	400	0	200	0	1,500	EQUIPMENT	2.80	3,500	.000	.00	1. INSTALL A CARBON REMOVER VAT (REDUCE AMT. OF CARBON

													REMOVER USED).(SOLUTION IS ETHANOLAMINE BASED AND IS CURRENTLY DISCHARGED TO SANITARY SEWER. SAVINGS IS ON REPLACEMENT COST ONLY.
MUNITIONS MAINT.	HYDRAULIC FLUID	132	0	0	0	9	SELL	.00	0	-.070	.00		1. SOLD TO DRMO CONTRACTOR.
MUNITIONS MAINT.	SOLVENT(PD-680)	360	0	0	0	25	SELL	.00	0	-.070	.00		1. SOLD TO DRMO CONTRACTOR.
MUNITIONS MAINT.	NAPHTHA	110	0	40	0	338	TREATMENT/FRP	.00	0	6.650	.00		1. FILTER AND BURN NAPHTHA FOR ENERGY RECOVERY.
MUNITIONS MAINT.	MEK	10	0	10	0	66	SUBSTITUTION	.00	0	6.650	.00		1. SUBSTITUTE MIBK FOR MEK.
NDI	INSP PENETRANT	55	0	55	0	538	FRP	.00	0	9.250	.00		1. BURN IN FUEL RECOVERY PROGRAM.
NDI	EMULSIFIER	55	0	55	0	538	FRP	.00	0	9.250	.00		1. BURN IN FUEL RECOVERY PROGRAM.
NDI	MAGNETIC PARTICLE SOLN.	60	0	60	0	407	FRP	.00	0	6.250	.00		1. FILTER OUT IRON AND BURN IN FUEL RECOVERY PROGRAM.
NDI	DEVELOPER	55	0	0	0	0	SUBSTITUTION	.00	0	6.000	.00		1. SUBSTITUTE A CHROMATE-FREE DEVELOPER (UNDER DEVELOPMENT) FOR THE CURRENTLY USED DEVELOPER.
NDI	SOLVENT (PD-680)	70	0	70	0	920	SUBSTITUTION	.00	0	6.000	.00		1. SUBSTITUTE D-LIMONENE FOR PD-680.
FUELS MANAGEMENT	WASTE OIL (MOTOR OIL)	22,662	0	15,863	0	14,753	PROCEDURE	.00	0	-.070	.00		1. START AN OIL ANALYSIS PROGRAM SO THAT OIL IS CHANGED WHEN NECESSARY RATHER THAN WHEN SCHEDULED.
FUELS MANAGEMENT	SOLVENT (PD-680)	350	0	0	0	0	NONE	.00	0	-.070	.00		1. NO OPTION FOR REDUCTION SUGGESTED.
CE PAINT SHOP	PAINT THINNER	10	0	10	0	50	SUBSTITUTION	.00	0	6.350	.00		1. SUBSTITUTE WATER-BASED TRAFFIC PAINT FOR THE PAINT PRESENTLY IN USE. DISPOSAL COST IS ESTIMATED BY USING VEHICLE MAINT. DATA.
REPROGRAPHICS	BLANKET WASH (NAPHTHA)	5	0	5	0	25	FRP	.00	0	5.000	.00		

1. BURN FOR ENERGY RECOVERY.

REPROGRAPHICS	ELECTROSTATIC SOLN.	5	0	0	0	0 NONE	.00	0	5.000	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED. CONTAINS FERROCYANIDE AND HYDROGEN CYANIDE.
AUTO HOBBY SHOP	SOLVENT	300	0	0	0	0 SELL	.00	0	.000	.00	1. RECYCLED BY CONTRACTOR.
PAVEMENTS & GROUNDS	SOLVENT (PD-680)	5	0	5	0	0 FRP	.00	0	.000	.00	1. BURN FOR ENERGY RECOVERY.
AIRCRAFT WASH RACK	SOLVENT (PD-680)	2,400	0	2,400	0	540 SUBSTITUTION	.00	0	.000	.00	1. SUBSTITUTE BIOGENIC SE377 FOR PD-680. PD-680 IS CURRENTLY DISCHARGED TO A SEWER BUT SE377 COSTS LESS.
AIRCRAFT WASH RACK	CARBON REMOVER	4,800	0	4,800	0	6,000 SUBSTITUTION	.00	0	1.250	.00	1. SUBSTITUTE NON-HAZARDOUS PRODUCT FOR CARBON REMOVER. CARBON REMOVER IS A MIXTURE OF MONOETHANOLAMINE, ETHYLENE GLYCOL, AND MONOBUTYL ETHER. (CURRENTLY BEING DISCHARGED TO SANITARY SEWER.)

COMMAND: SAC/BASE: LORING

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	6,105	0	5,495	0	30,182	EQUIPMENT	2.60	65,955	3.620	.00	1. A. SUBSTITUTION OF PMB SYSTEM FOR ETHAN. AND MC: SAVES $30182; 1.7 YR PAYBACK 2. *** LESS SAVINGS; MORE IMMEDIATE PAYBACK *** ($35736) A. SUBSTITUTE ETHANOLAMINE FOR MC SAVES $19800 ; IMMEDIATE PAYBACK B. SOLVENT REC. SYSTEM FOR MEK AND ETHAN. SAVES $15936; 2 YR PAYBACK 3. *** LESS SAVINGS; MORE IMMEDIATE PAYBACK *** A. ELIMINATE WATER RINSE IN MC VAT SAVES $17820; IMMEDIATE PAYBACK B. DISPOSAL OF ETHANOLAMINE BY CONTRACTOR (AS FUEL) SAVES $2310; IMMEDIATE PAYBACK
CORROSION CONTROL	MEK	1,120	0	1,008	0	6,400	RECYCLE	1.33	7,575	3.090	.00	1. SOLVENT RECOVERY SYSTEM FOR MEK:2 YR PAYBACK 2 ** LESS SAVINGS; MORE IMMEDIATE PAYBACK *** RECYCLE MEK BY CONTRACTOR SAVES $3729; IMMEDIATE PAYBACK 3. OTHER OPTIONS FOR MEK INCLUDE A. SUSTITUTION OF MIBK/XYLENE (SAVE $2630;IMM. PAY.) B. SEGREGATION OF MEK AND ETH.(SAVE $50;IMM.PAY.)
CORROSION CONTROL	TETRACHLOROETHYLENE&PAINT	50	0	0	0	0	NONE	.00	0	5.000	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	BATTERY ACID	600	0	0	0	1,800	CONTRACTOR	.00	0	3.000	.00	1. EXCHANGE PROGRAM WITH OUTSIDE CONTRACTOR. CONTRACTOR HANDLES USED BATTERIES AND SELLS NEW ONES TO THE BASE.
VEHICLE MAINT.	SPD.DRY/HYD.FL/LUBE OIL	2,277	0	1,138	0	3,165	PROC/EQUIPMENT	.00	0	1.250	.00	1. REDUCE THE AMOUNT PRODUCED BY 50% BY CATCHING DRIPPING FLUID INSTEAD OF DRAINING THEM INTO A BED OF SPEEDY DRY ($315). DISPOSE OF THE REST IN THE COAL ASH DISPOSAL AREA ($2850). (2277 GALLONS = 8280 POUNDS)
VEHICLE MAINT.	PAINT THINNER	208	0	0	0	0	NONE	.00	0	3.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.

VEHICLE MAINT.	CLEAN CMPD/ENG DEG	50	0	0	0	0	NONE	.00	0	2.000	.00
											1. NO OPTION FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	PADS/WASTE OIL	0	1,735	0	1,735	870	EQUIPMENT/FRP	2.35	1,740	.000	.30
											1. INSTALLATION OF OIL/WATER SEPERATOR WOULD ELIMINATE: A. COST OF ABSORBENT PADS ($200). B. LABOR COSTS ($29/HR). C. DISPOSAL COST ($520). 2. BURN RECOVERED OIL IN FUEL RECOVERY PROGRAM ($120).
PHASE INSPECTION	SPEEDY DRY/HYD FLUID	1,683	0	841	0	2,069	CADA	.00	0	1.090	.00
											1. DISPOSAL OF SPEEDY DRY IN COAL ASH DISPOSAL AREA. 2. REDUCE USE OF SPEEDY DRY BY 50% (BY CAREFUL PRACTICES). ADDITIONAL SAVINGS IN COST OF SPEEDY DRY). (1683 GAL = 6120 LBS)
JET ENGINE	SOLVENT (PD-680)/OIL	45	0	45	0	90	FRP	.00	0	2.000	.00
											1. BURN IN FUEL RECOVERY PROGRAM.
JET ENGINE	WASTE FUEL/HYD FLUID	200	0	100	0	65	FRP	.00	0	1.500	.00
											1. SEPERATION OF JP-4 AND HYD. FLUID. A. JP-4 REUSED AS FUEL (SAVE $65 PER YEAR). B. HYD. FLUID REUSE (SAVE $1018 IN RAW MAT. COST). PRESENTLY NOT ECONOMICAL TO RECOVER.
JET ENGINE	SOLVENT (PD-680)	240	0	240	0	480	FRP	.00	0	2.000	.00
											1. PD-680 HANDLED BY OUTSIDE CONTRACTOR. 2. PD-680 BURNED AS FUEL IN FUEL RECOVERY PROGRAM. 3. SUBSTITUTION OF CITRIKLEEN HD FOR PD-680.
JET ENGINE	CARBON REMOVER	45	0	45	0	90	SEWER	.00	0	2.000	.00
											1. CAN BE TESTED FOR CONTAMINANTS AND DUMPED INTO SANITARY SEWER.
JET ENGINE	NAPHTHA	35	0	35	0	70	DISCONTINUED	.00	0	2.000	.00
											1. NO LONGER USED IN THIS SHOP.
JET ENGINE	SPEEDY DRY/HYD FLUID	85	0	0	0	93	CADA	.00	0	1.090	.00
											1. DISPOSAL OF SPEEDY DRY IN COAL ASH DISPOSAL AREA.(85 GAL = 310 LBS)
AGE	SOLVENT (PD-680)	240	0	240	0	480	FRP	.00	0	2.000	.00
											1. PD-680 HANDLED BY OUTSIDE CONTRACTOR. 2. PD-680 BURNED AS FUEL IN FUEL RECOVERY PROGRAM. 3. SUBSTITUTION OF CITRIKLEEN HD FOR PD-680.

PNEUDRAULICS	SODIUM HYDROXIDE	0	800	0	800	320	PROC/REUSE	.00	0	.000	.40	1. THIS DISPOSAL WAS A ONE TIME OCCURENCE WHEN THE MATERIAL BECAME WET. IT COULD POSSIBLY HAVE BEEN REUSED AND SAVED THE COST OF DISPOSAL AND MATERIAL REPLACEMENT.
PNEUDRAULICS	SPEEDY DRY/HYD FLUID	96	0	48	0	118	CADA	.00	0	1.090	.00	1. DISPOSAL OF SPEEDY DRY IN COAL ASH DISP. AREA. 2. REDUCE USE OF SPEEDY DRY BY 50% (BY CAREFUL PRACTICES). (THIS WOULD PROVIDE ADDITIONAL SAVINGS IN COST OF SPEEDY DRY). (96 GALLONS = 350 POUNDS)
PNEUDRAULICS	SOLVENT (PD-680)	120	0	120	0	240	FRP	.00	0	2.000	.00	1. PD-680 HANDLED BY OUTSIDE CONTRACTOR. 2. PD-680 BURNED AS FUEL IN FUEL RECOVERY PROGRAM. 3. SUBSTITUTION OF CITRIKLEEN HD FOR PD-680.
WHEEL & TIRE	SOLVENT (PD-680)	270	0	270	0	540	SUBSTITUTION	.00	0	2.000	.00	1. SUBSTITUTE CITRIKLEEN HD FOR PD-680.
MUNITIONS MAINT.	SPEEDY DRY/HYD FLUID	105	0	52	0	128	CADA	.00	0	1.090	.00	1. DISPOSE OF SPEEDY DRY IN COAL ASH DISPOSAL AREA. 2. REDUCE USE OF SPEEDY DRY BY 50% (BY CAREFUL PRACTICES). (THIS WOULD PROVIDE ADDITIONAL SAVINGS IN COST OF SPEEDY DRY). (105 GALLONS = 380 POUNDS)
EQUIPMENT MAINT.	SOLVENT (PD-680)	205	0	205	0	410	FRP	.00	0	2.000	.00	1. PD-680 HANDLED BY OUTSIDE CONTRACTOR. 2. PD-680 BURNED AS FUEL IN FUEL RECOVERY PROGRAM. 3. SUBSTITUTION OF CITRIKLEEN HD FOR PD-680.
BATTERY	BATTERY ACID	720	0	0	0	2,160	CONTRACTOR	.00	0	3.000	.00	1. EXCHANGE PROGRAM WITH OUTSIDE CONTRACTOR. CONTRACTOR HANDLES BATTERY ACID AND SELLS NEW BATTERIES TO THE BASE.
NDI	INSP PENETRANT	100	0	100	0	165	FRP	.00	0	1.000	.00	1. BURN IN FUEL RECOVERY PROGRAM (FUEL SAVINGS ACCOUNTS FOR ADDITIONAL SAVINGS).
NDI	EMULSIFIER	100	0	100	0	100	SEWER	.00	0	1.000	.00	1. DISCHARGE INTO SANITARY SEWER.
NDI	MAGNETIC PARTICLE SOLN.	180	0	180	0	297	FRP	.00	0	1.000	.00	

1. FILTER AND BURN FOR ENERGY RECOVERY.

NDI	1,1,1-TRICHLOROETHANE	65	0	65	0	130	SUBSTITUTION	.00	0	2.000	.00	1. SUBSTITUTION OF CITRIKLEEN FOR 1,1,1 TRICHLOROETHANE.
CLEANERS	PERCHLOROETHYLENE	80	0	0	0	5,298	CONTRACTOR	.00	0	5.000	.00	1. CONTRACT WITH SAFETY KLEEN TO PROVIDE MATERIALS AND DISPOSE OF WASTE.
CLEANERS	FILTERS	660	0	0	0	19,500	CONTRACTOR	.00	0	5.390	.00	1. CONTRACT WITH SAFETY KLEEN TO PROVIDE MATERIALS AND DISPOSE OF WASTE. (660 GALLONS = 1940 POUNDS)
FUELS MANAGEMENT	WASTE FUEL (JP-4)	30,000	0	30,000	0	19,500	FRP	.00	0	.000	.00	1. FILTER, BLEND WITH NO. 2 FUEL,BURN IN BOILER OR FURNACE.
FUELS MANAGEMENT	WASTE OIL (MOTOR OIL)	20,000	0	20,000	0	13,000	FRP	.00	0	.000	.00	1. FILTER, BLEND WITH NO. 2 FUEL, BURN IN BOILER OR FURNACE.
ASBESTOS DISPOSAL	ASBESTOS	0	10,806	0	10,806	4,332	LANDFILL	.00	0	.000	.40	1. DISPOSAL IN AN APPROVED LANDFILL.
MACHINE SHOP	SOLVENT (PD-680)	50	0	50	0	100	FRP/SUBST	.00	0	2.000	.00	1. PD-680 HANDLED BY OUTSIDE CONTRACTOR. 2. PD-680 BURNED AS FUEL IN FUEL RECOVERY PROGRAM. 3. SUBSTITUTION OF CITRIKLEEN HD FOR PD-680.

