

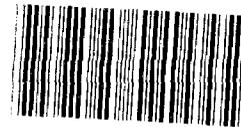
GAO

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

July 1987

HAZARDOUS WASTE

Tinker Air Force Base Is Making Progress in Cleaning Up Abandoned Sites



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Washington, D.C. 20548

National Security and
International Affairs Division

B-213706

July 10, 1987

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

Dear Mr. Chairman:

In June 1984, you requested that we review the Department of Defense's efforts to dispose of hazardous waste at Tinker Air Force Base, Oklahoma, a major generator of hazardous waste. Problems with the generation, storage, and disposal of hazardous waste have resulted in the contamination of several sites on base. In December 1984, your Subcommittee held hearings and we testified on the results of our review. We subsequently issued our report, Hazardous Waste Management at Tinker Air Force Base--Problems Noted, Improvements Needed (GAO/NSIAD-85-91, July 19, 1985).

On May 14, 1986, you requested that we review the Air Force's actions to identify and clean up abandoned hazardous waste sites at Tinker and to correct problems we found relating to the generation, storage, and disposal of hazardous waste. This briefing report presents the results of our work on actions taken on abandoned sites.

In 1981, the Air Force started implementing the Department of Defense's Installation Restoration Program to identify and clean up contaminated sites at Tinker. Actions taken after your Subcommittee hearings were as follows:

- In January 1985, Tinker created the Installation Restoration Program Technical Review Committee, which directly involved environmental experts of state and federal regulatory agencies in resolving Installation Restoration Program problems in a more timely and effective manner.
- In February 1985, Tinker established an Environmental Action Group to increase its responsiveness to hazardous waste issues and to act as a clearinghouse for all environmental actions. The group's weekly meetings are attended by representatives from all base activities that handle hazardous material.

- In August 1985, Tinker created a Technical Working Group staffed with technical experts to assist the Technical Review Committee. This group meets, prior to scheduled quarterly meetings of the Committee, to establish agenda items for the Committee covering questions and technical issues concerning Tinker's Installation Restoration Program, such as possible cleanup alternatives.

- In October 1985, Tinker established a single point of contact for environmental issues by creating a new Environmental Management Directorate. This action raised the visibility level of environmental problems and enhanced the working relationship with regulatory agencies.

- In March 1986, Tinker contracted with the Army Corps of Engineers for completing the Installation Restoration Program on a cost-reimbursement basis. This action eliminated the need for private contractors and the time-consuming need to amend a contract each time requirements change. The Corps also compressed parts of two phases of the Installation Restoration Program into one study which should reduce the time needed to begin site cleanup work.

Tinker officials are addressing deficiencies in the hazardous waste management structure. By centralizing the organization and decision-making process, Tinker should be able to better manage the restoration program. Officials of federal and state regulatory agencies generally agree that the Air Force is on the right track in identifying and cleaning up contaminated sites on Tinker. Appendix I provides more details on the organizations responsible for the Installation Restoration Program activities.

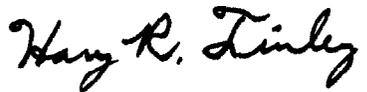
While the Air Force has taken actions to restore hazardous waste sites on Tinker, much still needs to be done. Seventeen sites (including four streams on base which are considered one site by Tinker) were identified as contaminated. Eleven of the 17 sites have contamination problems with a high or moderate potential for migrating to other areas. The only remedial actions taken so far are the removal of contaminated sediment from one of the streams and a connecting drainage ditch and the placing of a clay cap over landfill number 6. However, regulatory officials have stated that the source of the stream's contamination must be stopped or it will have to be cleaned up again. Appendix II contains details of the various work being performed.

Appendix III provides the status of each of the 17 contaminated sites. Besides dealing with each contaminated site, the Air Force has directed the Corps of Engineers to conduct groundwater assessments to ensure that contamination has not moved off base. The Air Force is also testing the base's water supply wells quarterly for signs of contamination.

