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United States General Accounting Office

GAO

Report to the Chairman, Subcommittee on  
Environment, Energy and Natural  
Resources, Committee on Government  
Operations, House of Representatives

October 1987

# HAZARDOUS WASTE

## Tinker Air Force Base's Improvement Efforts



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United States  
General Accounting Office  
Washington, D.C. 20548

National Security and  
International Affairs Division

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October 29, 1987

The Honorable Mike Synar  
Chairman, Subcommittee on Environment,  
Energy and Natural Resources  
Committee on Government Operations  
House of Representatives

Dear Mr. Chairman:

In response to your request, this report provides information on Tinker Air Force Base's efforts to correct the problems noted in our report Hazardous Waste Management at Tinker Air Force Base—Problems Noted, Improvements Needed (GAO: NSIAD-85-91, July 19, 1985). The views of responsible officials were sought during the course of our work and are incorporated where appropriate.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of its issuance. At that time, we will send copies to the chairmen of other concerned committees; the Secretary of Defense; the Secretaries of the Army, Navy, and Air Force; the Director, Office of Management and Budget; and other interested parties upon request.

Sincerely yours,

Frank C. Conahan  
Assistant Comptroller General

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# Executive Summary

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## Purpose

Tinker Air Force Base, a major military industrial activity, generates a large volume of hazardous waste from maintenance and repair operations. In a 1985 report, GAO discussed problems associated with the generation, containment, and disposal of hazardous waste at Tinker which resulted in the contamination of the Garber-Wellington aquifer, a source of drinking water for about 300,000 people in central Oklahoma.

On May 14, 1986, the Chairman, Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations, asked GAO to review and evaluate Air Force efforts to correct the problems discussed in the 1985 report.

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## Background

Tinker provides maintenance support for a number of aircraft, aircraft engines, missiles, and reparable spare components. The chemicals used in a number of maintenance functions, which include electroplating and paint removal, generate about a million gallons of contaminated wastewater daily. In addition, more than a million gallons of waste chemicals and over 6,000 tons of hazardous sludge are hauled to commercial waste disposal sites each year.

In 1985 GAO reported that Tinker had

- violated the Resource Conservation and Recovery Act of 1976, as amended, and the Federal Water Pollution Control Act of 1972, as amended, by allowing discharges of wastes that polluted its streams and groundwater;
- generated hazardous waste unnecessarily;
- sold, transferred, or disposed of waste oils, fuels, and solvents rather than recycling and reusing them;
- underused and poorly managed its industrial waste treatment plant; and
- exercised inadequate management control over its disposal contractors and could not assure that hazardous waste generated on base was disposed of in an environmentally safe manner.

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## Results in Brief

Tinker has made significant strides in correcting many of the problems identified in GAO's 1985 report. Tinker has

- placed more emphasis on hazardous waste management,
- reduced the amount of hazardous waste discharged into the streams and groundwater,
- reduced the amount of hazardous waste requiring disposal,

- resolved management and operational problems at the industrial waste treatment plant, and
- improved controls over hazardous waste disposal contractors and the selection of disposal sites.

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## Principal Findings

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### Actions to Correct Containment Problems

Tinker has taken actions to reduce the amount of hazardous waste, but pollution continues to reach the base streams and groundwater. Tinker's stream monitoring analysis and the existence of fish populations just off base in the streams originating or flowing across Tinker indicate that the quality of water is improving. Regulatory agency officials are pleased with Tinker's efforts and plans to prevent pollution. However, regulatory agency and Tinker officials believe that it may take years to completely resolve the remaining pollution problems because of their size and complexity.

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### Reducing Hazardous Waste Requiring Disposal

Since 1984 Tinker has reduced the amount of hazardous waste requiring disposal by (1) implementing a recycling program, (2) treating substances it formerly disposed of, and (3) implementing projects that reduce the amount of hazardous waste generated such as a closed loop recycling system to reuse hazardous material in metal plating operations. Most of the recycling equipment Tinker has procured will not be operational until 1988 because the construction of facilities to house the equipment is not complete. Substantial reductions in hazardous waste generations should continue to occur in future years as Tinker continues to implement ongoing projects.

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### Discharge Violations and Management Problems

Tinker has improved its ability to regulate the flow of wastewater entering the industrial waste treatment plant by installing sensor activated cutoff valves in the plating shop and the chemical cleaning facility, thus lessening the severity and frequency of its discharge compliance problems. It has also resolved many of the management problems identified in GAO's 1985 report by providing training, contracting for a constant supply of treatment chemicals, and instituting a preventive maintenance program. Additional improvements to control the flow of wastewater into the plant are in process. Air Force and regulatory agency officials

expect these improvements to bring the plant into compliance with the Federal Water Pollution Control Act by December 1988.

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## Contractor Problems

Tinker has improved controls over off-base hazardous waste shipments, contractors, and the selection of disposal sites, but some problems remain with on-base shipments, such as not accounting for all waste oil shipped from one site to another on base.

Tinker now requires disposal contractors to use only disposal sites that meet the Resource Conservation and Recovery Act's requirements. Through the use of the Environmental Protection Agency's manifest system, Tinker now tracks hazardous waste shipped off base to ensure it reaches the designated disposal site.

Tinker has improved accounting controls over payments for off-base shipments of hazardous waste. The Air Force has collected \$52,000 and expects to collect an additional \$24,000 in overpayments for hazardous waste shipped off base for disposal.

Tinker is instituting new on-base shipment procedures that require (1) shipment invoices to indicate the amount of oil being transported, (2) records to indicate the amount of oil transported and stored in the tanks, and (3) a reconciliation of the records and invoices.

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## Agency Comments

As requested, GAO did not obtain official agency comments on a draft of this report. However, GAO did discuss its findings with agency program officials and their comments have been incorporated where appropriate.



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**Abbreviations**

DOD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
DRMS	Defense Reutilization and Marketing Service
EPA	Environmental Protection Agency
GAO	General Accounting Office
NPDES	National Pollutant Discharge Elimination System
RCRA	Resource Conservation and Recovery Act

# Introduction

The Oklahoma City Air Logistics Center, one of five such centers of the Air Force Logistics Command, is the largest of the 40 Air Force organizations located on Tinker Air Force Base. The Air Logistics Center provides worldwide maintenance support for a variety of weapon systems, including B-1B, B-52, A-7D, C-137, E-3, and E-4 aircraft; 16 types of aircraft engines; four types of missiles; and thousands of reparable spare components. Tinker, with 27,000 employees, is Oklahoma's largest employer. In fiscal year 1986, Tinker had an economic impact on the state of about \$2.5 billion.

The Air Logistics Center's primary maintenance functions that generate hazardous waste include electroplating, engine preparation and cleaning, sandblasting, and aircraft paint stripping and painting. Chemicals used in these operations, when mixed with rinse water, generate about a million gallons of contaminated wastewater that flows through 10 miles of sewer lines to the industrial waste treatment plant each day. More than a million gallons of waste chemicals and over 6,000 tons of hazardous sludge are hauled to commercial hazardous waste disposal sites each year. Over 70 types of hazardous wastes are generated on Tinker, including

- toxins, such as cyanide;
- phenol-based paint strippers;
- thinners, such as methyl ethyl ketone;
- solvents, such as perchloroethylenes and trichloroethanes;
- corrosives, such as chromic acid;
- heavy metals, such as cadmium, lead, and chromium; and
- oil products.

Tinker, located on 4,775 acres, has 70 miles of storm sewer drains leading to the three main watersheds on base—Crutcho, Khulman, and East Soldier Creeks. These streams flow to the North Canadian River located 7 miles north of the base. This watershed system also serves as a recharge area over the Garber-Wellington aquifer, which is the primary source of drinking water for about 300,000 people in central Oklahoma.