COMMAND: SAC/BASE: PLATTSBURGH

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	2,400	0	1,090	0	13,100	TREATMENT/EQUIP	.13	1,500	6.250	.00	1. INSTALL NEW LINES WHICH FILTER STRIPPER TO EXTEND ITS LIFE. (SAVE $6800 FOR DISPOSAL, SAVE $6300 FOR MATERIAL REPLACEMENT)
CORROSION CONTROL	RINSEWATER/STRIPPER	3,600	0	900	0	5,850	EQUIPMENT	.19	1,000	6.500	.00	1. INSTALL A STILL RINSE TANK TO REDUCE THE AMOUNT OF RINSATE PRODUCED.
CORROSION CONTROL	MEK	1,200	0	0	0	0	NONE	.00	0	6.250	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
CORROSION CONTROL	MISC. SOLID WASTES	1,200	0	0	0	0	NONE	.00	0	6.850	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
CORROSION CONTROL	SHOP RAGS	600	0	600	0	3,960	SUBSTITUTION	.00	0	6.600	.00	1. SUBSTITUTE MIBK FOR CURRENTLY USED SOLVENTS (MEK/TOLUENE). THIS ALLOWS THE SHOP RAGS TO BE WASHED AND REUSED AND PRODUCES NO HAZARDOUS WASTE.
CORROSION CONTROL	ALODINE	60	0	0	0	0	NONE	.00	0	6.250	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	SOLVENT (SAFETY KLEEN)	680	0	680	0	959	SUBST/FRP	.46	400	3.050	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE PD-680 NOW IN USE, FILTER TO EXTEND ITS LIFE, AND BURN WASTE FOR ENERGY RECOVERY.
VEHICLE MAINT.	PAINT RELATED WASTE	156	0	156	0	1,100	SUBSTITUTION	.00	0	7.050	.00	1. SUBSTITUTE WATERBORNE ACRYLICS FOR THE PAINTS NOW IN USE (WILL REQUIRE A CHANGE IN THE TECHNICAL ORDER).
VEHICLE MAINT.	WATERFALL DISCHARGE	12,000	0	12,000	0	69,000	SUBSTITUTION	.00	0	5.750	.00	1. SUBSTITUTE WATERBORNE ACRYLICS FOR THE PAINTS NOW IN USE. (THIS WILL REQUIRE A CHANGE IN THE TECHNICAL ORDER).
JET ENGINE	SOLVENT(PD-680)	230	0	230	0	1,494	REUSE/SUBST/FRP	.00	0	6.150	.00	1. A. REUSE PD-680 FROM BEARING ROOM FOR GENERAL CLEANING. B. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143

												DEGREES F (SUCH AS DYNA 143) FOR THE PD-680 NOW IN USE IN BOTH THE BEARING ROOM AND THE GENERAL PARTS CLEANING VAT. THE WASTE COULD THEN BE USED IN THE USED OIL PROGRAM FOR ENERGY RECOVERY.
JET ENGINE	CARBON REMOVER	6	0	0	0	0	NONE	.00	0	17.250	.00	1. NO OPTION FOR REDUCTION SUGGESTED. CARBON REMOVER CONTAINS ORTHODICHLOROBENZENE. DISPOSAL COST ESTIMATED FROM CHARLESTON AIR FORCE BASE WHERE LABOR AND DISPOSAL COSTS FOR THE JET ENGINE SHOP'S PD-680 ARE SIMILAR TO THOSE AT PLATTSBURG.
JET ENGINE	FINGERPRINT REMOVER	10	0	10	0	20	FRP	.00	0	3.950	.00	1. BURN FOR ENERGY RECOVERY IN THE USED OIL PROGRAM. DISPOSAL COST ESTIMATED FROM CHARLESTON AIR FORCE BASE WHERE LABOR AND DISPOSAL COSTS FOR THE JET ENGINE SHOP'S PD-680 ARE SIMILAR TO THOSE AT PLATTSBURG.
AGE (NON-POWERED)	SOLVENT (PD-680)	55	0	55	0	340	SUBST/FRP	.00	0	6.150	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE PD-680 NOW IN USE AND BURN WASTE FOR ENERGY RECOVERY.
AGE (POWERED)	SOLVENT (PD-680)	60	0	55	0	340	SUBST/FRP	.00	0	6.150	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE PD-680 NOW IN USE AND BURN FOR ENERGY RECOVERY.
WHEEL & TIRE	SOLVENT (PD-680)	600	0	600	0	3,970	SUBST/FRP	.00	0	6.150	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE PD-680 NOW IN USE AND BURN FOR ENERGY RECOVERY.
WHEEL & TIRE	CLEANING CMPD.	1,800	0	1,800	0	3,000	SUBST/SEWER	.00	0	5.750	.00	1. SUBSTITUTION OF A NON-HAZARDOUS, BIODEGRADABLE CLEANING COMPOUND FOR THE CLEANING COMPOUND NOW IN USE WOULD: A. REDUCE TH AMOUNT OF WASTE TO 620 GALLONS (DUE TO LONGER USEFUL LIFE) B. ALLOW THE WASTE TO BE DISCHARGED TO SANITARY SEWER (SINCE THE WASTE CONTAINS ASBESTOS FIBERS, THE BASE MAY CONSIDER FILTRATION OF THE WASTE BEFORE DISCHARGE).
MUNITIONS MAINT.	SOLVENT (PD-680)	55	0	50	0	350	SUBST/FRP	.00	0	6.150	.00	1. SUBSTITUTE A SOLVENT WITH FLASH POINT OF AT LEAST 143 DEGREES F FOR THE PD-680 NOW IN USE AND BURN FOR ENERGY

												RECOVERY.
NDI	INSP PENETRANT	220	0	220	0	1,326	FRP	.00	0	5.500	.00	1. BURN FOR ENERGY RECOVERY.
NDI	MAGNETIC PARTICLE SOLN.	390	0	390	0	2,417	FRP	.00	0	5.500	.00	1. FILTER AND BURN FOR ENERGY RECOVERY.
NDI	DEVELOPER	220	0	0	0	0	SEWER	.00	0	6.000	.00	1. CAN BE DISCHARGED TO SANITARY SEWER.
NDI	1,1,1-TRICHLOROETHANE	100	0	100	0	580	SUBST/FRP	.00	0	6.500	.00	1. SUBSTITUTE BUTYL CELLOSOLVE FOR TCA AND BURN RESULTING WASTE FOR ENERGY RECOVERY.
FUELS MANAGEMENT	WASTE FUEL (JP-4)	17,000	0	17,000	0	44,450	FT/REUSE	.00	0	5.750	.00	1. A. PRACTICE STRICT SEGREGATION OF WASTE FLUIDS. B. REUSE IN AGE SHOP (MAY REQUIRE FILTRATION). C. USE 10000 GALLONS FOR FIRE TRAINING.
FUELS MANAGEMENT	WASTE OIL	14,000	0	14,000	0	74,900	FRP	.00	0	4.750	.00	1. BURN FOR ENERGY RECOVERY.
FUELS MANAGEMENT	WASTE FLUID	11,000	0	11,000	0	76,550	SELL/FRP	.00	0	5.850	.00	1. SEGREGATE FROM OTHER FLUIDS AND SEGREGATE PETORLEUM BASED HYDRAULIC FLUID FROM SYNTHETIC HYDRAULIC FLUID AND: A. BURN PETROLEUM BASED FLUID FOR ENERGY RECOVERY (9350 GAL, $60300). B. SELL SYNTHETIC FLUID (1650 GAL, $16250).
FUELS MANAGEMENT	WASTE OIL/FEED SLOPS	5,000	0	0	0	0	NONE	.00	0	4.750	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST ESTIMATED FROM WASTE OIL COSTS.
FUELS MANAGEMENT	SPEEDY DRY	7,425	0	0	0	0	NONE	.00	0	5.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST ESTIMATED FROM SPILL RESIDUE AT CHARLESTON AIR FORCE BASE (WHOSE DISP. COSTS ARE SIMILAR TO THOSE IN PLATTSBURG).
CE PAINT SHOP	PAINT THINNER	100	0	55	0	557	PROCEDURE	.00	0	6.500	.00	1. USE ABRASIVE STRIPPING RATHER THAN CHEMICAL STRIPPING.
REPROGRAPHICS	BLANKET WASH	3	0	3	0	23	SUBST/FRP	.00	0	7.500	.00	1. SUBSTITUTE AN ALIPHATIC HYDROCARBON BLANKET WASH FOR THE PERCHLOROETHYLENE BLANKET WASH NOW IN USE.

REPROGRAPHICS	SILVER	0	0	0	0	0	RECYCLE	.00	50	.000	.00
											1. INSTALL A SILVER RECOVERY SYSTEM (AMOUNT OF SILVER PRODUCED IS UNKNOWN).
AUTO HOBBY SHOP	SOLVENT (PD-680)	650	0	650	0	3,900	SUBSTITUTION	.45	1,600	6.150	.00
											1. SUBSTITUTE BIOGENIC SE377c (WHICH CAN BE DISCHARGED TO A SANITARY SEWER) FOR PD-680. EXTEND ITS USEFUL LIFE BY FILTRATION.(PORTABLE FILTRATION UNIT)
AUTO HOBBY SHOP	FILTERS	0	0	0	0	0	SUBSTITUTION	.00	0	.000	.00
											1. (SINCE PAINT BOOTHE HAS NOT BEEN IN USE FOR LONG, THE VOLUMES OF WASTE FILTERS TO BE PRODUCED IS NOT KNOWN) SUBSTITUTE WATERBORNE ACRYLICS FOR THE PAINT NOW IN USE.
CENTRAL HEAT PLANT	SOLVENT (PD-680)	480	0	480	0	3,512	SUBST/FRP	.00	0	6.150	.00
											1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR PD-680. AFTER USE, BURN THIS SOLVENT FOR ENERGY RECOVERY.