We discussed the issues in this briefing report with officials responsible for managing the Installation Restoration Program and included their comments where appropriate. As you requested, we did not obtain official agency comments. Appendix IV describes the objective, scope, and methodology of our work.

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, the Navy, and the Air Force; the Director, Office of Management and Budget; and other interested parties upon request.

Sincerely yours,



Harry R. Finley
Senior Associate Director

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ABBREVIATIONS

AFB	Air Force Base
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COE	Corps of Engineers
DOD	Department of Defense
EPA	Environmental Protection Agency
HARM	Hazard Assessment Rating Method
IRP	Installation Restoration Program
OEHL	Occupational & Environmental Health Laboratory
ppb	parts per billion
TCE	trichloroethylene

ORGANIZATIONAL RESPONSIBILITIES FOR THE
INSTALLATION RESTORATION PROGRAM
AT TINKER AIR FORCE BASE

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. 9601) and the 1986 amendments, commonly known as Superfund, were enacted to provide for cleanup of the nation's hazardous waste¹ sites. The law provides that federal agencies must comply with CERCLA's requirements to the same extent as private entities must comply.

The Department of Defense's Installation Restoration Program (IRP) is an expansion of a program the Army started in 1975 to (1) identify and evaluate suspected problems associated with past hazardous waste disposal sites located on Department of Defense (DOD) installations and (2) control the migration of hazardous waste contamination from these sites. These requirements were later stipulated in CERCLA.

The Air Force formulated its initial IRP policy guidance in December 1980 and started its program in January 1981. The Office of the Deputy for Environment, Safety, and Occupational Health in the Office of the Deputy Assistant Secretary of the Air Force for Installations, Environment, and Safety sets the overall policy for the Air Force's IRP.

The IRP consists of four phases. During Phase I, the installation assessment is made, including site inspections and records searches, to identify bases with closed, potentially hazardous waste sites. During Phase II, the existence of contaminants affecting the environment is confirmed. During Phase III, technology, if needed, is developed or advanced to solve some of the problems. During Phase IV, remedial action is designed and executed.

PROGRAM ORGANIZATIONAL STRUCTURE AND ROLES

The following is a brief description of the offices or activities involved in the IRP and the responsibilities of each.

¹Hazardous waste is defined as waste which, because of its quantity; concentration; or physical, chemical, or infectious characteristics, may cause or contribute to an increase in mortality or pose a substantial hazard to human health or the environment when improperly treated, stored, transported, or disposed of.

Headquarters and major commands

The Directorate of Engineering and Services, Air Force Headquarters, Washington, D.C., has overall management responsibility for the Air Force's IRP; but major commands, such as the Air Force Logistics Command at Wright-Patterson Air Force Base (AFB), Ohio, are the IRP managers for bases in their commands. The Logistics Command expects its bases to manage their own programs, with the Command responsible for program oversight and approval.

Air Force Engineering and Services Center

The Air Force Engineering and Services Center at Tyndall AFB, Florida, is a technical support organization of the Air Force's Directorate of Engineering and Services, providing support to the major commands upon request. This support has included providing contractors for most of the Phase I studies to date.

Occupational and Environmental Health Laboratory

The Air Force Occupational and Environmental Health Laboratory (OEHL) at Brooks AFB, Texas, is under the command of the Air Force Systems Command. OEHL, the Air Force's technical manager for Phase II, initiates work on a base when requested by a major command. OEHL monitors Phase II studies performed by contractors awarded contracts by the Air Force Systems Command's Aeronautical Systems Division at Wright-Patterson AFB, Ohio.

Base level

Generally, Air Force base-level IRP responsibility rests with the base's civil engineer. However, Tinker has given this responsibility to the newly created Environmental Management Directorate.

ORGANIZATIONS CREATED TO AID TINKER'S IMPLEMENTATION OF THE INSTALLATION RESTORATION PROGRAM

Tinker reorganized its hazardous waste management structure to centralize responsibility for all environmental matters, including the IRP, and to respond to oversight reviews by the Subcommittee on Environment, Energy and Natural Resources, House Committee on Government Operations; state and federal regulatory agencies; and cognizant Air Force organizations.