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## Hazardous Waste Management Requirements

The Environmental Protection Agency (EPA) has primary responsibility for regulating the management of hazardous waste and monitoring compliance with the Resource Conservation and Recovery Act (RCRA) of 1976, as amended, and the Federal Water Pollution Control Act of 1972, as amended.

RCRA and EPA's implementing regulations, set requirements for containment, management, control, and disposal of hazardous waste. The Federal Water Pollution Control Act of 1972 created the National Pollutant Discharge Elimination System (NPDES) whereby anyone discharging any pollutant into navigable waters, including federal agencies, must obtain a permit from EPA or the state.

It is illegal to discharge pollutants into the nation's surface water supply without a permit. NPDES permits are issued on the condition that the discharge will meet all applicable requirements of EPA or state regulations relating to, among other things, effluent limitations for specific pollutants, water quality standards, toxic effluent standards, inspections, actions required and time frames needed for compliance, self-monitoring requirements for wastewater flow, and periodic reporting of compliance.

Under RCRA, EPA has established regulations for reporting, record keeping, performance, and facility operations for entities that generate, transport, and own or operate a treatment, storage, or disposal facility. EPA delegates much of its responsibility to state regulatory agencies if a state's hazardous waste program is as stringent and comprehensive as the federal program. EPA has delegated the responsibility for permitting, inspecting, and regulating under RCRA in Oklahoma to the State Department of Health and works in partnership with the state in enforcing NPDES. The Oklahoma Water Resources Board has primary authority for control of the discharges from the industrial waste treatment plant under NPDES.

In 1980 the Department of Defense (DOD) established an overall policy to implement RCRA regulations established by EPA or that states enact under EPA authorization. The policy also encourages hazardous waste generators to

- limit the generation of hazardous waste through alternative procurement practices and operational procedures that are attractive environmentally, yet are fiscally competitive;
- reuse, reclaim, or recycle resources, including hazardous waste, where practical, thus avoiding disposal costs and the procurement of new material; and
- dispose of hazardous waste in an environmentally acceptable manner.

## Objectives, Scope, and Methodology

On May 14, 1986, the Chairman of the Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations, requested us to (1) follow up on Air Force efforts to correct the problems described in our 1985 report<sup>1</sup> (referred to hereinafter as the 1985 report) and (2) review Tinker's efforts to clean up abandoned hazardous waste sites. In 1985 we reported that Tinker had violated DOD and EPA regulations concerning hazardous waste management. Specifically, Tinker

- violated RCRA and the Federal Water Pollution Control Act of 1972 by allowing discharges of wastes that polluted its streams and groundwater;
- generated hazardous waste unnecessarily;
- sold, transferred, or disposed of waste oils, fuels, and solvents rather than recycling and reusing them;
- underused and poorly managed its industrial waste treatment plant; and
- had inadequate management control over its disposal contractors and could not be assured that the hazardous waste generated on base was disposed of in an environmentally safe manner.

In July 1987, we issued a briefing report<sup>2</sup> to the Chairman describing Tinker's Installation Restoration Program and its efforts to clean up abandoned hazardous waste sites.

To accomplish our objectives in this review, we

- reviewed EPA, DOD, Air Force, and state of Oklahoma regulations governing the handling and disposal of hazardous waste;
- interviewed officials at Tinker Air Force Base, Defense Reutilization and Marketing Office (DRMO), Air Force Logistics Command, and the Air Force Engineering and Services Center involved in generating, recycling, treating, disposing, or the managing of hazardous waste at Tinker;
- reviewed Tinker's hazardous waste manifests for the 11-month period ending June 30, 1986, to determine the amounts and types of hazardous waste being disposed of and disposal sites being used;
- reviewed Tinker's contract files and contractor billings for hazardous waste disposal;

<sup>1</sup>Hazardous Waste Management at Tinker Air Force Base—Problems Noted, Improvements Needed (GAO/NSIAD-85-91, July 19, 1985).

<sup>2</sup>Hazardous Waste—Tinker Air Force Base is Making Progress in Cleaning Up Abandoned Sites (GAO/NSIAD-87-164BR, July 10, 1987).

- interviewed officials from EPA and state regulatory agencies responsible for regulating hazardous waste management about their oversight and control over Tinker's disposal of hazardous waste in Oklahoma disposal sites;
- reviewed EPA and state regulatory agency inspection reports;
- interviewed officials at the Oklahoma Water Resources Board—which is responsible for ensuring the quality of surface and groundwater—and obtained reports concerning inspections made at Tinker;
- interviewed disposal site officials and reviewed records concerning Tinker's use of their disposal sites;
- interviewed Air Force Office of Special Investigation and Air Force Audit officials relative to the status of their investigation of the base disposal contractor and the repayment of funds from this contractor for the overcharges identified in our 1985 report; and
- interviewed officials from the Garber-Wellington Association relative to the effects of Tinker's hazardous waste on the Garber-Wellington aquifer and streams that originate on or cross Tinker.

In examining whether Tinker was making progress in implementing its hazardous waste program, we evaluated the effectiveness of various internal controls. This included reviewing the adequacy of management and accounting controls such as plans, procedures, and payment records. Our examination of these controls was limited to those areas where program problems existed and did not represent a comprehensive review of Tinker's internal control systems.

We discussed the report with agency program officials responsible for managing hazardous waste on Tinker and their comments have been incorporated where appropriate. As requested, we did not obtain official agency comments.

Our review was performed between August 1986 and September 1987 in accordance with generally accepted government auditing standards.

# Overview of Actions Taken by Tinker to Improve Its Management of Hazardous Waste

In our 1985 report we discussed a number of problems associated with the generation, containment, and disposal of hazardous waste at Tinker which resulted in the contamination of the Garber-Wellington aquifer, a source of drinking water for about 300,000 people in central Oklahoma. The Air Force has undertaken or will undertake a number of efforts to address organizational and programmatic problems.

The installation commander is ultimately responsible for establishing the internal controls necessary to ensure compliance with all environmental laws and implementing EPA and state regulations. On Tinker, several major commands are represented. The Air Logistics Center reports to the Air Force Logistics Command, the Airborne Warning and Control wing reports to the Tactical Air Command, and other base organizations report to other commands. Because various organizations on base report through different chains of command, the Air Force has established an Environmental Protection Committee to carry out hazardous waste management programs as required by Air Force regulations.

Tinker's Environmental Protection Committee, established in 1972, acts as a focal point for coordinating, reviewing, and guiding base environmental programs, including compliance with RCRA and NPDES. It consists of 19 members, representing all major base organizations, and the committee chairperson, who is the Air Logistics Center's vice commander. A working group supports the committee.

Notwithstanding this arrangement, we noted in our 1985 report that state regulatory agency officials were concerned that no single group or person had direct authority to correct or eliminate practices causing environmental problems at Tinker. They complained that Tinker was often slow to respond to the regulatory agencies because initiatives had to go through the various chains of command before action was taken to correct the problems.

To resolve these organizational problems, Tinker reorganized its hazardous waste management structure under the Environmental Protection Committee in October 1985 by creating the Environmental Management Directorate, the Tinker Environmental Action Group, and the Technical Review Committee. The Environmental Management Directorate was established as the single point of contact for carrying out Tinker's environmental program. Its director reports directly to the commander of the Air Logistics Center and is the chairman of the Environmental Protection Committee's working group.

**Chapter 2  
Overview of Actions Taken by Tinker to  
Improve Its Management of Hazardous Waste**

The Environmental Management Directorate's staff was assembled from the various on-base organizations responsible for environmental matters. By creating the Directorate, Tinker centralized responsibility for all environmental matters, including control of hazardous waste generation, recycling, storage, and disposal.