COMMAND: ATC/BASE: KEESLER

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER/RINSEWATER	5,080	0	3,900	0	38,000	SUBST/PROC/TREA	.66	22,800	4.730	.00	1. A. SUBSTITUTE HEATED STRIPPER BASED ON GLYCOL ETHERS, ALCOHOLSAND EHANOLAMINE FOR PHENOLIC STRIPPER. (COULD BE ONLY CHARACTERISTICALLY HAZARDOUS, BUT MAY NOT BE HAZARDOUS AT ALL WHEN MIXED TOGETHER.) B. IMPROVED RACKING TECHNIQUES REDUCE DRAGOUT AND, THEREFORE REDUCE SLUDGE PRODUCTION. C. VAT FILTRATION AND COUNTERFLOW RINSE TECHNIQUES REDUCE VOLUMES OF RINSEWATER USED.
CORROSION CONTROL	STRIPPER (METH. CHLORIDE)	200	0	80	0	500	TREATMENT	2.09	900	7.000	.00	1. FILTER AND REUSE TWICE.
CORROSION CONTROL	SOLVENT	590	0	240	0	2,000	PROC/TREATMENT	2.35	4,000	5.390	.00	1. A. MODIFY CLEAN-UP PROCEDURES TO USE LESS SOLVENT. B. FILTER USED SOLVENT AND REUSE IT TWICE.
CORROSION CONTROL	PAINT RESIDUE	42	0	42	0	100	PROCEDURE	.00	0	4.760	.00	1. TEST RESIDUE FOR EP TOXICITY. IF BELOW TOXICITY LIMITS, DISPOSE OF AS NON-HAZARDOUS WASTE. IF ABOVE LIMITS, MIX WITH PORTLAND CEMENT UNTIL THE MIXTURE IS BELOW TOXICITY LIMITS AND DISPOSE OF THE MIXTURE AS NON-HAZARDOUS WASTE.
CORROSION CONTROL	ALODINE	20	0	20	0	100	SUBST/REUSE	.00	0	3.500	.00	1. SUBSTITUTE A POWDER FORMULATION FOR THE PREMIXED ALODINE NOW USED. COLLECT THE USED ALODINE SOLUTION AND MIX IT WITH THE POWDER (AND MAYBE ADDITIONAL WATER) FOR MORE ALODINE SOLUTION.
CORROSION CONTROL	FILTERS	110	0	65	0	3,520	EQUIPMENT	2.94	8,600	3.000	.00	1. USE OF AN ELECTROSTATIC SPRAY SYSTEM PROVIDES TRANSFER EFFICIENCIES OF 70-80%, EXTENDING THE LIFE OF THE FILTERS. (INSTALL 2 SYSTEMS AT $4300 EACH. $120 SAVED ON FILTER DISPOSAL, $3400 SAVED ON PAINT USAGE.)
CORROSION CONTROL	SHOP RAGS	200	0	200	0	2,000	SUBSTITUTION	.00	0	5.000	.00	

											1. SUBSTITUTION OF MIBK FOR MEK ON SHOP RAGS ALLOWS FOR THE RAGS TO BE CLEANED AND REUSED.
VEHICLE MAINT.	PAINT RELATED WASTE	110	0	80	0	670	REUSE/RECYCLE	.00	0	6.000	.00	1. SEGREGATE SOLVENTS (SUCH AS MIBK, TOLUENE, AND NAPTHA) BY COLOR AND REUSE THEM AS THINNER. RECLAIM URETHANE SOLVENTS.
VEHICLE MAINT.	SOLVENT (PD-680)	230	0	220	0	1,200	SUBSTITUTION	.00	0	3.500	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR PD-680.
VEHICLE MAINT.	WASTE OIL	5,000	0	5,000	0	4,000	FRP	.00	0	-.000	.00	1. TEST FOR TOXICITY, MIX WITH VIRGIN FUEL, AND BURN FOR ENERGY RECOVERY.
VEHICLE MAINT.	FILTERS	1,500	0	1,500	0	2,000	PROCEDURE	.00	0	1.470	.00	1. A. ELIMINATE THE USE OF COMMERCIAL THINNER BLENDS. B. DISCONTINUE PRACTICE OF DISCHARING CLEAN-UP SOLVENT INTO WATERFALL.
AGE	SOLVENT (PD-680)	220	0	220	0	1,200	SUBSTITUTION	.00	0	3.500	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE SOLVENT IN USE.
AGE	WASTE OIL/WASTE FUEL	19,000	0	16,000	0	12,800	FRP	.00	0	.000	.00	1. TEST FOR TOXICITY, MIX WITH VIRGIN FUEL, AND BURN FOR ENERGY RECOVERY.
AGE	MISC. SOLID WASTES	0	0	0	0	0	EQUIPMENT	.00	0	.000	.00	1. VOLUMES OF AEROSOL CANS AND SHOP RAGS PRODUCED ARE UNKNOWN. THE VOLUME OF AEROSOL CANS COULD BE REDUCED BY CONSTRUCTING A DEDICATED WASH RACK. (CONSTRUCTION COST NOT ESTIMATED)
NDI	INSP PENETRANT	110	0	110	0	370	FRP	.00	0	3.360	.00	1. CONTROLLED BLENDING OF PENETRANT AND NON-CHROMATE BASED DEVELOPER ALLOWS FOR THE MIXTURE TO BE MIXED WITH USED OIL AND BURNED FOR ENERGY RECOVERY.
NDI	DEVELOPER	110	0	110	0	370	SUBSTITUTION	.00	0	3.360	.00	1. SUBSTITUTE A NON-CHROMATE BASED DEVELOPER FOR THE CHROMATE BASED DEVELOPER NOW IN USE.
NDI	MAGNETIC PARTICLE SOLN.	110	0	0	0	0	RECYCLE	.00	0	3.360	.00	

1. COULD FILTER OLD IRON OUT OF SOLUTION AND REPLACE IT WITH NEW IRON AND REUSE. THIS IS NOT SUGGESTED BECAUSE THE FLOURESCENCE IS LOST INTO THE SOLVENT. DISP. COST ESTIMATED FROM OTHER WASTES IN THE NDI SHOP.

REPROGRAPHICS	BLANKET WASH/DEGLAZER	285	0	160	0	1,000	SUBSTITUTION	.00	0	5.000	.00	1. SEPERATE WATER FROM ALIPHATIC HYDROCARBONS WITH OIL/WATER SEPARATOR. FILTER AND REUSE THE ALIPHATIC HYDROCARBONS. DISPOSAL COST ESTIMATED TO BE EQUAL TO THAT OF A SIMILAR WASTESTREAM AT K.I.SAWYER AIR FORCE BASE.
REPROGRAPHICS	ACTIVATOR	25	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST NOT AVAILABLE.
REPROGRAPHICS	STABILIZER	24	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST NOT AVAILABLE.
REPROGRAPHICS	DEVELOPER	185	0	0	0	0	NONE	.00	0	2.650	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
REPROGRAPHICS	FIXER	142	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST NOT AVAILABLE.
REPROGRAPHICS	TONER	30	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST NOT AVAILABLE.
REPROGRAPHICS	DISPERSANT	30	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
REPROGRAPHICS	REPLENISHER	96	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
AUTO HOBBY SHOP	WASTE OIL	11,700	0	11,700	0	9,360	FRP	.00	0	-.000	.00	1. TEST FOR TOXICITY, MIX WITH VIRGIN FUEL, AND BURN FOR ENERGY RECOVERY.
AUTO HOBBY SHOP	SOLVENT (PD-680)	960	0	960	0	3,100	SUBSTITUTION	.00	0	3.230	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR PD-680.
AUTO HOBBY SHOP	CARBON REMOVER	480	0	480	0	2,600	SUBSTITUTION	.00	0	5.420	.00	

1. SUBSTITUTE EITHER ETHANOLAMINE/BUTYL CELLOSOLVE OR SODIUM PYROPHOSPHATE/CELLOSOLVE AND AROMATIC NAPHTHA FOR THE DICHLOROBENZENE NOW IN USE. (CARBON REMOVER USED FOR CARBURETOR CLEANER.)

ENTOMOLOGY & GOLF COURSE	PESTICIDES	0	0	0	0	500	PROCEDURE	.00	0	.000	.00	1. PROCEDURAL ALTERATIONS SUCH AS THE ALTERNATE USE OF TYPES OF PESTICIDES AND FERTILIZER MIXTURES, WHICH PREVENTS TOLERANCE BUILD-UP AND PROMOTES GOOD TURF, WILL RESULT IN LESS USE OF PESTICIDES.
TRAINING AIDS FACILITY	PHOSPH ACID/SLUDGE/LIME	190	0	190	0	700	SEWER	.00	0	3.330	.00	1. WHEN LIME IS MIXED WITH PHOSPHORIC ACID, THE MIXTURE IS NEUTRALIZED AND CAN BE DISCHARGED TO THE SANITARY SEWER.
TRAINING AIDS FACILITY	ETCHANT	96	0	90	0	900	SUBST/TREATMENT	1.11	900	4.170	.00	1. SUBSTITUTE PEROXIDE/SULFURIC ETCHANT FOR THE FERRIC CHLORIDE ETCHANT NOW IN USE. FILTER THIS ETCHANT CONTINUOUSLY.
TRAINING AIDS FACILITY	RESIST	12	0	0	0	0	NONE	.00	0	5.830	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
TRAINING AIDS FACILITY	ELECTROPLATING SOLN.	3	0	0	0	0	NONE	.00	0	3.330	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
TRAINING AIDS FACILITY	SHOP RAGS	65	0	65	0	325	SUBSTITUTION	.00	0	5.000	.00	1. USE OF ONLY F003 SOLVENTS FOR CLEAN-UP ALLOW THE RAGS TO BE WASHED AND REUSED.
TRAINING AIDS FACILITY	SOLVENT	150	0	75	0	400	REUSE	.00	0	5.500	.00	1. SEGREGATE USED SOLVENTS BY COLOR AND REUSE THEM AS PAINT THINNER.
TRAINING AIDS FACILITY	FIXER/DEVELOPER	24	0	24	0	70	SEWER	.00	0	2.920	.00	1. SOLUTION CAN BE DISCHARGED TO SANITARY SEWER.
TRAINING AIDS FACILITY	WASTE FLUID	2,025	0	1,575	0	12,000	PROCEDURE	.00	0	7.620	.00	1. USE OF STATE-OF-THE-ART TECHNOLOGY IN THE PRODUCTION OF THP AND NON-THP BOARDS REDUCES THE PRODUCTION OF WASTE. THE MIXTURE CONSISTS OF ALKALINE CLEANER, PERSULFATE ETCHANT, ELECTROLESS COPPER SOLN/CATALYST, RESIST, RESIST DEVELOPER, SODIUM PERSULFATE, COPPER PLATING SOLN., TIN/LEAD PLATING SOLN., RESIST STRIPPER, AND ETCHANT.

TRAINING AIDS FACILITY	SUPEROXIDE CARTRIDGES	0	420	0	340	700 SEWER	.00	0	.000	2.06	1. MATERIAL IS NEUTRALIZED WHEN MIXED WITH PHOSPHORIC ACID AND CAN BE DISCHARGED TO SANITARY SEWER.

COMMAND: ATC/BASE: LOWRY

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	930	0	630	0	4,600	TREATMENT	2.38	9,300	3.010	.00	THIS CATAGORY CONSISTS OF SPENT CAUSTIC, AND STRIPPER. 1. CAUSTIC: FILTER VAT FREQUENTLY TO EXTEND CAUSTIC LIFE.(FILTER SYSTEM COSTS $5300 & SAVES $1000/YEAR) 2. STRIPPER: FILTER AND REUSE. (FILTER SYSTEM COSTS $4000 & SAVES $3600/YEAR)
CORROSION CONTROL	SOLVENT	400	0	300	0	1,650	REUSE/TREAT	4.07	5,300	2.000	.00	1. A: REUSE UNTIL NO LONGER USABLE. B: FILTER AND REUSE AGAIN.
CORROSION CONTROL	FILTERS	1,400	0	900	0	13,700	EQUIPMENT	1.01	12,600	1.570	.00	1. INSTALL 3 ELECTROSTATIC SPRAY SYSTEMS TO REDUCE OVERSPRAY. (SAVES $1700/YR FOR FILTER DISPOSAL & $12000/YR ON PAINT)
CORROSION CONTROL	SHOP RAGS	700	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
CORROSION CONTROL	PAINT	300	0	300	0	8,400	PROCEDURE	.00	0	.000	.00	1. STORE PAINT INSIDE TO EXTEND LIFE. (SAVES $300/YR FOR DISPOSAL & $8100/YR FOR PAINT REPLACEMENT)
VEHICLE MAINT.	PAINT RELATED WASTE	55	0	0	0	0	NONE	.00	0	3.180	.00	1. POSSIBLE OPTIONS ARE NOT PRESENTLY ECONOMICAL.
VEHICLE MAINT.	WASTE OIL	6,000	0	0	0	0	NONE	.00	0	.010	.00	1. WASTE OIL IS NOT CONSIDERED TO BE A HAZARDOUS WASTE IN TEXAS.
VEHICLE MAINT.	SOLVENT	540	0	540	0	100	SUBSTITUTION	.00	0	2.000	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THAT PRESENTLY IN USE.
VEHICLE MAINT.	FILTERS	240	0	120	0	5,100	EQUIPMENT	2.35	10,200	2.500	.00	1. INSTALL AIRLESS SPRAY EQUIPMENT TO REDUCE OVERSPRAY AND EXTEND THE LIFE OF THE FILTERS.

VEHICLE MAINT.	STRIPPER (CAUSTIC SOLN)	1,200	0	900	0	3,500	TREATMENT	2.73	8,000	1.330	.00	1. FILTER TO EXTEND LIFE. (SOLUTION USED TO CLEAN RADIATORS)
REPROGRAPHICS	TONER/DISPERSANT	55	0	44	0	248	SUBST/RECYCLE	4.63	883	3.270	.00	1. SUBSTITUTE NON-CHLORINATED SOLVENTS FOR THOSE PRESENTLY IN USE. 2. USE A COMBINATION OF FILTRATION AND DISTILLATION TO RECOVER SOLVENTS. COST OF $6500 - SPLIT FOR ALL REPROGRAPHICS WASTESTREAMS.
REPROGRAPHICS	CONVERSION SOLUTION	55	0	44	0	1,680	SUBST/RECYCLE	.58	883	1.820	.00	1. SUBSTITUTE NON-CHLORINATED SOLVENTS FOR THOSE PRESENTLY IN USE. 2. USE A COMBINATION OF FILTRATION AND DISTILLATION TO RECOVER SOLVENTS. COST OF $6500 SPLIT FOR ALL REPROGRAPHICS WASTESTREAMS.
REPROGRAPHICS	DEGLAZER	295	0	236	0	3,160	SUBST/RECYCLE	1.71	4,735	3.220	.00	1. SUBSTITUTE NON-CHLORINATED SOLVENTS FOR THOSE PRESENTLY IN USE. 2. USE A COMBINATION OF FILTRATION AND DISTILLATION TO RECOVER SOLVENTS. COST OF $6500 SPLIT BETWEEN ALL REPROGRAPHICS WASTESTREAMS.
AUTO HOBBY SHOP	SOLVENT	90	0	90	0	180	SUBST/FRP	.00	0	2.000	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F (SUCH AS DYNA 143) FOR THAT PRESENTLY IN USE. RESULTING WASTE CAN BE HANDLED AS USED OIL.
AUTO HOBBY SHOP	WASTE OIL	3,000	0	0	0	0	FRP	.00	0	.010	.00	1. ALTHOUGH THIS OIL IS OF HIGH ENOUGH QUALITY TO BURN FOR ENERGY RECOVERY ON BASE, THE LACK OF A NEED FOR FUEL OIL AND THE MONEY RECEIVED FOR THE SELL OF USED OIL MAKES THIS OPTION UNATTRACTIVE.
MEDICAL/DENTAL FACILITY	SILVER	3	0	3	0	0	PROCEDURE/EQUIP	.00	0	.000	.00	1. TEST DISCHARGED ELECTROLYTE FOR SILVER CONTENT AND RECOVER BY ADDING A CHEMICAL RECOVERY CARTIDGE DOWNSTREAM FORM THE ELECTROLYTIC UNIT (COST OF $300/YEAR - UNKNOWN SAVINGS)
PMEL	FREON 113	20	0	18	0	120	REUSE	.00	0	2.000	.00	1. REUSE FREON UNTIL IT HAS REACHED ITS MAXIMUM CONTAMINATION LIMIT.
PMEL	SHOP RAGS	0	0	0	0	0	TREATMENT	.00	0	.000	.00	1. LAUNDER AND REUSE RAGS (AMOUNTS PRODUCED AND DISPOSAL COSTS NOT AVAILABLE).