Technical Review Committee

The Technical Review Committee consists of designated representatives from the parties required to approve IRP plans, including the Air Force, Environmental Protection Agency (EPA), and the State of Oklahoma. The Committee was created on January 15, 1985, to expedite remedial actions by eliminating the delay associated with the normal review process. This face-to-face forum provides the Air Force with the expertise of the regulatory agencies in the decision-making process.

Tinker, including the Air Logistics Center, is represented by the Director of the Environmental Management Directorate, and the State of Oklahoma is represented by officials from the Oklahoma State Department of Health. EPA Region VI officials represent EPA on the Technical Review Committee. Officials from other agencies, such as the Oklahoma Water Resources Board, the Association of Central Oklahoma Governments, the Garber Wellington Aquifer Association (represents towns and cities using the aquifer), the Army Corps of Engineers, and the Oklahoma Geological Survey, may attend and comment on matters before the Committee.

The Committee members meet quarterly to discuss all IRP proposals and to reach a consensus on the specific IRP actions to be taken.

Environmental Action Group

The Environmental Action Group was established in February 1985 to increase Tinker's responsiveness to hazardous waste issues and to act as a clearinghouse for all on-base activities' environmental actions. The group is responsible for IRP problems and other issues such as hazardous waste removal, unpermitted discharges, industrial waste treatment plant discharge, and hazardous waste storage. This group assists Air Force management in measuring the progress being made in each area and in ensuring that issues are being dealt with in a timely manner.

The group, which meets weekly, consists of representatives from all base activities that handle hazardous material. Representatives from other organizations may be asked to attend when their technical assistance is required. Each representative is authorized by his or her staff office to act on decisions made during the meetings.

Technical Working Group

Established in August 1985, the Technical Working Group supports the Technical Review Committee with technical representatives from the same agencies. The Technical Working Group meets one

month prior to the Committee meetings to study proposed IRP actions and establish agenda items for the Committee. These meetings cover questions and the technical aspects concerning Tinker's IRP, such as possible cleanup alternatives.

Environmental Management Directorate

The Environmental Management Directorate was established in October 1985 as the sole point of contact for outside agencies on all environmental issues. This Directorate consolidates functions of the Director of Engineering and the Surgeon General on environmental matters. The Directorate, staffed with 45 to 50 people, reports directly to the command section of the Air Logistics Center.

ROLE OF THE CORPS OF ENGINEERS

Before Phase II was complete, Tinker officials discontinued using OEHL as program manager and contracted directly with the Army's Corps of Engineers in an effort to complete the IRP in a more timely manner. According to Corps officials, they reviewed the work performed in Phase II and used it where applicable. The Corps' investigation, which began in March 1986, is scheduled for completion in fiscal year 1988.

The members of the Corps' project team are environmental specialists with backgrounds in civil engineering and geology. The Corps' duties as Tinker's IRP project manager include investigating and identifying the sites on base contaminated by hazardous waste, developing the processes to be used for remedial action, and preparing the plans and specifications to enable a contractor to clean up the sites.

According to Corps officials, individual IRP projects can be completed in a more timely and effective manner by combining Phase II with the first part of Phase IV. In the past, Phase IV work could not begin until a final Phase II report had been issued. Under the Corps' approach, the time frame for implementing the IRP is reduced by eliminating the report and by collecting the data necessary to design a remedial action plan (Phase IV) while obtaining data needed to quantify the contamination at a site (Phase II).

In addition, it is no longer necessary to amend a contract each time the scope of work changes because the Corps staff perform the work themselves on a cost-reimbursement basis. Previously, OEHL had to modify contracts with private environmental firms on a stage-by-stage basis.

The Corps staff prepare a work plan for each contaminated site after discussion with the Technical Working Group and present the plan to the Technical Review Committee for approval. The statement of work must be approved in writing by the State of Oklahoma and the EPA.