In addition to the organizational changes, Tinker has requested and received about \$5.7 million for fiscal year 1987 and has requested over \$8.3 million for additional projects to improve hazardous waste management. (See table 2.1.) Most are in response to specific problems identified or pointed out by various means, including EPA and state regulatory agencies' inspections, contractor reports, Air Force Logistics Command studies, and our audits.

**Table 2.1: Tinker Hazardous Waste Improvement or Corrective Action Projects Funded and Requested**

<b>Project</b>	<b>Funding year</b>	<b>Project cost</b>
<b>Funded projects:</b>		
Hazardous material storage facility	1987	\$1,800,000
Solvent recovery building	1987	395,000
Plating shop pretreatment system	1987	1,800,000
Locate improperly connected drains	1987	500,000
Equalization tanks at the industrial waste treatment plant	1987	957,000
Modification to building 3108 for calibration fluid recovery	1987	190,000
Trickling filter repair	1987	35,000
Replace sewage pumps	1987	16,355
<b>Total</b>		<b>5,693,355</b>
<b>Requested:</b>		
Replace comminutor at sewage plant	1988	27,500
Repair waste line to the industrial waste treatment plant	1988	33,000
Remove waste tanks at the industrial waste treatment plant	1988	756,000
DRMO hazardous waste storage facility	1989	1,700,000
Pave dikes at petroleum storage area	1989	700,000
Base hazardous waste facility	1990	5,100,000
<b>Total</b>		<b>8,316,500</b>
<b>Total</b>		<b>\$14,009,855</b>

Tinker officials state that most of their efforts so far have been responses to previously discussed problems. They stated that they do not have a comprehensive plan detailing (1) the various corrective actions needed and underway, (2) the interaction of these actions, (3) program cost, (4) program responsibilities, and (5) milestones for

completing these actions. Tinker officials agreed that there is a need for such an overall plan and have initiated efforts to implement such a plan that could provide management with a useful internal control to guide and measure progress in achieving improved hazardous waste management by, among other things, providing an assessment of

- the scope of remaining problems;
- needed corrective actions and projects, cost, and time frames; and
- relationships of corrective actions to each other.

This information could help ensure that projects are properly sequenced, are not redundant, and improve operational procedures. Tinker's efforts to correct the specific problems we identified in our 1985 report are discussed in chapters 3 through 6.



# Actions to Correct Containment Problems

In our 1985 report, we stated that Tinker was not in compliance with RCRA. According to studies by the U.S. Geological Service and the Oklahoma Water Resources Board, Tinker had contaminated three streams—Crutcho, Khulman, and East Soldier Creeks—that originate on or flow across the base. In addition, Tinker had partially contaminated the Garber-Wellington aquifer. The sources of this pollution were chemicals, heavy metals, and oil products that reached the groundwater and the streams through improper connections to storm sewer drains; runoff from hazardous materials and waste storage sites that had inadequate spill containment features; and improper handling of hazardous materials and waste.

Since 1985, Tinker has taken actions to reduce the amount of pollution reaching the base groundwater and streams. Oklahoma Water Resources Board officials are pleased with Tinker's progress in preventing pollution from reaching the base's groundwater and streams, but said it may take up to 10 years to completely resolve the pollution problems already identified at Tinker because of their magnitude and complexity. Additional time and resources will be required if other problems are identified in future inspections by the regulatory agencies.

## Improved Control Over Hazardous Waste Collection and Handling

Our 1985 report noted (1) hazardous material and waste storage sites with inadequate spill containment, (2) improper handling and storage of hazardous waste, and (3) evidence of open dumping or spills, which contributed to the contamination of the base streams and groundwater. Since the 1985 report, Tinker has (1) instituted management controls over hazardous waste containers and storage sites and (2) contracted for a training program to teach its employees how to properly handle hazardous materials and waste. Through these efforts, the collection and handling of hazardous waste has improved.

## Controls Over Containers and Storage Sites

The points where hazardous wastes are generated are regularly inspected by Tinker's Maintenance Directorate's Environmental and Industrial Safety Section. The Environmental and Industrial Safety Section was established in June 1985 to provide, among other things, a means for Tinker's management to inspect and monitor hazardous waste activities. These inspectors can shut down an operation if a major problem occurs that has an immediate effect on the environment, health, or safety. Generally, they issue notices of violation, which they are authorized to elevate through management levels until the problem is resolved.

Tinker uses 55-gallon drums to collect some of the hazardous waste generated on base. The Maintenance Directorate's Environmental and Industrial Safety Section numbers, labels, issues, and tracks these drums. The Industrial Safety Section also analyzes the contents of each drum to (1) ensure no hazardous waste containing more than 1-percent halogenated solvents, an extremely toxic type of cleaner, is disposed of in landfills as required by the EPA regulations implementing RCRA, (2) identify unnecessary contamination that would prevent or complicate recycling, and (3) follow up to ensure that actions are taken to correct problems identified.

Figure 3.1 shows a cabinet with spill containment features that the generating shops use to store hazardous waste collection drums until they are full. A label indicating the type of waste generated in the shop is prepared for each drum. Once full these drums are stored in temporary storage sites near the generation points until they are moved to the DRMO.

**Figure 3.1: Cabinet With Spill Containment Used to Collect Hazardous Waste**

RCRA regulations prohibit the storage of hazardous waste in temporary storage facilities without adequate spill containment features and

require protection from the weather when stored for more than 90 days. The DRMO has a storage facility, which has received a permit under RCRA, to store drums of hazardous waste more than 90 days. Drums of hazardous waste are stored in DRMO's facilities until a truck load is accumulated and then transported to a disposal site by the Defense Reutilization and Marketing Service's (DRMS's) contractor.

Figure 3.2 shows a temporary hazardous waste storage site used in 1985 that violated RCRA requirements because it was located near a storm sewer drain, lacked spill containment, and had no protection from the weather.