PMEL	MERCURY	0	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. (AMOUNT PRODUCED AND DISPOSAL COST NOT AVAILABLE).
MUSEUM	SOLVENT	0	0	0	0	0	PROCEDURE/SUBST	.00	0	.000	.00	1. ALTER CLEANING PRACTICES TO REDUCE AMOUNT OF SOLVENT PRODUCED, STANDARDIZE TO A SINGLE SOLVENT, AND USE WATERBORNE COATINGS.
MUSEUM	PAINT SLUDGE	0	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
MUSEUM	STRIPPER (B & B 4411)	0	0	0	0	0	SUBSTITUTION	.00	0	.000	.00	1. USE NON-EP TOXIC COATINGS AND A NON-HAZARDOUS STRIPPER IN PLACE OF THE B & B 4411 NOW IN USE.
MUSEUM	MISC. SOLID WASTE	0	0	0	0	0	NONE	.00	0	.000	.00	1. (INCLUDES DRIED PAINT RESIDUE, SOLVENT AND PAINT CONTAMINATED RAGS, AND CONTAMINATED CONTAINERS.) NO OPTION FOR REDUCTION SUGGESTED.
PHOTOGRAPHY SCHOOL	CLEANING CMPD.	3	0	3	0	0	SUBSTITUTION	.00	0	.000	.00	1. SUBSTITUTE SODIUM PERSULFATE/PHOSPHORIC ACID FOR SODIUM DICHROMATE/SULFURIC ACID.
TRAINING AIDS FACILITY	FERRIC CHLORIDE	23	0	0	0	0	NONE	.00	0	3.040	.00	1. PROCESS CHANGE COULD BE AN OPTION, BUT THE PROCESS CANNOT BE CHANGED AT BASE LEVEL.
TRAINING AIDS FACILITY	PAINT THINNER	60	0	0	0	0	NONE	.00	0	3.330	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
TRAINING AIDS FACILITY	PAINT SLUDGE	60	0	40	0	1,450	EQUIPMENT	2.17	2,700	2.250	.00	1. REPLACE AIR-ATOMIZED SPRAY EQUIP. WITH AIR-ASSISTED SPRAY EQUIIP. TO REDUCE OVERSPRAY (WHICH PRODUCES SLUDGE).
TRAINING AIDS FACILITY	SHOP RAGS	100	0	100	0	600	SUBST/TREAT	.28	150	2.850	.00	1. REPLACE RAGS CURRENTLY IN USE WITH REUSABLE RAGS, LAUNDER THEMAND REUSE THEM.
TRAINING AIDS FACILITY	WATERFALL DISCHARGE	0	0	0	0	0	TREATMENT	.00	0	.000	.00	1. FILTER SLUDGE FROM WASTEWATER AND DISCHARGE REMAINING WATER INTO SANITARY SEWER (CURRENTLY NOT BEING DISPOSED OF AS HAZARDOUS WASTE). IF FOUND TO BE HAZARDOUS, 900 GALLONS

												WOULD HAVE TO BE DISPOSED OF AND THE REDUCTION (OF 900 GALLONS BY THIS RECOMMENDATION) WOULD PROVIDE A COST SAVINGS OF $640. THE COST OF A FILTRATION UNIT IS NOT JUSTIFIED UNLESS THE ENTIRE WATERFALL IS FOUND TO BE HAZARDOUS.
AF ACCT. AND FINANCE	SOLVENT	30	0	30	0	130	SUBST/TREATMENT	.00	0	2.000	.00	1. A: SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THAT CURRENTLY IN USE. B: INSTALL FILTRATION SYSTEM TO EXTEND LIFE OF SOLVENT. (USE CORROSION CONTROLS FILTRATION UNIT - NO CAPITAL COST NECESSARY) DISP. COST ESTIMATED FROM SOLVENT IN VEHICLE MAINT. SHOP.
AF ACCT. AND FINANCE	CLEANING CMPD.	120	0	120	0	300	SUBSTITUTION	.00	0	2.500	.00	1. SUBSTITUTE PHOSPHORIC ACID CLEANING SOLUTION FOR THAT CURRENTLY IN USE.

COMMAND: ATC/BASE: RANDOLPH

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	660	0	420	0	8,610	EQUIP/TREAT	2.80	20,100	10.910	.00	1. A: INSTALL A HEATED STRIPPER VAT WHICH CONTAINS NON-HAZARDOUS CHEMICALS (ETHANOLAMINE, BENZYL ALCOHOL, ALKOXY ETHER). FILTER METALS FROM THIS VAT TO PREVENT THE STRIPPER FROM BECOMING EP TOXIC. B: INSTALL CART-MOUNTED FILTER SYSTEM TO FILTER MIXTURE OF SPENT STRIPPER AND FRESH STRIPPER -REUSE THIS MIXTURE.
CORROSION CONTROL	MEK/TOLUENE	700	0	500	0	6,900	SUBST/RECYCLE	1.13	7,000	10.860	.00	1. A: SUBSTITUTE MIBK/XYLENE FOR MEK/TOLUENE. B: FILTER OR DISTILL SOLVENT FOR REUSE.
CORROSION CONTROL	MISC. SOLID WASTES	1,000	0	1,000	0	10,000	SUBST/TREATMENT	.00	0	10.000	.00	1. A. SUBSTITUTION OF MIBK/XYLENE FOR MEK/TOLUENE ALLOWS RAGS TO BE WASHED AND REUSED RATHER THAN DISPOSED OF AFTER ONE USE.(700 GAL) B. USE OF MIBK/XYLENE-BASED THINNERS MAKES THE SOLID WASTES THAT ARE PRESENTLY MADE HAZARDOUS BY MIXTURE WITH PAINT OVERSPRAYS NON-HAZARDOUS. (300 GAL)
CORROSION CONTROL	ALODINE	80	0	80	0	1,000	SUBSTITUTION	.00	0	10.880	.00	1. SUBSTITUTE A PHOSPHATE BASED CONVERSION SOLUTION FOR ALODINE (REQUIRES A PRETEST FOR ITS EFFECTIVENESS BEFORE FULL IMPLEMENTATION.) IF TEST SHOWS THAT THIS OPTION IS NOT FEASIBLE, RETURN EXCESS ALODINE TO VAT AND MIX SPENT ALODINE WITH "POWDER FEED" TO PRODUCE NEW SOLUTION.
CORROSION CONTROL	WATERFALL DISCHARGE	0	0	0	0	0	NONE	.00	0	32.750	.00	1. CURRENTLY EXEMPT FROM RCRA REGULATION. IF IT WERE TO LOSE EXEMPTION STATUS, 2000 GAL/YEAR OF WATERFALL DISCHARGE WOULD HAVE TO BE HANDLED AS HAZARDOUS WASTE.
VEHICLE MAINT.	SOLVENT (PD-680)	100	0	100	0	1,000	SUBST/TREATMANT	.00	0	10.000	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F (DYNA 143) FOR PD-680. FILTER AND REUSE THIS SOLVENT. DISP. COST ESTIMATED FROM SOLVENT IN CORROSION CONTROL SHOP.
VEHICLE MAINT.	SOLVENT (MIXED)	300	0	0	0	0	PROC/EQUIP/SUBS	.00	3,500	10.000	.00	

												1. INSTALL AIRLESS SPRAY EQUIP. TO REDUCE OVERSPRAY. 2. RECLAIM POLYURETHANE CONTAMINATED THINNERS IN HANGER 48. 3. SEGREGATE USED THINNERS BY COLOR AND REUSE/OR RECYCLE URETHANE THINNERS. 4. REPLACE GREEN URETHANE WITH A NON-EP-BASED SYSTEM (HANTZEN), YELLOW LEAD-BASED COATINGS WITH MASTENOL, AND RED LEAD-BASED COATINGS WITH IRON OR COBALT OXIDES. (COST SAVINGS UNKNOWN) DISP. COST ESTIMATED FROM SOLVENT IN CORROSION CONTROL SHOP.
WHEEL & TIRE	SOLVENT (PD-680)	300	0	300	0	3,450	SUBST/TREATMENT	.80	2,500	10.000	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F (DYNA 143) FOR PD-680. FILTER THIS SOLVENT FOR REUSE. HANDLE WASTE AS USED OIL. (SAVE $3000 ON DISPOSAL AND $450 ON FEEDSTOCK). DISP. COST ESTIMATED FROM SOLVENT IN CORROSION CONTROL SHOP.
NDI	INSP PENETRANT	110	0	110	0	1,200	PROCEDURE	.00	0	10.910	.00	1. CODISPOSAL: BLENDING OF PENETRANTS OF A NON-HAZARDOUS NATURE(TURCO P-41) WITH AQUEOUS, NON-CHROMATE BASED DEVELOPERS DURING REMOVAL FROM VATS ALLOW THESE WASTES TO BE BLENDED WITH USED OIL WITHOUT INTRODUCTION OF HAZARDOUS WASTE TO USED OIL.
NDI	MAGNETIC PARTICAL SOLN.	110	0	0	0	0	RECYCLE	.00	0	10.910	.00	1. TRY THE MAGNAFLUX FILTRATION SYSTEM TO REMOVE IRON FILLINGS. ADD NEW FILLINGS AND REUSE. (LOSS OF FLOURESCENT INTO SOLVENT RESULTING IN INSPECTION INTERFERENCE MAY PRESENT A PROBLEM). DISP. COST ESTIMATED FROM OTHER WASTES IN THE NDI SHOP.
NDI	DEVELOPER	110	0	110	0	1,200	SUBSTITUTION	.00	0	10.910	.00	1. SUBSTITUTE A NON-CHROMATE-BASED DEVELOPER (SUCH AS SHERWIN DOUBLE CHECK, SHERWIN D-100, OR TURCO FLUROCHECK NAD) FOR THE CHROMATE-BASED DEVELOPER NOW IN USE.
NDI	1,1,1-TRICHLOROETHANE	0	0	0	0	0	SUBSTITUTION	.00	0	10.500	.00	1. SUBSTITUTE THF FOR TCA. THF IS HIGHLY VOLATILE AND LEAVES NO RESIDUE (VOLUME AND COST SAVINGS DATA ARE NOT AVAILABLE). DISP. COST ESTIMATED FROM TCA IN THE METALS CLEANING & TREATMENT SHOP.
REPROGRAPHICS	CLEANING CMPD.	0	0	0	0	0	SUBSTITUTION	.00	0	.000	.00	1. SUBSTITUTE SODIUM PERSULFATE/SULFURIC ACID FOR POTASSIUM DICHROMATE/SULFURIC ACID. (VOLUME AND COST SAVINGS DATA ARE