**Figure 3.2: 1985 Hazardous Waste Storage Site**

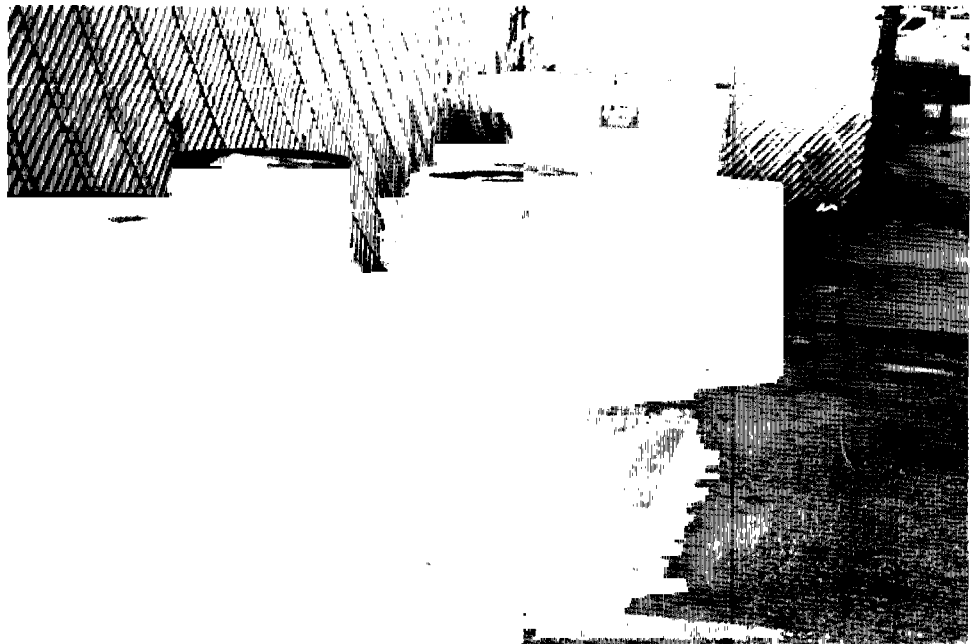
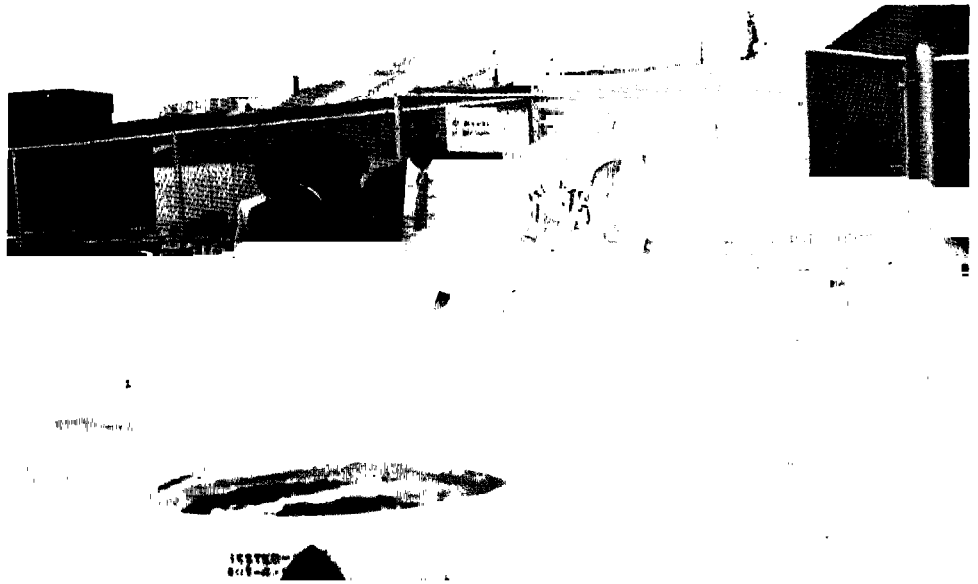


Figure 3.3 shows a current temporary hazardous waste storage location; note the sandbagged dikes and the fence. The new hazardous waste storage site does not provide the required spill containment or protection from the weather, but it is located away from the storm sewer drains.

In the past, drums were generally transported to the DRMO within a day or two after being filled. Now a drum may sit in a temporary storage site for about 45 days awaiting analysis of its contents so that the proper handling and disposal procedures for the waste can be determined.

Figure 3.3: Current Hazardous Waste Storage Site



Because these temporary sites do not provide the required amount of protection, there is a risk that the environment could be adversely affected.

As a interim solution, Tinker officials plan to consolidate the current inadequate storage locations for hazardous waste drums in a new facility with spill containment features at a cost of \$21,000. As a more permanent solution, Tinker plans to include a storage area for hazardous waste awaiting transportation to the DRMO in a 132,000-square foot facility. Tinker has requested \$5.1 million in the 1990 Military Construction Program for construction of this facility including an analysis laboratory. Tinker has also requested \$1.7 million in the 1989 Military Construction Program to relocate the DRMO storage facilities for hazardous wastes.

Plans for both the base and the DRMO facilities call for protection from the weather and adequate spill containment features as prescribed by the EPA regulations implementing RCRA. Tinker officials state that if they obtained a RCRA permit allowing them to store waste for more than 90 days in this new base facility, it would not be necessary to transport the waste to the DRMO. This would permit them to hold the drummed waste in the base facility until it was transported to the disposal site by the DRMS disposal contractor. In response to our inquiry, Tinker officials said that no study was made to determine total storage requirements,

including determining if one facility would be sufficient. Tinker officials told us that they will undertake a study to determine if there is a need for both facilities.

## Training

Employees involved in hazardous waste management are required to take RCRA training within 6 months of assignment and annually thereafter. In fiscal year 1986, this training, which covers hazardous waste regulations, safety, protective clothing and equipment, contingency planning, and spill response, was provided to 400 employees. These 400 employees include the personnel assigned to monitor the temporary hazardous waste storage sites. Tinker contracted for and received a more comprehensive training program in June 1987 to replace this program.

According to Tinker officials, training is expected to increase employee awareness of proper handling of hazardous waste and the detrimental effects of improper dumping. With this increased awareness, Tinker officials expect to reduce the incidence of improper dumping.

## Improperly Connected Drains

In 1985 some sewer drains, which Tinker officials believed led to the industrial waste treatment plant, actually emptied into the base streams. Chemicals, heavy metals, and oil products, which had been spilled or poured down these drains, were polluting the base streams and the groundwater. Conversely, some storm sewer drains, which Tinker believed led to the streams, actually led to the industrial waste treatment plant. As a result, when it rained the extra runoff diluted the wastewater going to the industrial waste treatment plant and had an adverse impact on the treatment process.

After our 1985 report, Tinker contracted with the Hazardous Material Technical Center, a private consulting firm, to locate improperly connected drains. The center's ongoing efforts have been complicated by outdated, inaccurate, and missing blue prints for the 10 miles of industrial waste sewer lines and 70 miles of storm sewer lines.

Tinker officials believe most of their earlier stream pollution problems were due to faulty designs in the base sewer systems and that most improper connections have been corrected. As of June 1987, Tinker had corrected 177 improperly connected drains. For example, they stated that the industrial waste treatment plant sewer system under the paint shops was designed to overflow into the storm sewer system. Tinker has redesigned the overflow connection. However, they believe it will take

years to identify all the improperly connected drains on base and plan to contract for smoke and dye tests to find them.

An example of Tinker's efforts to correct improper connections in the drains was its repair of an improper connection between an industrial sewer line lift station and a storm sewer drain that we had noted in our 1985 report. We noted in our report that an Oklahoma Water Resources Board inspector stated in 1984 that because of the improper connection, the water in Soldier Creek contained too much potassium permanganate and as a result the pH level in the stream was 12.5 while the state's desired level was between 6 and 9. Soldier Creek also contained tetrachloroethylene, a solvent, at a concentration of 72.9 micrograms per liter while the state's desired level is 0. The improper connection has been corrected.

## New Spill Procedures Adopted

Tinker and Oklahoma Water Resources Board officials agree that most of the pollution found in the base streams by the Water Resources Board during inspections in July, October, and November 1986 was caused by accidental spills or malfunctions. Previous inspections identified improperly connected drains as the cause of the problems; this has been corrected. In addition to correcting improperly connected drains and providing employees with training designed to prevent spills, Tinker officials hope to minimize the environmental damage caused when pollutants reach base streams by removing them quickly. Tinker has (1) procured devices that absorb oil from the streams in addition to the devices used to collect oil off the streams' surfaces and (2) installed oil and grease traps in the streams. Tinker officials hope these barriers will slow the flow and contain the contaminants in the streams until they can be removed by the base hazardous waste disposal contractor, who will periodically inspect the streams.

Tinker officials have prepared a spill abatement plan that sets up the procedures to be used when a spill occurs, including who responds to contain it, how it will be cleaned up, and how it will be reported to proper authorities. Oklahoma Water Resources Board officials said they are pleased with Tinker's spill abatement plan but are not sure it is always followed. They stated that Tinker is slow to report spills to them and they have no assurance that all spills are reported.

We found that during fiscal year 1986, only 8 of the 282 spills of hazardous substances on Tinker were reported to the Oklahoma Water Resources Board. Tinker documents indicate most of the 282 spills were

jet fuel spills of less than 10 gallons, which Tinker officials believed were not significant enough to be reported. In addition, Tinker officials stated that EPA and state regulations were not clear on what spills are to be reported. However, Tinker officials state that even though the regulations were not completely clear, there may have been other instances that should have been reported. The lack of guidance from Tinker's environmental offices on when spills should be reported has also contributed to non-reporting of spills. They believe these problems have or will be resolved through improvements in guidance and an increase in the related training.