												NOT AVAILABLE).
PMEL	HYDRAULIC FLUID/OIL	1	0	0	0	0	NONE	.00	0	10.000	.00	1. DUE TO SMALL AMOUNT OF WASTE, NO OPTION FOR REDUCTION IS SUGGESTED. DISPOSAL COST ESTIMATED TO BE EQUAL TO THAT OF SOLVENT.
PMEL	MERCURY	0	0	0	0	0	NONE	.00	0	.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST UNKNOWN. 113 LB = 1 GAL
PMEL	FREON 113	20	0	20	0	436	REUSE	.00	0	10.000	.00	1. REUSE WASTE FREON FROM THE PMEL SHOP IN THE BATTERY AND ELECTRONICS SHOP (WHERE 55 GAL/YR OF FREON IS USED BUT COULD BE REDUCED BY SEALING THE LID OF THE FREON TANK TO PREVENT THE FREON FROM VOLATILIZING AND ENTERING THE ATMOSPHERE.) DISPOSAL COST WAS ESTIMATED BY MULTIPLYING THE DISPOSAL COST OF FREON AT LOWRY AIR FORCE BASE BY 5 (SINCE MOST OF THE OTHER DISPOSAL COSTS AT RANDOLPH ARE ABOUT 5 TIMES THE DISPOSAL COST FOR SIMILAR WASTESTREAMS AT LOWRY).
METALS CLEANING & TREAT.	RINSEWATER	0	0	0	0	125	PROCEDURE	.00	0	.000	.00	1. USE OF COUNTERFLOW RINSING INCREASES EFFICIENCY (AND DECREASESWATER USE) BY 70% (REDUCTION OF 67900 GALLONS) IF THIS WATER WERE FOUND TO REQUIRE DISPOSAL AS A HAZARDOUS WASTE, THIS WOULD PROVIDE A SAVINGS OF $740000.
METALS CLEANING & TREAT.	SOLVENT (PD-680)	55	0	55	0	600	SUBSTITUTION	.00	0	10.910	.00	1. SUBSTITUTE SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F (SUCH AS DYNA 143) FOR PD-680.
METALS CLEANING & TREAT.	STRIPPER (COLD)	20	0	10	0	110	SUBSTITUTION	.00	0	11.000	.00	1. SUBSTITUTE THF (TETRAHYDROFURAN) FOR THE STRIPPER CURRENTLY IN USE.
METALS CLEANING & TREAT.	CARBON REMOVER	175	0	115	0	2,710	TREATMENT	1.03	2,538	10.910	.00	1. FILTRATION OF VATS EXTENDS LIFE BY 300 TO 400%.(SAVINGS ON BOTH DISPOSAL AND CHEMICAL REPLACEMENT COSTS.) CARBON REMOVER MADE OF ETHANOLAMINE. (INVESTMENT = TOTAL COST OF SYSTEM * RATIO OF GALLONS FOR THIS VAT TO TOTAL GALLONS TREATED BY UNIT)
METALS CLEANING & TREAT.	SODIUM HYDROXIDE (SOLN)	1,625	0	1,138	0	14,944	TREATMENT	1.92	25,000	10.910	.00	1. FILTRATION OF VATS EXTENDS LIFE BY 300 TO 400%. (SAVINGS ON BOTH DISPOSAL AND CHEMICAL REPLACEMENT

												COSTS.)(INVESTMENT = TOTAL COST OF SYSTEM * RATIO OF GALLONS FOR THIS VAT TO TOTAL GALLONS TREATED BY SYSTEM)
METALS CLEANING & TREAT.	ALKALINE PERMANGANATE	650	0	455	0	5,817	TREATMENT	1.98	10,000	10.920	.00	1. FILTRATION OF VATS EXTENDS LIFE BY 300 TO 400%. (SAVINGS ON BOTH DISPOSAL AND CHEMICAL REPLACEMENT COSTS.) (INVESTMENT = TOTAL COST OF SYSTEM * RATIO OF GALLONS FOR THIS VAT TO TOTAL GALLONS TREATED BY UNIT)
METALS CLEANING & TREAT.	PHOSPH. ACID/SURFACTANT	165	0	115	0	2,427	TREATMENT	1.17	2,538	10.910	.00	1. FILTRATION OF VATS EXTENDS LIFE BY 300 TO 400%. (SAVINGS ON BOTH DISPOSAL AND CHEMICAL REPLACEMENT COSTS.) (INVESTMENT = TOTAL COST OF SYSTEM * RATION OF GALLONS FOR THIS VAT TO TOTAL GALLONS TREATED BY UNIT)
METALS CLEANING & TREAT.	1,1,1-TRICHLOROETHANE	20	0	0	0	0	SUBSTITUTION	.00	0	10.500	.00	1. SUBSTITUTE REFINED TCA FOR THE TCA NOW IN USE TO PREVENT ACID FORMATION.
METALS CLEANING & TREAT.	STRIPPER (HOT)	300	0	0	0	0	EQUIPMENT	.00	0	11.000	.00	1. INSTALL TEMPERATURE CONTROLS AND A FILTRATION SYSTEM TO THE HOT STRIPPER VATS FOR A MORE EFFICIENT SYSTEM. COST OF INSTALLATION UNKNOWN.
METALS CLEANING & TREAT.	DRAGOUT	7	0	6	0	6,000	PROCEDURE	.00	0	.000	.00	1. DRAGOUT CAN BE REDUCED FROM 4-10 GAL/1000 SQUARE FEET BY 3.6-9.2 GAL/1000 SQUARE FEET OF PARTS BY USING IMPROVED RACKING AND RINSING TECHNIQUES. A. REDUCE PIECE WITHDRAWAL SPEED B. PROPERLY RACK PARTS FOR CLEANING C. ALLOW PARTS TO DRAIN THOROUGHLY OVER EACH VAT BEFORE MOVING TO THE SUBSEQUENT VAT.
LSI OPERATIONS	MISC. SOLID WASTES	1,320	0	0	0	0	NONE	.00	0	10.910	.00	1. NO OPTIONS FOR REDUCTION SUGGESTED.
LSI OPERATIONS	RINSEWATER/STRIPPER	47,000	0	33,700	0	313,000	PROCEDURE/TREAT	.25	70,000	10.800	.00	1. ELIMINATE RINSE STEPS DURING STRIPPING AND SEGREGATE RINSEWATER FROM STRIPPER (RESULTS IN PRODUCTION OF 14000 GAL OF STRIPPER AND 17000 GAL OF WASTEWATER. SAVES $163000) 2. COLLECT 14000 GALLONS OF STRIPPER BEFORE RINSING. FILTER PAINT FROM STRIPPER, MIX 1:1 WITH FRESH STRIPPER, AND REUSE.(REDUCE BY 5400 GAL. SAVE $50000, COSTS $35000) 3. RINSE FLOOR OF STRIPPING AREA WITH ONLY 100 GALLONS OF WATER. COLLECT THIS HEAVILY CONTAMINATED WATER, TREAT USING

												BATCH PRECIPITATION AND CARBON ADSORPTION. THEN, RINSE AREA AGIAN. THIS SECOND BATCH OF RINSEWATER SHOULD BE CONTAMINATED LIGHTLY ENOUGH TO BE DISCHARGED TO SANITARY SEWER.(REDUCE BY 12300 GAL. SAVE $100,000 COSTS $35000). THES STEPS PROVIDE COMPLIANCE WITH RELAVENT TECHNICAL ORDERS.
HANGER 48 PAINTING OPS	MEK/TOLUENE	5,400	0	2,000	0	19,000	TREAT/REUSE	.58	10,000	8.610	.00	1. A. SEGREGATE SOLVENTS, FILTER PAINT FROM THEM, AND REUSE. (REDUCES WASTE BY 1400 GAL, SAVES $12000, COSTS $10000) B. MODIFY CLEAN-UP PROCEDURES (REDUCES WASTE BY 600 GAL, SAVES $7000)
HANGER 48 PAINTING OPS	MISC. SOLID WASTES	3,960	0	1,650	0	18,000	SUBSTITUTION	.00	0	10.860	.00	1. SUBSTITUTION OF MIBK FOR MEK ALLOWS FOR THE RAGS TO BE CLEANED ON SITE AND REUSED.
HANGER 48 PAINTING OPS	FILTERS	21,000	0	10,000	0	75,000	EQUIPMENT	.05	3,500	4.290	.00	1. USE OF AIR-ASSISTED AIRLESS SPRAY EQUIPMENT TO REDUCE OVERSPRAY AND PROLONG THE LIFE OF THE FILTERS.(SAVES $48000). ADDITIONAL SAVINGS OF $17000 IS A RESULTS FROM THE MORE EFFICINT USE OF PAINT BY THE NEW EQUIPMENT.(USE 800 GAL/YEAR RATHER THAN 1400 GAL/YEAR)
OPERATIONAL MAINT.	SOLVENT (PD-680)	1,000	0	800	0	6,000	SUBSTITUTION	.00	0	10.000	.00	1. SUBSTITUTE A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR PD-680.

COMMAND: MAC/BASE: CHARLESTON

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	250	0	0	0	0	NONE	.00	0	17.250	.00	1. CANNOT SUBSTITUTE MEK/MIBK BECAUSE OF THE RUBBER RADOMES ON THE AIRCRAFT.
CORROSION CONTROL	MEK	1,275	0	600	0	3,750	SUBSTITUTION	.00	0	6.750	.00	1. SUBSTITUTE MIBK (IGNITABLE WASTE) FOR MEK (LISTED WASTE). THIS SUBSTITUTION WOULD ALLOW THE WASTE TO BE RECYCLED (OFF BASE). (ALTHOUGH SOLVENT IS STILL HAZARDOUS BY IGNITABILITY, SOME SOLVENT RELATED WASTES ARE ELIMINATED.)
CORROSION CONTROL	SHOP RAGS	600	0	600	0	3,750	SUBSTITUTION	.00	0	5.000	.00	1. THE USE OF MIBK/XYLENE INSTEAD OF MEK MAKES SHOP RAGS NON-HAZARDOUS WHEN WASHED. (RINSEWATER IS ALSO NON-HAZARDOUS).
CORROSION CONTROL	MISC. SOLID WASTE	60	0	0	0	0	PROCEDURE	.00	0	5.000	.00	1. (INCLUDES PAINT BARRIER PAPER) USE PAPER AS LONG AS POSSIBLE BEFORE DISCARDING.
CORROSION CONTROL	ABRASIVE WASTE	1,400	0	1,400	0	9,450	SUBSTITUTION	.00	0	6.750	.00	1. THE USE NON-EP TOXIC COATINGS WILL MAKE THIS WASTE NON-HAZARDOUS.(THIS WOULD REQUIRE A CHANGE IN THE TECHNICAL ORDER.)
CORROSION CONTROL	WATERFALL DISCHARGE	5,000	0	5,000	0	20,000	RECYCLE	.00	0	4.000	.00	1. FILTER THE WATERFALL DURING ITS RECIRCULATION. THE USE OF NON-EP TOXIC COATINGS WOULD ALLOW FILTERS TO BE DISCARDED OF AS NON-HAZARDOUS.
VEHICLE MAINT.	BATTERIES	0	0	0	0	0	NONE	.00	0	.000	.00	VOLUME OF THIS WASTE IS VERRY SMALL. 1. NO OPTION FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	WASTE OIL	7,920	0	7,920	0	36,828	FRP	.00	0	4.400	.00	1. MIX ACCORDING TO SPECS. AND BURN FOR ENERGY RECOVERY.
VEHICLE MAINT.	PAINT RELATED WASTE	220	0	220	0	1,330	SUBSTITUTION	.00	0	5.950	.00	1. THE USE OF WATERBORNE ACRYLICS WILL ELIMINATE THIS WASTE. THE USE OF MORE EFFICIENT PAINT SPRAY EQUIPMENT SHOULD ALSO

BE CONSIDERED.

VEHICLE MAINT.	SOLVENT	83	0	0	0	486	SUBSTITUTION	.00	0	5.250	.00	1. THE USE OF THE SAFETY-KLEEN SERVICE WILL REQUIRE THAT THE SAME AMOUNT OF WASTE BE MANIFESTED, BUT THE COST WILL BE CONSIDERABLY LESS. IF THE SHOP PERSONNEL ARE DISPLEASED WITH THIS SERVICE, TWO OTHER OPTIONS ARE AVAILABE: A: USE A PD-680 LIKE SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F. B: RETURN TO USE OF PD-680 AND BURN THE WASTE FOR ENERGY RECOVERY.
VEHICLE MAINT.	SHOP RAGS	55	0	55	0	275	SUBSTITUTION	.00	0	5.000	.00	1. THE USE OF MIBK/XYLENE INSTEAD OF MEK MAKES THE RAGS NON-HAZARDOUS WHEN WASHED. (THE RINSEWATER IS ALSO NON-HAZARDOUS.)
JET ENGINE	SOLVENT (PD-680)	636	0	636	0	3,405	FRP/SUBST	.00	0	5.350	.00	1. A: PD-680 IN BEARING LINE: BURN FOR ENERGY RECOVERY (COULD BE REUSED, BUT EXTRA EFFORT MAKES THIS NOT ECONOMICAL) B: VAT OF PD-680: SUBSTITUTE ROCHESTER MILAND'S 377c FOR THE PD-680 NOW IN USE. 377c CAN BE FILTERED AND DISCHARGED TO A SANITARY SEWER.
JET ENGINE	WASTE FUEL (JP-4)	200	0	100	0	570	REUSE	.00	0	2.700	.00	1. SEGREGATE FROM OTHER FLUIDS, TEST THE FUEL FOR SPECIFICATIONS, AND REUSE (RETURN TO STOCK, SEND TO AGE, OR, IF IT IS OFF-SPEC, USE FOR FIRE TRAINING).
JET ENGINE	HYDRAULIC FLUID	300	0	300	0	210	FRP	.00	0	2.700	.00	1. SEGREGATE FROM OTHER FLUIDS AND BURN FOR ENERGY RECOVERY.
JET ENGINE	WASTE OIL (SYNTHETIC)	300	0	0	0	1,710	SELL	.00	0	2.700	.00	1. SEGREGATE FROM OTHER FLUIDS AND SELL FOR RECLAMATION.
JET ENGINE	CARBON REMOVER	24	0	24	0	390	SUBSTITUTION	.00	0	17.250	.00	1. TRY USING OAKITE PRODUCTS, INC.'S CARBON REMOVER (WHICH IS ETHANOLAMINE BASED). THIS PRODUCT CAN BE DISCHARGED TO A SANITARY SEWER BY FOLLOWING GUIDELINES FOR SLOW DISCHARGE, FILTERING, AND RINSING. CARBON REMOVER CURRENTLY IN USE CONTAINS ORTHODICHLOROBENZENE.
JET ENGINE	FINGERPRINT REM/BEAR.OIL	28	0	28	0	88	FRP	.00	0	4.050	.00	1. BURN FOR ENERGY RECOVERY.

PNEUDRAULICS	HYDRAULIC FLUID (SYNTH)	250	0	0	0	0 RECYCLE	.00	0	3.200	.00	1. SEGREGATE FROM OTHER FLUIDS AND DISPOSE OF AS HAZARDOUS WASTE UNTIL RECYCLING IS POSSIBLE.
PNEUDRAULICS	SOLVENT (PD-680)	150	0	150	0	802 SUBSTITUTION	.00	0	5.350	.00	1. SUBSTITUTE SIMPLE GREEN FOR PD-680. SIMPLE GREEN HAS A LONGER LIFE AND CAN BE DISCHARGED TO A SANITARY SEWER. IF SIMPLE GREEN PROVES TO BE UNEFFECTIVE, USE ROCHESTER MILAND'S SE373.
PNEUDRAULICS	SHOP RAGS	0	0	0	0	0 TREATMENT	.00	0	.000	.00	VOLUME OF RAGS PRODUCED IS UNKNOWN. 1. HAVE RAGS LAUNDERED OFF BASE AND REUSE THEM.
WHEEL & TIRE	SOLVENT (CITRO-KLEEN)	300	0	295	0	1,578 TREATMENT	.00	0	3.350	.00	1. TEST WASTE FOR CADMIUM CONTENT. IF NECESSARY, FILTER BEFORE DISCHARGING TO SEWER.
WHEEL & TIRE	STRIPPER (B & B 9201)	400	0	395	0	3,351 TREATMENT	.43	1,300	8.500	.00	1. FILTER PAINT PARTICLES FROM WASTE AND DISCHARGE TO A SANITARY SEWER GRADUALLY (<20 GALLONS/HOUR). THE FILTERS MUST BE DISPOSED OF AS HAZARDOUS WASTE. (WASTE IS HAZARDOUS ONLY BECAUSE OF THE PAINT CONTENT.)
WHEEL & TIRE	SOLVENT (PD-680)	450	0	150	0	802 SUBSTITUTION	.00	0	5.350	.00	1. SUBSTITUTE DYNA 143 FOR PD-680 IN BOTH VATS. (SUBSTITUTION OF CITRIKLEEN MAY CAUSE A PROBLEM WITH THE TECHNICAL ORDER FOR BEARING CLEANING.) A: BEARING LINE VAT: (300 GAL) METAL CONTENT MAY CAUSE THIS WASTE TO REMAIN HAZARDOUS. B: PARTS CLEANING VAT: (150 GAL) NO LONGER HAZARDOUS (BY IGNITABILITY) AND CAN BE BURNED FOR ENERGY RECOVERY.
NDI	INSP PENETRANT	40	0	40	0	426 FRP	.00	0	10.250	.00	1. BURN FOR ENERGY RECOVERY.
NDI	EMULSIFIER	40	0	40	0	426 FRP	.00	0	10.250	.00	1. BURN FOR ENERGY RECOVERY.
NDI	MAGNETIC PARTICLE SOLN.	100	0	100	0	575 FRP	.00	0	5.350	.00	1. BURN FOR ENERGY RECOVERY.
NDI	SOLVENT (PD-680)	100	0	50	0	300 SUBSTITUTION	.00	0	6.000	.00	1. SUBTITUTE CITRIKLEEN HD OR ROCHESTER MILAND'S 377c OR SIMPLE GREEN (ALL OF WHICH CAN BE DISCHARGED TO A SANITARY

											SEWER) FOR PD-680.
NDI	AEROSOL CANS	220	0	55	0	0 PROCEDURE	.00	0	.000	.00	1. (400 CANS EQUALS 220 GALLONS) EMPTY CANS (IE. SAME PRESSURE INSIDE CANS AS OUTSIDE) BEFORE DISPOSAL.
NDI	SHOP RAGS	0	0	0	0	0 TREATMENT	.00	0	.000	.00	VOLUME OF RAGS USED IS UNKNOWN.1. HAVE RAGS LAUNDERED OFF BASE AND REUSE.
FUELS MANAGEMENT	WASTE FUEL/CLEAN UP MAT.	1,400	0	700	0	4,725 PROCEDURE	.00	0	6.750	.00	(WASTE FUEL IS JP-4) 1. A. PLACE SPILL RESOPNSE EQUIPMENT IN THE IMMEDIATE VICINITY OF REFUELING/DEFUELING OPERATIONS AND SUPPLIES. B. TRAIN PERSONNEL OPERATING FUEL LOADING/UNLOADING EQUIPMENT IN SPILL RESPONSE ACTIONS. C. PLACE RESPONSIBILITY FOR CLEAN-UP (INCLUDING FINANCIAL RESPONSIBILITY) ON THE PERSONNEL (ORGANIZATION) CAUSING THE RELEASE. D. INSTALL SPILL ALARMS ON ALL FUEL STORAGE EQUIPMENT.
FUELS MANAGEMENT	FILTERS (FUEL)	60	0	0	0	0 NONE	.00	0	6.750	.00	1. NO OPTION FOR REDUCTION AVAILABLE AT THIS TIME.
REPROGRAPHICS	DISPERSANT/DEVELOPER	12	0	11	0	72 EQUIP/PROC/FRP	7.73	375	6.500	.00	1. REPLACE CURRENT OFFSET PRINTING PROCESS WITH A XEROGRAPHIC PROCESS WHICH PRODUCES ALMOST NO WASTE. (COST OF $1500 IS SPLIT BETWEEN ALL OF THE REPROGRAPHICS WASTE STREAMS.) 2. IF THE FIRST OPTION IS NOT POSSIBLE (AT LEAST NOT IMMEDIATELY), REDUCE THIS WASTESTREAM COMPLETELY BY USING AND CHANGING THE 885 PLATEMAKER ONLY WHEN NECESSARY AND BURNING THE WASTE PRODUCED FOR ENERGY RECOVERY.
REPROGRAPHICS	BLANKET WASH	12	0	11	0	59 EQUIP/SUBST/FRP	10.60	375	5.350	.00	1. REPLACE CURRENT OFFSET PRINTING PROCESS WITH A XEROGRAPHIC PROCESS WHICH PRODUCES ALMOST NO WASTE. (COST OF $1500 IS SPLIT BETWEEN ALL OF THE REPROGRAPHICS WASTE STREAMS.) 2. IF THE FIRST OPTION IS NOT POSSIBLE (AT LEAST NOT IMMEDIATELY), REDUCE THIS WASTESTREAM COMPLETELY BY SUBSTITUTING AM MULTIGRAPHICS MULTILITH BLANKROLLA II FOR THE BLANKET WASH NOW IN USE AND BURN THE RESULTING WASTE FOR ENERGY RECOVERY.
REPROGRAPHICS	ELECTROSTATIC SOLN.	12	0	11	0	77 EQUIP/SUBST	7.00	375	7.000	.00	

												1. REPLACE CURRENT OFFSET PRINTING PROCESS WITH A XEROGRAPHIC PROCESS WHICH PRODUCES ALMOST NO WASTE. (COST OF $1500 IS SPLIT BETWEEN ALL OF THE REPROGRAPHICS WASTE STREAMS.) 2. IF THE FIRST OPTION IS NOT POSSIBLE (AT LEAST NOT IMMEDIATELY), WAIT FOR A SUBSTITUTION WHICH IS IN DEVELOPMENT BY AM MULTIGRAPHICS.
REPROGRAPHICS	MISC. SOLID WASTES	12	0	12	0	51	EQUIP/PROCEDURE	13.95	375	4.250	.00	1. REPLACE CURRENT OFFSET PRINTING PROCESS WITH A XEROGRAPHIC PROCESS WHICH PRODUCES ALMOST NO WASTE. (COST OF $1500 IS SPLIT BETWEEN ALL OF THE REPROGRAPHICS WASTE STREAMS.) 2. IF THE FIRST OPTION IS NOT POSSIBLE (AT LEAST NOT IMMEDIATELY), TEST PADS AND WICKS FOR CONTAMINATION. IF THEY MEET CRITERIA, DISPOSE OF AS NON-HAZARDOUS WASTE. HAVE RAGS LAUNDERED OFF BASE AND REUSE.
AIRCRAFT WASH RACK	SOLVENT (PD-680)	3,500	0	3,150	0	13,965	SUBSTITUTION	.00	0	4.450	.00	1. SUBSTITUTE A D-LIMONENE SOLVENT FOR THE PD-680 NOW IN USE. THE D-LIMINENE SOLVENT WOULD DO THE SAME JOB USING ONLY 10% OF THE SOLVENT.
AIRCRAFT WASH RACK	CLEANING CMPD.	0	0	0	0	0	PROCEDURE	.00	0	.000	.00	1. WASH FEWER AIRCRAFT.(82,000 GALLONS OF CLEANING COMPOUND ARE CURRENTLY DISCHARGED TO THE SANITARY SEWER)
CENTRAL HEAT PLANT	SLUDGE (OIL)	950	0	950	0	4,655	FRP	.00	0	4.900	.00	1. BURN FOR ENERGY RECOVERY IN HEATING PLANT ONLY.
CENTRAL HEAT PLANT	WASTE OIL (NO.6 FUEL)	950	0	950	0	4,655	FRP	.00	0	4.900	.00	1. BURN FOR ENERGY RECOVERY IN HEATING PLANT ONLY.
CENTRAL HEAT PLANT	NAPHTHA	1,175	0	1,175	0	6,860	SUBSTITUTION	.00	0	5.840	.00	1. SUBSTITUTE A D-LIMONENE SOLVENT (WHICH CAN BE DISCHARGED TO A SANITARY SEWER) FOR NAPHTHA.
CENTRAL HEAT PLANT	WASTE OIL	14,600	0	14,600	0	72,160	FRP	.00	0	4.600	.00	1. PETROLEUM PRODUCTS INCLUDE LUBRICATION OILS, PETROLEUM BASED HYDRAULIC FLUID, CUTTING OILS, AND CRANKCASE OIL. BURN FOR ENERGY RECOVERY.
LIQUID FUEL MAINT.	SLUDGE (FUEL)	4,053	0	3,240	0	17,334	FRP	.00	0	5.350	.00	1. BLEND WITH NO. 6 FUEL AND BURN FOR ENERGY RECOVERY.

LIQUID FUEL MAINT.	SPILL RESIDUE	5,200	0	2,600	0	13,000	PROCEDURE	.00	0	5.000	.00	1. A. TRAIN PERSONNEL FOR SPILL RESPONSE. B. PLACE INITIAL SPILL RESPONSE KITS ON LOADING EQUIPMENT. C. PLACE RESPONSIBILITY FOR WASTES DERIVED FROM FLIGHT LINE ACTIVITIES ON THE ORGANIZATION THAT PRODUCED IT. D. PLACE SPILL RESPONSE EQUIPMENT IN 3 TO 5 STRATEGIC LOCATIONS NEAR THE MOST SPILL-SUSCEPTIBLE ACTIVITIES. E. CONTAIN SPILLS USING A CONTAINMENT BOOM RATHER THAN AN ABSORBENT BOOM. THIS WOULD ALLOW THE FUEL TO BE VACUUMED AND USED FOR FIRE TRAINING.
LIQUID FUEL MAINT.	FILTERS (FUEL)	56	0	0	0	0	NONE	.00	0	5.350	.00	1. NO OPTION FOR REDUCTION SUGGESTED.
MACHINE SHOP	SOLVENT (PD-680)	110	0	110	0	590	SUBSTITUTION	.00	0	6.050	.00	1. SUBSTITUTE A BIODEGRADABLE DEGREASER SUCH AS BIOGENIC 377c (BY ROCHESTER MIDLAND) FOR THE PD-680 TYPE II NOW IN USE. THE BIOGENIC 377c COULD BE DISCHARGED THROUGH AN OIL/WATER SEPARATOR AND DISCHARGED TO A SANITARY SEWER.
MACHINE SHOP	WASTE OIL	55	0	55	0	332	FRP	.00	0	6.050	.00	1. SEGREGATE WASTE OILS AND BURN FOR ENERGY RECOVERY.
MACHINE SHOP	WASTE FLUID (TAPPING)	55	0	55	0	332	SUBSTITUTION	.00	0	6.050	.00	1. SUBSTITUTE NON-HAZARDOUS DELERON SAFE TAP FOR THE HAZARDOUS TAPPING FLUIDS CURRENTLY IN USE.
REFURBISHMENT	MISC. SOLID WASTES	110	0	110	0	590	SUBSTITUTION	.00	0	5.000	.00	1. THE USE OF WATERBORNE COATINGS (WHICH CAN BE CLEANED-UP USING SOAP AND WATER) WILL ELIMINATE THE NEED TO USE SOLVENTS, AND, THEREFORE, ELIMINATE THE PRODUCTION OF HAZARDOUS SOLID WASTE THAT WERE PRODUCED DUE TO CONTAMINATION WITH LISTED WASTES. (THIS WILL REQUIRE A CHANGE IN THE TECHNICAL ORDER).
REFURBISHMENT	PAINT THINNERS/SOLVENTS	1,680	0	1,680	0	9,982	SUBSTITUTION	.00	0	6.050	.00	1. THE USE OF WATERBORNE COATINGS (WHICH CAN BE CLEANED UP USING SOAP AND WATER) ELIMINATES THE NEED FOR SOLVENTS.
REFURBISHMENT	PAINT	1,320	0	660	0	3,993	PROCEDURE	.00	0	6.050	.00	1. BY REFURBISHING ONLY WHEN NECESSARY INSTEAD OF WHEN SCHEDULED, PAINT USAGE COULD PROBABLY BE CUT IN HALF. (THIS WOULD ALSO CUT THE PRODUCTION OF SOLID AND SOLVENT WASTES IN HALF IF THEY WERE NOT ALREADY ELIMINATED.)