## Stream and Groundwater Monitoring

Tinker monitors contamination levels in the groundwater and streams on base. Tinker's groundwater monitoring program draws water samples from a network of monitoring and drinking water wells on and off the base. Tinker officials state that while contamination has been detected in the groundwater on base, this contamination is not moving off the base.

Tinker officials also obtain water samples from the base streams using portable sampling equipment at various times and locations. These officials state that they emphasize testing close to where the streams leave the base. The test results for these samples are provided to the Oklahoma Water Resources Board. The Board's inspectors also collect samples at desired locations in the streams during unannounced compliance inspections. According to Tinker and Board officials, the results of recent stream water quality tests indicate less contamination is reaching these streams.

In our 1985 report, we stated that the streams on or near Tinker were so polluted that no aquatic life existed for several miles downstream from the base. Fish placed in water removed from Tinker's streams died in less than a day's time, according to EPA tests conducted in late 1984. In June 1987, a Garber-Wellington Association official stated that large populations of fish now exist downstream in Crutch Creek just off base. This official states that the water quality in the streams has improved dramatically since 1984.

## Conclusions

Tinker has taken actions to correct the problems we identified in our 1985 report, including

- improving controls over hazardous waste collection and handling, such as controls over containers and storage sites;
- requiring employees to take training in hazardous waste management;
- correcting improperly connected drains; and
- initiating a stream and groundwater monitoring program.

These actions have reduced the amount of pollution reaching the base groundwater and the streams. Regulatory officials believe, however, that it may take 10 years to completely resolve all problems.



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# Reducing the Amount of Hazardous Waste Requiring Disposal

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In 1980 DOD established a policy to reduce the volume of hazardous waste requiring disposal. Through this policy, DOD intended to reduce (1) the potential for contamination and adverse effects on public health and the environment and (2) its potential long-term liability for sharing the future cost of cleaning up the environment.

DOD directives require the military services to reduce hazardous waste requiring disposal by reducing generations to the maximum extent practical and to reuse, reclaim, or recycle the waste where practical. Another way to reduce the volume of hazardous waste requiring disposal is to treat it so that a smaller amount of residue remains hazardous. Tinker has responded by instituting a program to reduce the amount of hazardous waste its activities generate and to recycle or treat the wastes that are generated.

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## Reducing Hazardous Waste

In the 1985 report, we stated that Tinker's activities were generating unnecessarily large volumes of hazardous waste. We also discussed the commingling of substances such as oil, solvents, paint, and paint thinners, which then required disposal because they could not be recycled.

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## Reduced Sludge Generations

Large amounts of industrial waste treatment plant sludge were being generated because the sludge drying unit (vacuum filter) was frequently inoperable. Tinker disposed of 4,244 tons of treatment plant sludge during the year ending July 21, 1984. By repairing the sludge drying unit, Tinker reduced this volume to 2,466 tons in 1986. Tinker officials stated that this saved them about \$900,000 in disposal costs. Appendix I compares the amounts of hazardous waste generated by Tinker for the years ending July 31, 1984, and 1986.

Tinker is now testing and instituting new techniques and management controls that will further reduce the amount of hazardous waste being generated. Tinker is testing a new process to remove heavy metals from the wastewater that uses ferrous sulfate and sodium sulfide instead of lime (the primary ingredient of the treatment plant sludge). According to Tinker officials, this process could reduce the amount of sludge requiring disposal by at least 80 percent, saving about \$400,000 per year in disposal costs.

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## Contamination

Tinker has spent \$922,000 on test equipment to analyze, on a shop-by-shop basis, how their hazardous wastes are generated. The results of

these tests will be used to build a data base. This data base will provide greater visibility over the use of hazardous materials and be used to identify instances where management controls are needed to

- prevent commingling of hazardous substances, such as oil and solvents, and minimize the amount of nonhazardous substances such as water that are contaminated and
- eliminate or reduce hazardous wastes by substituting materials or changing processes.

Tinker officials stated that most of the contamination caused by commingling hazardous materials with other substances could be avoided. These officials plan to use the new test equipment to analyze the contents of each drum or tank of hazardous waste to identify the type of waste and the generation point of commingled and contaminated substances. Once these are identified, Tinker officials plan to eliminate contamination by (1) training employees to enforce segregation and to properly handle and control hazardous waste drums, (2) obtaining necessary equipment, and (3) making necessary process changes to eliminate this contamination.

Our 1985 report noted that jet fuel removed from aircraft awaiting repairs was allowed to evaporate. Tinker officials told us that this fuel becomes contaminated when it is exposed to the air. Tinker has since spent \$60,400 for equipment to remove the fuel without exposing it to the air. By testing and reusing this fuel, Tinker officials expect to save \$50,000 a year in fuel costs.

Our 1985 report also noted that various types of waste oils were commingled. Mixing the waste oils reduced the resale value and prevented the oils from being reused or recycled. Tinker continues to dispose of large amounts of waste oil that have been commingled and contaminated. For example, Tinker officials estimate that about 45,000 gallons of waste turbine oil is generated each year. Only about 17,000 gallons of this turbine oil, which is generated in the constant speed drive repair shop, is contaminated with freon. Freon is used to clean the constant speed drives during the repair process. However, all of the waste turbine oil from the constant speed drive shop is mixed together and then transported to storage tanks where it is commingled with various other types of waste oils from a number of base organizations. As a result of the 17,000 gallons of freon contaminated oil being commingled with the waste oil stored in these tanks, all of it is considered contaminated. In

addition, no attempt is made to segregate the various types of oils before storing them in the tanks.

Tinker has paid to dispose of the contaminated oil as a hazardous waste for at least the last 3 years because DRMO has been unable to sell it. DRMO recently received a bid for some of the freon contaminated hydraulic oil and may be able to sell it depending upon the extent of contamination. Selling this oil for a few cents per gallon is a significant improvement over paying for disposal as a hazardous waste. Its value, however, would be much greater if it were not contaminated. Tinker officials said that some contamination could be avoided, and they plan to study various management controls and procedures to prevent commingling and contamination.

## Process and Material Changes

Tinker will continue to dispose of the chromic acid and cyanide from the plating shop until January 1988 when it completes the \$1.8 million closed loop recycling system which was being installed as of September 1987. This closed loop system will recover the nickel and chrome, oxidize cyanide, neutralize acids and bases, and remove the residual heavy metals and organic contaminants from the rinse waters, allowing the water to be recycled to the plating shop. Once installed, Tinker will no longer dispose of chromic acid or cyanide and the amount of rinse waters from the plating shop to be treated at the industrial waste treatment plant will be reduced from 250,000 gallons a day to about 100,000 gallons a day. Tinker officials estimate that the recycling system will result in annual savings of \$241,000 in procurement, treatment, and disposal costs.

Tinker officials are also studying other process changes and material substitutions that will reduce the amount of hazardous waste generated. The following are some concepts that Tinker officials believe may further reduce hazardous waste generations.

- The life of perchloroethylene and other degreasing solvents could be extended with self-distilling vats. These will remove contaminants as the solvents are used.
- Biodegradable solvents could be substituted for halogenated solvents and water-based paint could be substituted for oil-based paints.
- The use of water pressure to remove silicone rubber gasket material rather than chemicals which results in both the material and the chemicals having to be disposed of as hazardous waste.

- A plastic bead media applied with air pressure could be used to remove paint from selected aircraft parts in lieu of a phenol-based stripper and detergents. Tinker generates large volumes of phenolic wastewater. This wastewater must be treated at the industrial waste treatment plant because once the stripper has been applied and has acted on the old paint, warm soapy water is used to remove the paint and the stripper. The use of this plastic bead media would reduce the amount of waste generated.