COMMAND: MAC/BASE: HURLBURT

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	660	0	330	0	2,227	RECYCLE	2.08	4,000	6.750	.00	1. FILTER SOLVENT TO EXTEND ITS LIFE. INVESTMENT ESTIMATED FROM A SIMILAR SYSTEM AT BARKSDALE AIR FORCE BASE.
CORROSION CONTROL	MEK/PAINT	1,000	0	800	0	5,000	RECYCLE	3.75	15,000	6.250	.00	1. THE USE OF ONLY ONE SOLVENT (MEK) WILL SIMPLIFY SEGREGATION AND ALLOW ON-BASE RECYCLING (DISTILLATION).
CORROSION CONTROL	MISC. SOLID WASTES	330	0	200	0	1,250	SUBSTITUTION	.00	0	.000	.00	1. THE USE OF MIBK INSTEAD OF MEK WOULD ALLOW THE RAGS TO BE WASHED AND REUSED (PRODUCING NO HAZARDOUS WASTE). THIS SUBSTITUTION CAN ONLY BE MADE, THOUGH, IF THE TECHNICAL ORDER IS CHANGED TO ALLOW IT. (SAVINGS AND REDUCTION UNKNOWN)
CORROSION CONTROL	ABRASIVE WASTE	110	0	25	0	168	EQUIPMENT	3.72	500	6.750	.00	1. INSTALLATION OF A PLASTIC MEDIA BLASTING TO PERFORM ALL ABRASIVE STRIPPING WILL REDUCE AMOUNT OF WASTE PRODUCED.
CORROSION CONTROL	WATERFALL DISCHARGE	0	0	0	0	0	TREATMENT	.00	0	.000	.00	1. MIGHT BE ACCEPTABLE TO DISCHARGE TO SANITARY SEWER. IF NOT, 37500 GALLONS WILL REQUIRE DISPOSAL AS HAZARDOUS WASTE. TO REDUCE THIS WASTE, INSTALL A FILTER TO FILTER WATERFALL DURING RECURCULATION.
VEHICLE MAINT.	MEK (SPRAY GUN CLEANER)	240	0	201	0	1,236	SUBST/PROC	.00	0	4.060	.00	1. A. SUBSTITUTE WATERBORNE COATINGS FOR THE COATINGS NOW IN USE. THIS SUBSTITUTION WILL ALLOW CLEAN-UP WITH WATER RATHER THAN MEK ORMIBK TYPE SOLVENTS.(WILL REQUIRE A CHANGE IN THE MILITARY TECHNICAL ORDER) (VEHICLE MAINTENANCE) B. EXTEND SERVICE INTERVAL (VEHICLE MAINTENANCE BRANCH).
VEHICLE MAINT.	PAINT THINNER	60	0	21	0	156	PROCEDURE	.00	0	4.060	.00	1. EXTEND SPRAY GUN CLEANER SERVICE INTERVAL. DISPOSAL COST ESTIMATED FROM THAT OF MEK.
VEHICLE MAINT.	PAINT RELATED WASTE	180	0	180	0	1,080	SUBSTITUTION	.00	0	2.820	.00	1. SUBSTITUTE WATERBORNE ACRYLICS FOR THE EP-TOXIC COATINGS

												NOW IN USE. (THIS WOULD REQUIRE A CHANGE IN THE TECHNICAL ORDER.)
VEHICLE MAINT.	SOLVENT (SAFETY KLEEN)	1,040	0	792	0	1,117	PROC/SUBST	2.01	1,947	2.480	.00	1. A. THE 260 GALLONS OF SOLVENT USED IN ONE PART OF THE VEHICLE MAINTENANCE SHOP CAN BE REDUCED BY 149 GALLONS BY EXTENDING THE SERVICE INTERVAL FOR THE PARTS CLEANER. (SAVES $299/YEAR) B. THE OTHER 780 GALLONS CAN BE REDUCED BY 643 GALLONS BY SUBSTITUTION OF A SOLVENT WITH A FLASH POINT OF AT LEAST 143 DEGREES F FOR THE SOLVENT NOW IN USE.(THE WASTE COULD THEN BE DISPOSED OF AS USED OIL.) (SAVES $818/YEAR. REQUIRES PURCHASE OF 3 GOVERNMENT OWNED PARTS WASHER VATS WITH FILTRATION)
VEHICLE MAINT.	ANTIFREEZE	660	0	0	0	0	NONE	.00	0	.000	.00	1. CURRENTLY BEING DISCHARGED TO SANITARY SEWER. SHOULD PROBABLY BE COLLECTED AND SENT TO THE FUELS MANAGEMENT BRANCH.
VEHICLE MAINT.	FILTERS	34	0	34	0	0	SUBSTITUTION	.00	0	.000	.00	1. THE SUBSTITUTION OF WATERBORNE ACRYLICS ELIMINATES THE USE OF SOLVENTS FOR CLEAN-UP. THEREFORE, THE FILTERS ARE NOT HAZARDOUS WHEN DISPOSED OF. (POTENTIAL COST SAVINGS UNKNOWN; 34 GALLONS = 100 POUNDS; THIS WILL REQUIRE A CHANGE IN THE TECHNICAL ORDER.) DISPOSAL COST UNAVAILABLE.
VEHICLE MAINT.	SHOP RAGS	2,100	0	2,100	0	0	SUBSTITUTION	.00	0	.000	.00	1. THE SUBSTITUTION OF WATERBORNE ACRYLICS ELIMINATES THE USE OF SOLVENTS FOR CLEAN-UP. THEREFORE, SHOP TOWELS ARE NOT HAZARDOUS. THEY CAN BE WASHED AND REUSED. (POTENTIAL COST SAVINGS UNKNOWN) DIPOSAL COST UNAVAILABLE.
JET ENGINE	SOLVENT (SAFETY KLEEN)	120	0	120	0	132	SUBSTITUTION	.00	0	2.700	.00	1. SUBSTITUTE A NON-HAZARDOUS, BIODEGRADABLE SOLVENT (SUCH AS ROCHESTER MILAND'S SE 377c, CITRIKLEEN HD, OR MIRACHEM 100) FOR THE SOLVENT PRESENTLY IN USE. THESE SOLVENTS CAN BE DISCHARGED TO THE SANITARY SEWER.
AGE	SOLVENT (SAFETY KLEEN)	260	0	145	0	205	PROCEDURE	.00	0	2.260	.00	1. EXTEND SERVICE INTERVAL.
AGE	PAINT RELATED WASTE	50	0	18	0	161	EQUIPMENT	.00	0	6.000	.00	1. USE OF SAFETY KLEEN'S SPRAY GUN CLEANER WILL PRODUCE LESS WASTE THAN THE CURRENT GUN CLEANING PRACTICE.

WHEEL & TIRE	SOLVENT (SAFETY KLEEN)	1,470	0	1,470	0	1,573	SUBSTITUTION	1.13	1,600	2.790	.00	1. SUBSTITUTE A NON-HAZARDOUS, BIODEGRADABLE SOLVENT FOR THE SOLVENT NOW IN USE. INSTALLEDVAT SHOULD BE FILTERED TO PROLONG ITS USEFUL LIFE. THE NON-HAZARDOUS SOLVENT CAN BE DISCHARGED TO SANITARY SEWER.
WHEEL & TIRE	STRIPPER (B & B 9201)	278	0	278	0	864	EQUIPMENT	2.15	1,600	3.100	.00	1. INSTALL A FILTRATION SYSTEM. FILTRATION OF THE STRIPPER WILL REMOVE THE CONTAMINANTS THAT MAKE IT HAZARDOUS. AFTER FILTRATION IT MAY BE DISCHARGED TO SANITARY SEWER.
MUNITIONS MAINT.	SOLVENT (SAFETY KLEEN)	4,330	0	2,100	0	4,678	PROCEDURE	.00	0	2.160	.00	1. EXTEND SERVICE INTERVAL FROM EVERY 12 WEEKS TO EVERY 24 WEEKS. ANOTHER POSSIBLE OPTION WOULD BE TO INSTALL A FILTRATION SYSTEM TO THE VAT AND FILTER THE SOLVENT TO EXTEND ITS USEFUL LIFE.
BATTERY	BATTERIES (NiCd)	40	0	0	0	0	NONE	.00	0	60.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST ESTIMATED FROM BARKSDALE AIR FORCE BASE. ASSUME 30 LB = 1 GAL
BATTERY	BATTERIES (LEAD ACID)	133	0	0	0	0	NONE	.00	0	30.000	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST ESTIMATED FROM BARKSDALE AIR FORCE BASE. 30 LB = 1 GAL
NDI	EMULSIFIER	27	0	0	0	1	SELL	.00	0	.000	.00	1. INSTEAD OF DISPOSING THROUGH DRMO, INCORPORATE INTO THE USED OIL PROGRAM SO THAT IT IS SOLD FOR OFF-BASE ENERGY RECOVERY.
NDI	DEVELOPER	27	0	25	0	50	SUBSTITUTION	.00	0	2.000	.00	1. CHANGE IN TECHNICAL ORDER ALLOWS THE USE OF A NON-CHROMATE DEVELOPER IN MOST CASES. THIS DEVELOPER CAN BE DISCHARGED TO A SANITARY SEWER AFTER USE.
FUELS MANAGEMENT	WASTE OIL	6,950	0	0	0	875	SELL	.00	0	.000	.00	1. A. SEGREGATE SYNTHETIC AND PETROLEUM BASED MATERIALS. B. SELL SYNTHETIC OIL FOR RECYCLEING. C. CONTINUE TO SELL PETROLEUM BASED OILS TO OFF-SITE ENERGY RECOVERY PROGRAM AS LONG AS IT IS ECONOMICAL. IF THIS PROGRAM BECOMES DISATISFACTORY, IMPLEMENT AN ON-BASE ENERGY RECOVERY PROGRAM.

FUELS MANAGEMENT	SOLVENT (PETRO-BASED)	270	0	0	0	0	NONE	.00	0	1.950	.00	1. RECYCLING IS NOT WORTH THE EXTRA COST AND EXTRA MAN-POWER REQUIRED.
FUELS MANAGEMENT	WASTE FUEL (JP-4)	2,700	0	2,700	0	1,890	REUSE	.00	0	.000	.00	1. A. IMPROVE SEGREGATION AND PROTECTION FROM WATER, AND REUSE. REUSE COULD BE ACCOMPLISHED BY FILTERING AND BLENDING WITH VIRGIN JP-4 FOR REUSE IN AGE OR BLENDING WITH DIESEL FUEL AND USING IN CONSTRUCTION EQUIPMENT.
REPROGRAPHICS	BLANKET WASH	20	0	20	0	20	SUBSTITUTION	.00	0	1.000	.00	1. SUBSTITUTE A NON-HAZARDOUS BLANKET WASH (SUCH AS BANKROLLA WASH) FOR THE BLANKET WASH CURRENTLY IN USE.
REPROGRAPHICS	RAGS (SOLVENT WIPES)	250	0	225	0	230	SUBSTITUTION	.00	0	.920	.00	1. SUBSTITUTE A REUSABLE RAG FOR THE DISPOSABLE WIPES NOW IN USE. 1 LB = 1 GAL
AUTO HOBBY SHOP	SOLVENT (SAFETY KLEEN)	130	0	130	0	16	SUBSTITUTION	.00	0	2.650	.00	1. SUBSTITUTE A D-LIMONENE-BASED SOLVENT (SUCH AS BIOGENIC SE377c OR CITRIKLEEN HD) FOR SAFETY KLEEN SOLVENT.
PAVEMENT & GROUNDS	SOLVENT (SAFETY KLEEN)	240	0	240	0	271	SUBSTITUTION	.00	0	1.120	.00	1. SUBSTITUTE A NON-HAZARDOUS DEGREASER (SUCH AS D-LIMONENE SOLVENT) FOR THE SOLVENT NOW IN USE.
MACHINE SHOP	WASTE FLUID (TAPPING)	55	0	55	0	332	SUBSTITUTION	.00	0	6.040	.00	1. SUBSTITUTE A WATER SOLUBLE, NON-HAZARDOUS CUTTING FLUID (SUCH AS DELCON SAFE-TAP) FOR THE CUTTING FLUID NOW IN USE.
POWER PRODUCTION	SOLVENT (SAFETY KLEEN)	260	0	149	0	299	PROCEDURE	.00	0	3.150	.00	1. EXTEND SERVICE INTERVAL FROM EVERY 4 WEEKS TO EVERY 9 WEEKS.
CARPENTRY	PAINT RELATED WASTE	10	0	7	0	45	REUSE/PROCEDURE	.00	0	6.000	.00	1. A. VOLUME IS REDUCED BY 4.5 GALLONS BY REUSING RESIDUAL PAINT FOR A SPOT PRIMER. B. THE VOLUME IS REUDCED BY AN ADDITION 3 GALLONS BY ALLOWING THE PAINT/THINNER MIXTURE TO SEPERATE , POURING OFF THINNER, AND REUSING IT.
ENVIRONMENTAL ACCESSORIES	REFRIGERANT (HALON 1301)	82	0	65	0	1,157	RECYCLE	3.91	3,598	.000	.00	1. RECYLE ON BASE USING A SYSTEM SUCH AS THE REJUVENATOR ST-100 (BY REFRIGERANT RECOVERY SYSTEM) THAT RECYCLES FREON.11 LB = 1 GAL

COMPONENT REPAIR	RAGS (CLEANING)	200	0	200	0	184	SUBSTITUTION	.00	0	.920	.00	1. SUBSTITUTE NON-HAZARDOUS WD-40 (WHICH IS USED UP DURING USE) FOR THE HAZARDOUS BREAKFREE CLP NOW IN USE. 1 LB = 1 GAL
STRUCTURAL REPAIR	MEK	12	0	0	0	0	NONE	.00	0	4.060	.00	1. NO OPTION FOR REDUCTION SUGGESTED. DISPOSAL COST ESTIMATED FROM VEHICLE MAINT. SHOP.
COMBAT ARMS TRAINING	RAGS (CLEANING)	200	0	200	0	184	SUBSTITUTE	.00	0	.920	.00	1. SUBSTITUTE NON-HAZARDOUS WD-40 (WHICH IS USED UP DURING USE) FOR THE HAZARDOUS PRODUCTS NOW IN USE. 1 LB = 1 GAL
TACTICAL CONTROL	PAINT THINNER/PAINT	120	0	90	0	540	REUSE/PROCEDURE	.00	0	4.060	.00	1. ALLOW PAINT/THINNER MIXTURE TO SEPERATE. POUR OFF THINNER AND REUSE IT. DISPOSAL COST ESTIMATED FROM MEK DISPOSAL COST IN VEHICLE MAINT. SHOP.

APPENDIX B. TEST CASE DATA

COMMAND: SAC/BASE: OFFUTT

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CORROSION CONTROL	STRIPPER	2,640	0	1,875	0	12,656	EQUIPMENT	1.98	25,000	2.840	0.00	1. INSTALL A PLASTIC MEDIA BLASTING SYSTEM TO ELIMINATE USE OF CHEMICAL STRIPPERS.
CORROSION CONTROL	MEK	150	0	75	0	470	SUBSTITUTION	0.00	0	2.500	0.00	1. SUBSTITUTE MIBK FOR MEK IN EQUIPMENT CLEAN-UP.
CORROSION CONTROL	MISC. SOLID WASTES	600	0	600	0	3,750	SUBSTITUTION	0.00	0	2.000	0.00	1. SUBSTITUTE MIBK FOR MEK IN EQUIPMENT CLEAN-UP (MAKES RAGS A SOLID WASTE AFTER WASHING).
CORROSION CONTROL	ABRASIVE WASTES	55	0	0	0	0	NONE	0.00	0	2.000	0.00	1. NO OPTION FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	PAINT RELATED WASTE	180	0	0	0	0	NONE	0.00	0	3.000	0.00	1. NO OPTION FOR REDUCTION SUGGESTED.
VEHICLE MAINT.	SOLVENT (SAFETY KLEEN)	540	0	0	0	0	NONE	0.00	0	2.250	0.00	1. CONTINUE USE OF SAFETY KLEEN SERVICE.
VEHICLE MAINT.	CARBON REMOVER (SAFE.KLN)	64	0	0	0	0	NONE	0.00	0	3.450	0.00	1. CONTINUE USE OF SAFETY KLEEN SERVICE.
VEHICLE MAINT.	SOLVENT (SPRAY GUN CLNER)	72	0	0	0	0	NONE	0.00	0	5.000	0.00	1. CONTINUE USE OF SAFETY KLEEN SERVICE.
VEHICLE MAINT.	WASTE OIL	2,460	0	2,460	0	7,630	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
VEHICLE MAINT.	WASTE FUEL	720	0	300	0	525	PROCEDURE	0.00	0	2.000	0.00	1. CAREFULLY SEGREGATE FUEL FROM OTHER FLUIDS. REUSE FUEL AS DIESEL FUEL.
PHASE INSECTION	HYDRAULIC FLUID	250	0	250	0	723	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
PHASE INSECTION	WASTE FUEL (JP-4)	150	0	150	0	420	REUSE	0.00	0	2.000	0.00	1. BLEND WITH AND USE AS DEISEL FUEL.
PHASE INSECTION	WASTE OIL (SYNTHETIC)	200	0	0	0	0	PROCEDURE	0.00	0	2.250	0.00	1. SEGREGATE FROM PETROLEUM BASED FLUIDS TO ALLOW SALE.
JET ENGINE	SOLVENT (PD-680)	842	0	842	0	1,802	SUBSTITUTION	0.00	0	1.500	0.00	1. SUBSTITUTE A HIGH FLASH POINT SOLVENT FOR THAT NOW IN USE.
JET ENGINE	CARBON REMOVER	6	0	0	0	0	SUBSTITUTION	0.00	0	1.500	0.00	1. TRY USING MONOETHANOLAMINE.
JET ENGINE	FINGERPRINT REMOVER	2	0	2	0	4	REUSE	0.00	0	1.500	0.00	1. REUSE IN GENERAL PARTS WASHING VAT.
JET ENGINE	WASTE FLUID (CALIBRATION)	25	0	25	0	72	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
JET ENGINE	WASTE FLUID (CLEANER)	96	0	96	0	144	PROCEDURE	0.00	0	1.500	0.00	1. TEST - IF pH>2.5, DISCHARGE TO SANITARY SEWER.
JET ENGINE	WASTE OIL	658	0	658	0	1,902	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
AGE	WASTE OIL	6,710	0	6,710	0	19,392	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
AGE	NAPHTHA	55	0	55	0	123	SUBSTITUTION	0.00	0	2.250	0.00	1. SUBSTITUTE A NON-HAZARDOUS SOLVENT FOR THE NAPHTHA.
AGE	FILTERS (FUEL)	2,750	0	2,750	0	6,188	PROCEDURE	0.00	0	2.250	0.00	1. DRAIN OUT FREE LIQUIDS AND DISPOSE OF AS SOLID WASTE.
PNEUDRAULICS	HYDRAULIC FLUID	660	0	660	0	1,909	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
PNEUDRAULICS	SOLVENT (PD-680)	660	0	660	0	1,485	FRP	0.00	0	1.500	0.00	1. BURN FOR ENERGY RECOVERY.
WHEEL & TIRE	SOLVENT (PD-680)	55	0	55	0	123	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
WHEEL & TIRE	SOLVENT (BIOGENIC 377c)	660	0	660	0	1,485	TREATMENT	0.00	0	2.250	0.00	1. FILTER AND RELEASE TO SEWER.
EQUIPMENT MAINT.	HYDRAULIC FLUID	36	0	36	0	104	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
BATTERY	BATTERY ACID	75	0	0	0	0	NONE	0.00	0	1.500	0.00	1. COULD BE REDUCED IF MORE BATTERY STORAGE WERE AVAILABLE.
NDI	INSP PENETRANT	25	0	25	0	60	FRP	0.00	0	1.750	0.00	1. BURN FOR ENERGY RECOVERY.
NDI	EMULSIFIER	55	0	55	0	131	FRP	0.00	0	1.750	0.00	1. BURN FOR ENERGY RECOVERY.
NDI	DEVELOPER	55	0	0	0	0	SUBSTITUTION	0.00	0	2.000	0.00	1. SUBSTITUTE A NON-CHROMAT DEVELOPER (WHICH IS IN DEVELOPMENT) WHEN IT IS AVAILABLE.
NDI	MAGNETIC PARTICLE SOLN.	100	0	100	0	239	FRP	0.00	0	1.750	0.00	1. BURN FOR ENERGY RECOVERY.
FUELS MANAGEMENT	WASTE FUEL (JP-4)	6,000	0	5,500	0	5,500	PROC/REUSE	0.00	0	1.000	0.00	1. SEGREGATE FROM HYDRAULIC FLUID. BLEND WITH DIESEL FUEL AND REUSE.
FUELS MANAGEMENT	SLUDGE	110	0	0	0	0	NONE	0.00	0	1.000	0.00	1. NO OPTION FOR REDUCTION SUGGESTED.
FUELS MANAGEMENT	SPILL RESIDUE	0	20	0	0	0	NONE	0.00	0	1.000	0.00	1. NO OPTION FOR REDUCTION SUGGESTED.
MACHINE SHOP	WASTE FLUID (TAP/CUT)	25	0	25	0	165	SUBSTITUTION	0.00	0	3.000	0.00	1. SUBSTITUTE NON-HAZARDOUS DELERON SAFE TAP FOR THE FLUIDS NOW IN USE.
MACHINE SHOP	HYDRAULIC FLUID	20	0	20	0	40	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
MACHINE SHOP	WASTE OIL (CUTTING)	10	0	10	0	20	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
CE PAINT SHOP	PAINT THINNER	110	0	55	0	0	SUBSTITUTION	0.00	0	3.000	0.00	1. USE SPRAY GUN CLEANER SERVICE (NO FINANCIAL SAVINGS)

SHOP	MATERIAL	GALLONS	POUNDS	LESSGAL	LESSLB	COST-SAVE	OPTION	PAYBACK	INVEST	COST/GAL	COST/LB	NOTES
CE PAINT SHOP	SHOP RAGS	55	0	55	0	124	SUBSTITUTION	0.00	0	2.000	0.00	1. SUBSTITUTE NON-EP TOXIC COATINGS FOR THE ONES NOW IN USE.
AUTO HOBBY SHOP	SOLVENT (PD-680)	360	0	360	0	540	SUBSTITUTION	0.00	0	1.500	0.00	1. SUBSTITUTE A HIGH FLASH POINT SOLVENT FOR THE ONE NOW IN USE.
AUTO HOBBY SHOP	WASTE OIL (SYNTHETIC)	9,600	0	0	0	0	NONE	0.00	0	0.000	0.00	1. CONTINUE TO GIVE TO CONTRACTOR.
MEDICAL FACILITY	WASTE OIL	247	0	247	0	766	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
MEDICAL FACILITY	CIDEX	99	0	0	0	0	NONE	0.00	0	0.000	0.00	1. NO OPTION FOR REDUCTION SUGGESTED.
MEDICAL FACILITY	ACID	5	0	5	0	2	NEUTRALIZE	0.00	0	0.500	0.00	1. MIX WITH SODIUM HYDROXIDE TO NEUTRALIZE AND DISCHARGE TO SEWER.
MEDICAL FACILITY	SODIUM HYDROXIDE	1	0	1	0	1	NEUTRALIZE	0.00	0	2.250	0.00	1. MIX WITH ACID TO NEUTRALIZE AND DISCHARGE TO SEWER.
REFUELING MAINT (TRUCK)	WASTE OIL	95	0	95	0	225	FRP	0.00	0	2.250	0.00	1. BURN FOR ENERGY RECOVERY.
REFUELING MAINT (TRUCK)	WASTE FUEL	5,000	0	4,000	0	11,200	REUSE	0.00	0	2.000	0.00	1. SEGREGATE FROM OIL, BLEND WITH DIESEL, AND REUSE.
REFUELING MAINT (TRUCK)	FILTERS (FUEL)	440	0	367	0	825	PROCEDURE	0.00	0	2.250	0.00	1. ALLOW TO DRY COMPLETELY AND DISPOSE OF AS SOLID WASTE.
LIQUID FUELS MAINT	SLUDGE	550	0	0	0	0	NONE	0.00	0	2.250	0.00	1. NO OPTION FOR REDUCTION SUGGESTED.
LIQUID FUELS MAINT	FILTERS	25	0	25	0	55	PROCEDURE	0.00	0	2.250	0.00	1. ALLOW TO DRY COMPLETELY AND DISPOSE OF AS SOLID WASTE.
POWER PRODUCTION	WASTE FUEL	220	0	220	0	495	TREATMENT	3.23	1,600	2.250	0.00	1. FILTER WATER FROM FUEL AND REUSE.
POWER PRODUCTION	BATTERY ACID	100	0	100	0	150	PROCEDURE	0.00	0	1.500	0.00	1. TURN BATTERIES IN TO DRMO WET.
FUEL SYSTEMS REPAIR	WASTE FUEL (JP-4)	1,200	0	1,200	0	3,360	REUSE	0.00	0	2.000	0.00	1. BLEND WITH AND REUSE AS DIESEL FUEL.
AEROREPAIR	ANTIFREEZE	400	0	400	0	120	SEWER	0.00	0	0.300	0.00	1. DISCHARGE TO SANITARY SEWER. (DISPOSAL COST ESTIMATED FROM THAT AT BARKSDALE).
AEROREPAIR	WASTE OIL (SYNTHETIC)	2,400	0	0	0	0	NONE	0.00	0	2.250	0.00	1. TRY TO FIND A RECYCLER TO SELL TO.
GLOBAL WEATHER	MONOBATH	3,600	0	3,600	0	9,000	PROC/EQUIPMENT	0.33	3,000	2.500	0.00	1. NEUTRALIZE WITH SULFURIC ACID AND RECOVER SILVER THROUGH SILVER RECOVERY UNIT.

VITA

Kimberly Gayle Murray was born in Tullahoma, Tennessee on February 6, 1967. She attended elementary schools in that city and was graduated from Tullahoma High School in May 1985. The following September she entered Tennessee Technological University, participated in the cooperative education program for one year, and, in early August of 1989, received a Bachelor of Science degree in Mechanical Engineering. In late August of 1989, she accepted a research assistantship at the University of Tennessee working with Martin Marietta Energy Systems, Inc. and began study towards a Master of Science degree in Environmental Engineering. This degree should be awarded in August of 1991.

The author is a member of Tau Beta Pi, Pi Tau Sigma, and the American Society of Mechanical Engineers. Mrs. Murray will be employed by Radian Corporation upon completion of all Master's degree requirements.