Tinker, along with the Air Force Engineering and Services Center, is also participating in a pilot study of new technology to recover the solutions used in plating baths that become contaminated.

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## **Recycling**

DOD established the Used Solvent Elimination program in January 1984 to eliminate the disposal of used solvents in landfills. Since 1986, RCRA regulations have prohibited the disposal of certain types of solvents in landfills. DOD studies found that if sufficient quantities exist, recycling, in addition to reducing hazardous waste disposal costs, provides usable materials at less cost than buying new materials.

In our 1985 report, we stated that Tinker officials had done little to comply with this DOD policy. Subsequently, Tinker officials initiated efforts to address the recycling problems we identified and to comply with DOD policy. Table 4.1 shows the problems described in our 1985 report and Tinker's efforts and plans to resolve them.

**Chapter 4**  
**Reducing the Amount of Hazardous Waste**  
**Requiring Disposal**

**Table 4.1: Tinker's Recycling Problems Identified in Our 1985 Report and Tinker's Efforts and Plans to Resolve Them**

Problems Identified	Corrective Actions
Waste vapor degreaser solvents disposed of or sold.	Tinker spent \$173,300 for two atmospheric stills, which are expected to be operational by February 1988. Tinker expects to eliminate the need to dispose of these solvents as hazardous waste and save \$53,000 a year in procurement and disposal costs.
Waste paint thinner commingled with waste paint, preventing recycling, and requiring their disposal. Tinker had no plans to recycle the paint thinner.	Tinker spent \$14,000 for a still to recycle the thinner starting in February 1988. Because of improved controls, paint and thinners are no longer commingled and as a result do not require disposal.
Waste calibration fluid transferred to Department of Energy rather than recycled or reused on base.	Tinker spent \$161,000 for two vacuum stills, which should be operational in February 1988. Tinker expects to save \$170,000 a year in procurement and disposal costs.
JP-5 jet fuel used to purge JP-4 jet fuel from tanks and fuel controls of aircraft awaiting repairs. The JP-4 was allowed to evaporate so the JP-5 could be used again.	Tinker plans to blend JP-5/JP-4 mixture purged from aircraft with large volumes of JP-4 and use it for aircraft fuel.
More than 45,000 gallons of machine coolant disposed of in an injection well in 1984.	Tinker spent \$60,000 for a centrifuge to recycle this machine coolant. Tinker expects to save \$50,000 a year in procurement and disposal costs.

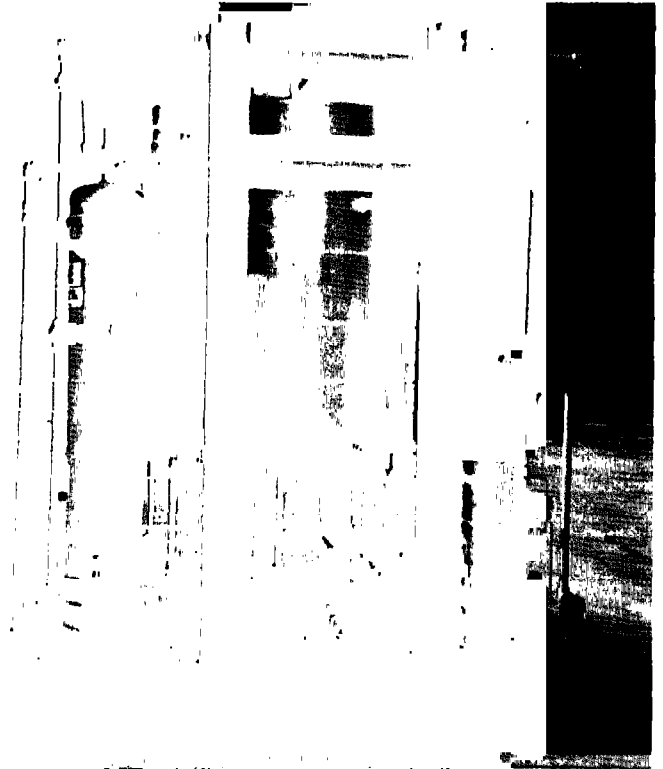
In total Tinker has spent \$408,300 for equipment to recycle solvents, machine coolant, calibration fluid, and paint thinners. Tinker officials expect to save \$270,000 annually by recycling these substances. However, most of the recycling equipment, which was procured in 1985 has been sitting (see figure 4.1) awaiting the construction of a building to house the equipment. Tinker has received \$395,000 for a solvent recovery building and anticipates receiving another \$190,000 to modify a building for the calibration recycling equipment. Currently, Tinker is recycling about 16,000 gallons of machine coolant a year; however, Tinker officials expect to increase this to 50,000 gallons a year by January 1988 and to start using the other recycling equipment in February 1988.

Tinker has decided to either recycle or study the feasibility of recycling hazardous waste substances it generates in large quantities.

## Treatment

Tinker continues to dispose of some hazardous waste chemicals from the engine cleaning facility but is studying ways to pretreat them so they can be processed through the industrial waste treatment plant. Several used chemicals from the engine cleaning facility, such as alkaline pre-cleaner, alkaline rust remover, and potassium permanganate, are being used as treatment chemicals at the industrial waste treatment plant. Tinker saved \$16,800 by reusing these chemicals during the 90-day period ending April 30, 1987. Also, Tinker now treats all of the phenolic

Figure 4.1: Recycling Equipment  
Awaiting Facility Construction



(paint stripper) contaminated wastewater at the treatment plant, saving the disposal cost of phenolic wastewater that in 1984 was collecting in clogged drains.

## Conclusions

In accordance with DOD directives, Tinker has instituted a program to reduce the amount of hazardous waste generated by its activities and to recycle or treat the wastes that are generated. However, only a small amount of waste is actually being recycled because the buildings to house the recycling equipment have not been completed.

# Industrial Waste Treatment Plant Discharge Violations and Management Problems

Tinker's industrial waste treatment plant has been out of compliance with the permit standards set by EPA under NPDES and state regulations for handling industrial wastewaters since it was built in the 1960s. Tinker had taken a number of actions before 1985 to improve management practices and operational problems that caused the NPDES discharge violations, including a \$7.6 million plant upgrade in 1984, but the compliance problems persisted despite these efforts.

Since then Tinker has made several facility and internal control improvements at the plant, which have lessened the severity and frequency of discharge violations. Tinker has also signed a compliance agreement with EPA and the Oklahoma Water Resources Board to make further improvements. These officials and the Air Force expect these improvements will bring the plant into compliance by December 1988.

## Industrial Waste Treatment Plant Operations

The industrial waste treatment plant treats about 1 million gallons of polluted industrial rinse waters per day, primarily from the plating shop, engine cleaning facility, and aircraft painting and paint stripping operations. This wastewater contains heavy metals, oils, cleaning solutions, and chemicals. Figure 5.1 illustrates the flow process through the treatment plant. Initially, the wastewater is passed through an oil separator that removes oil before the wastewater enters the equalization basins. The equalization basins blend the wastewater from various shops, which dilutes any concentrated chemicals, and allows the operators to control the flow rate into the plant. The plant then

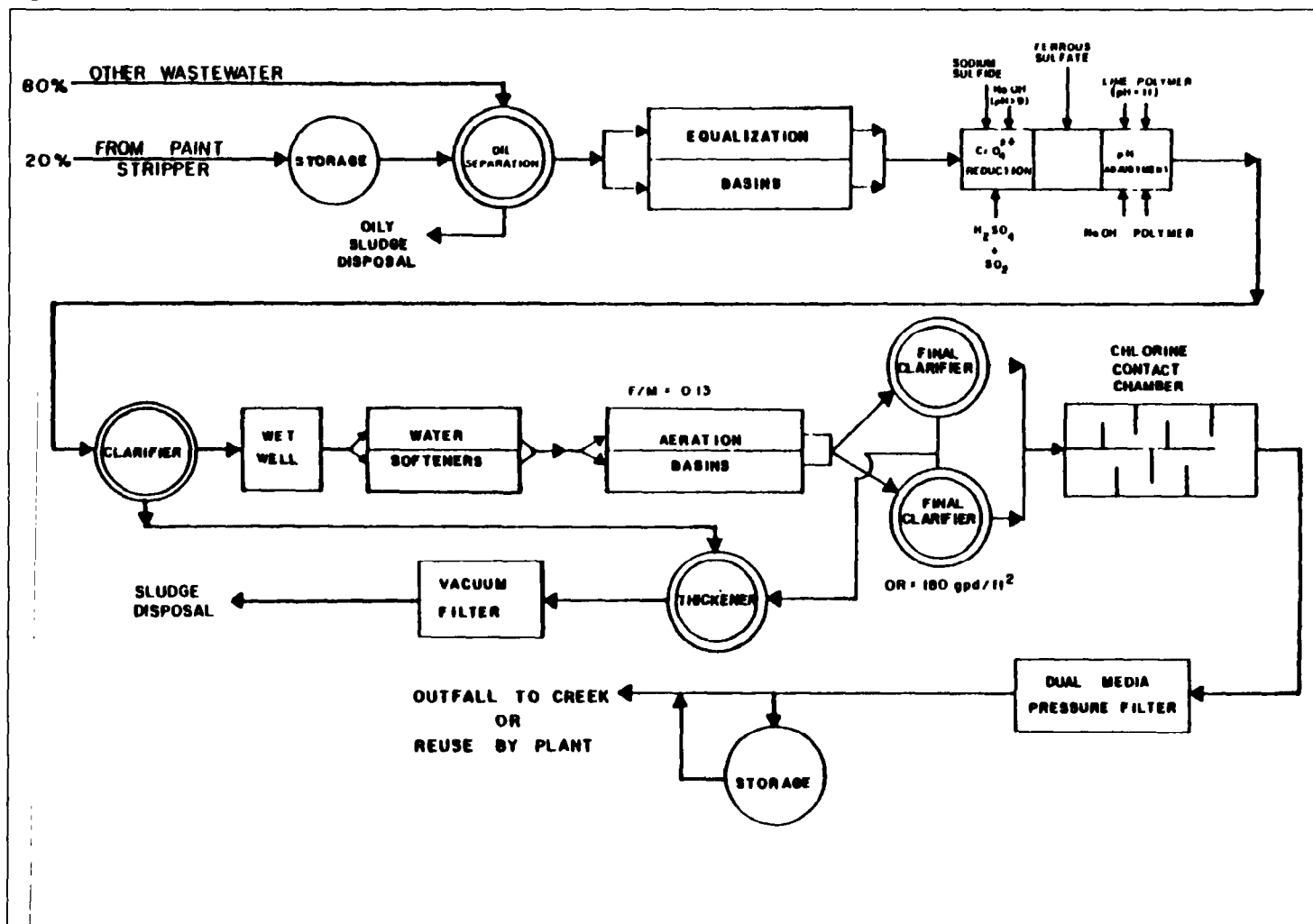
- removes cyanide by alkaline chlorination,
- removes metals using lime and sulfuric acid,
- degrades organic chemicals in an activated sludge basin containing bacteria bred to eat chemicals,
- settles out the solids from the wastewater in several clarifiers (similar to settling tanks), and
- dries sludge removed from the clarifiers in a vacuum filter.

## Plant Deficiencies in 1985

In our 1985 report, we stated that Tinker's industrial waste treatment plant was not operated effectively or efficiently and as a result the NPDES discharge compliance standards were frequently violated. The reasons included

- lack of qualified personnel to operate the plant;

Figure 5.1: Tinker's Industrial Waste Treatment Plant Operations



- uncorrected management and operational problems that were identified in a 1981 Air Force Engineering and Services Center report;
- inoperable plant equipment; and
- inability to control either the chemical composition or the flow of the wastewater entering the plant.

We identified the lack of qualified and trained personnel as a primary reason for the treatment plant's operating problems. These operating problems led to the plant discharging contaminants to the stream in violation of NPDES requirements. Employees were military personnel, without prior training or experience in plant operations, who were usually



reassigned by the time they became familiar with plant operations and procedures.

Specific operating problems noted in the 1981 Engineering and Services Center's report had not been resolved by 1985, including (1) a lack of preventive maintenance, (2) shortages of essential treatment chemicals, and (3) a lack of written operating procedures and equipment manuals. The lack of a preventive maintenance program was cited as the primary cause for inoperable plant equipment.

Plant officials could not prevent concentrated surges of phenol, chrome, and other chemicals from being spilled or poured down sewer drains leading to the plant. The plant's equalization basins were not large enough to allow these concentrated chemicals to be effectively diluted before entering the plant. As a result, concentrated chemicals were reaching and killing the bacteria in the plant's biological treatment basin causing compliance problems.

## Plant Improvements Made and Planned

To alleviate plant operator problems and improve management controls over plant operations, Tinker officials

- appointed a civilian chemist to manage the plant,
- placed civilian employees in key positions,
- contracted for a staff training program and plant operating instructions,
- obtained plant and equipment operating manuals,
- repaired equipment and instituted a preventive maintenance program, and
- entered into a requirements contract to ensure an adequate supply of treatment chemicals.

Tinker officials are also taking actions to prevent concentrated chemicals that have been spilled or poured down sewer drains from reaching the plant. They

- installed cutoff valves with automatic sensors in the plating shop and engine cleaning facility that will automatically close when a spill occurs or the contamination reaches a specified level,
- placed controls on the flow of the contaminated wastewater from the paint and paint stripping operations into the plant to help prevent damage to the bacteria in the biological basin,
- contracted for and received an awareness training program for employees to prevent improper handling of hazardous waste, and

- contracted for a study to evaluate the design and operational adequacy of the industrial waste treatment plant to handle the wastewater it receives.

Because the current equalization basins are not large enough to contain the wastewater until it is properly blended and analyzed before it is metered into the plant at a constant rate, Tinker officials have received emergency Military Construction Program 1987 funds to construct two equalization tanks by October 1988. Each tank will hold 1 million gallons and cost \$957,000.

However, there is uncertainty as to how much capacity is needed. The contractor Tinker hired to evaluate the design and operational adequacy of the industrial waste treatment plant to handle the wastewater it receives, recommended two 750,000-gallon tanks. We were told that neither Tinker's nor the contractor's estimates considered the effects of the closed loop system being installed in the plating shop, discussed in chapter 4, which should reduce the flow of wastewater to the plant by 150,000 gallons a day.

As a result of our inquiry, Tinker officials told us that they plan to determine what effect these changes in maintenance operations will have on the flow of pollutants to the treatment plant and if necessary make adjustments to the size of the tanks.

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## Conclusions

Even though Tinker's industrial waste treatment plant has been out of compliance since it was built in the 1960s, recent improvements and the improvements to be accomplished as a result of the compliance agreement with EPA, should enable the plant to discharge pollutants to the streams in compliance with permit requirements. Most of the deficiencies that we identified in our 1985 report have been corrected or will be corrected as a result of actions to be taken in accordance with the compliance agreement.

# Contractor and Disposal Problems

In 1980 DOD established a policy to dispose of hazardous waste in an environmentally acceptable manner. Under this policy, the Defense Logistics Agency provides disposal services to DOD bases for hazardous waste generated on base except for a few types of wastes. The Defense Logistics Agency has delegated operational responsibility to DRMS. Actual disposal contract execution and disposal related operations are carried out by DRMO at Tinker.

In our July 1985 report, we stated that Tinker, along with the DRMO, could not ensure that its hazardous waste was being disposed of safely because Tinker's controls over hazardous waste contractors, shipments, and the selection of disposal sites were inadequate. Since then Tinker has improved controls over hazardous waste contractors, off-base shipments, and the selection of disposal sites. However, Tinker needs to improve its management controls over the waste oils transported on base by the base contractor, and has begun to do so.

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## Contractor Problems

Most of the hazardous wastes generated by the Air Logistics Center's maintenance shops are disposed of under a contract awarded by DRMS. This waste is stored in bulk tanks or 55-gallon drums. The DRMS contractor uses tanker trucks to pick up the waste from the bulk tanks that are located near the generation points. The 55-gallon drums are transported by Tinker personnel to DRMO where they are stored until there is a truck load for the DRMS contractor to pick up.

Tinker Air Force Base contracts separately with a local firm (1) to dispose of contaminated aluminum oxide, industrial waste treatment plant sludge, or hazardous waste that must be removed from operational process tanks and (2) to transport waste oil from various locations on base to two large storage tanks near the industrial waste treatment plant. Under certain circumstances, Tinker may also use the base contractor to dispose of hazardous waste normally disposed of under the DRMS contract.

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## Ability to Execute Contract

In our 1985 report, we stated that the DRMS contractor could not always fulfill the contract requirements. For example, because of the slow response time of the DRMS contractor, the base's local contractor was often called to dispose of waste in the bulk tanks covered under the DRMS contract to avoid the need to shut down maintenance and repair operations. To remedy this situation, DRMS subsequently contracted with a

firm that has the ability to execute contract requirements in a more timely manner.

About 400,000 gallons were removed from these tanks by the DRMS contractor during the year ending June 30, 1986. Under emergency circumstances, Tinker officials called the base contractor only twice in the 6-month period ending June 30, 1987, to dispose of approximately 8,000 gallons of hazardous waste which would have normally been disposed of under the DRMS contract.

## Payment Controls

In our 1985 report, we stated that the base contractor overcharged Tinker by \$54,000 during the 11-month period ending June 30, 1984. After the report, the Air Force Office of Special Investigations reviewed payments to the base contractor beyond the 11 months our review covered. The Office of Special Investigations identified additional overpayments of \$22,000, for a total of \$76,000. The Air Force has collected \$52,000 and expects to collect the remaining \$24,000 from the contractor. Our review of Tinker's payment records for the 8-month period ending April 30, 1986, revealed none of the overpayment problems found in our 1985 review.

Tinker still uses the contractor it used in 1985; however, it has improved internal controls over payments and shipments of hazardous waste. DRMS and Tinker officials (1) weigh base and DRMS disposal contractors' trucks before loading, (2) monitor truck loading, and (3) reweigh the trucks on the DRMO scales before they leave the base. Tinker officials also confirm the amount of waste shipped is the same as the amount received at the disposal site.

## Improved Manifest Controls

RCRA regulations require that EPA's manifest system be used in documenting the transfer of hazardous waste to disposal facilities. Under RCRA regulations, facilities that generate and dispose of hazardous wastes are responsible for preparing shipping manifests and confirming that wastes are delivered to designated disposal sites. The shipping manifest accompanies a shipment; the recipient at the disposal site verifies and records that the waste was received; and the recipient signs and returns a copy of the manifest to the shipping activity to confirm the waste reached the disposal site.

In our 1985 report, we stated that Tinker's manifest tracking system did not provide reasonable assurance that all hazardous waste shipped from

Tinker reached the designated disposal sites. Thus, Tinker had created a potentially serious threat to the environment and a potential liability for DOD.

Tinker has improved its manifest tracking system by instituting better record keeping practices that meet EPA requirements. We reviewed all of Tinker's manifests for the 11-month period ending June 30, 1986, and found none of the types of discrepancies we identified in our earlier review. All shipments were accounted for and delivered to RCRA approved disposal sites.

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## Controls Over Waste Oil

Tinker officials do not fully account for the disposition of waste oil generated in its maintenance operations. The contract for the waste oil requires the contractor to collect and transport waste oil from several base organizations to the storage tanks at the industrial waste treatment plant with little monitoring by Tinker officials. Due to inadequate internal controls, Tinker officials could not reconcile the amount of waste oil loaded and transported from the waste oil storage tanks.

The Maintenance Directorate maintains records indicating the volume of waste oil transported from its shops to the storage tanks at the industrial waste treatment plant, but civil engineering, which pays the contractor to transport waste oil from all other base organizations, pays by the load not by volume. An individual invoice merely indicates that one load was transported—a load can range from a small amount to 1,250 gallons—the invoices seldom indicated the gallons transported.

We called this matter to the attention of Tinker officials who have begun to implement better internal controls. For example, Tinker is instituting new procedures that require (1) shipment invoices to indicate the amount of oil being transported, (2) records to indicate the amount of oil transported and stored in the tanks, and (3) a reconciliation of the records and invoices.

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## Potential Future Costs

Tinker began disposing of hazardous waste in commercial disposal sites in the 1960s. Tinker had previously used on-base landfills and pits. The cost of cleaning up these on-base disposal sites is unknown. However, Tinker has spent millions on its Installation Restoration Program's clean-up efforts to date and much remains to be done.

In 1985 Tinker was allowing disposal contractors to select disposal sites which were not in compliance with RCRA. Two of these sites are contaminating the environment and are being cleaned up under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. 9601, commonly called Superfund. Under Superfund, generating entities (those that produce hazardous waste), including federal agencies, may be held liable for cleanup of uncontrolled hazardous waste sites that received their hazardous waste. EPA estimates Tinker's share of the cleanup cost to be between \$5.2 million and \$13 million. In the future, Tinker may be held responsible for the cleanup of other sites under Superfund.

To limit DOD's future liability, Tinker plans to reduce the amount of hazardous waste requiring disposal and has stopped disposal contractors from using disposal sites that do not comply with RCRA.

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## Conclusions

Tinker's improved controls over the hazardous waste contractors, off-base shipments, and the disposal sites used and the management controls that they have initiated over the shipment of waste oils, should reduce the potential for environmental pollution. As a result, Tinker's potential future liabilities resulting from improper disposal of hazardous waste should be minimized.



# Types of Hazardous Waste Disposed of by Contract at Tinker Air Force Base (Years Ending July 31, 1984, and July 31, 1986)

Hazardous waste	Quantities	
	1984	1986
<b>Gallons:</b>		
Oily bottom sludge	621,250	86,270
Paint stripper and chips	199,530	0
Alkaline precleaner	124,200	27,112
Mixed acids	60,600	60,100
Sodium hydroxide	46,625	98,589
Machine coolant	45,550	25,500
Carbon remover	36,450	22,320
Cyanide solution	31,500	27,100
Phosphoric acid	27,835	11,700
Potassium permanganate	23,500	24,420
Miscellaneous chemicals	20,446	5,387
Chromic acid	19,500	13,075
Waste oil	0	5,000
Paint stripper	19,300	4,070
Emulsion cleaner	13,300	4,300
<b>Total</b>	<b>1,289,586</b>	<b>414,943</b>
<b>Tons:</b>		
Industrial sludge	4,244	2,466
Contaminated aluminum oxide	380	440
Waste paint	0	65
Metal containers	0	30
<b>Total</b>	<b>4,624</b>	<b>3,001</b>
<b>Pounds:</b>		
Various chemicals (such as cyanide and polychlorinated biphenyls)	5,845	26,040
<b>Drums:</b>		
Chemicals (such as perchloroethylene)	1,596	4,640



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