IMPLEMENTATION OF THE
INSTALLATION RESTORATION PROGRAM

Tinker AFB is one of the largest military industrial installations in the world. Tinker, which was activated in March 1942 and covers 4,775 acres in central Oklahoma (southeast of Oklahoma City), hosts about 40 tenant organizations, including the Oklahoma City Air Logistics Center. The Air Logistics Center, under the Air Force Logistics Command, operates a maintenance depot on Tinker. This depot, which overhauls or modifies more jet engines than any facility in the free world, serves as a repair depot for several aircraft and weapons. The repair and overhaul processes require the use of large quantities of hazardous materials and result in Tinker's status as the largest hazardous waste generator in the Air Force.

Problems in the past with the generation, storage, and disposal of this hazardous waste have caused contamination of several sites and the groundwater at Tinker AFB. Tinker lies directly over the known recharge area for the Garber Wellington aquifer from which Tinker and several cities near Oklahoma City obtain their drinking water. Tinker is currently implementing the IRP to identify and clean up these contaminated sites. EPA has identified two sites to be included on its National Priorities List²--building 3001 and Soldier Creek (one of the base streams).

PHASE I

The Air Force Engineering and Services Center at Tyndall AFB prepared the statement of work³ for Phase I of Tinker's IRP and coordinated it with the Air Force Logistics Command. The Air Force Engineering and Services Center obtained a private contractor, Engineering-Science, to conduct the IRP Phase I study for Tinker. Engineering-Science began the Phase I study in July 1981 by reviewing records and files, conducting field inspections, and interviewing officials from Tinker and the applicable regulatory agencies to identify current and past areas of hazardous waste generation and disposal as well as disposal methods. The final report was issued in April 1982. The completed study cost \$45,900.

²The National Priorities List identifies those sites deemed to pose the greatest potential for long-term threat to human health and the environment.

³The statement of work describes tasks, establishes a schedule for conducting the tasks, lists all expected deliverables, and presents a cost estimate.

Study findings

Engineering-Science's Phase I final report identified 14 sites on Tinker as having potential environmental contamination. Using the Air Force's Hazard Assessment Rating Method (HARM), a system to set priorities for the sites that is similar to the system used by EPA, the contractor scored each site on a scale of 0 to 100 (worst case being 100) based on the following considerations:

- characteristics of the waste at the site,
- possible sites for contaminant migration,
- potential pathways for contaminant migration, and
- current efforts to contain the contamination.

Based on these HARM scores, the contractor then classified each site as having high, moderate, or low potential for migration of contaminants to other areas. Areas having HARM scores greater than 64 were of primary concern and were considered by the contractor to have high potential for contaminant migration. These sites required further investigation in Phase II. The contractor concluded that 3 of the 14 sites at Tinker fell into this category: two landfills and an industrial waste pit.

Sites with HARM scores of 50 to 64 indicated moderate potential for contaminant migration and were recommended for further investigation in Phase II. Six of the Tinker sites--three landfills, an industrial waste pit, a radioactive waste disposal site, and a fire training area--fell into this category.

The five remaining sites had HARM scores lower than 50, which indicated low potential for contaminant migration. They were therefore not recommended for Phase II investigation. These included one landfill, three radioactive waste disposal sites, and a fire training area. Although these sites were not recommended for further investigation, three were investigated in Phase II. The Corps of Engineers included the three sites in its Phase II work because it felt that not enough work had been done in Phase I. For detailed descriptions, HARM scores, and recommendations for each site, see appendix III.

Surface and groundwater testing

Water quality data from the U.S. Geological Survey, the Bioenvironmental Engineering Officer's monitoring program, and sediment samples taken by the Oklahoma Water Resources Board helped Engineering-Science determine that the surface drainage systems on base had been sources of contaminant migration since

base operations began in 1942. The potential exists for the contaminants in the streams to migrate through the sediment, leaching into the local surface waters and into the groundwater system. For this reason, Engineering-Science recommended sampling the streams and some of Tinker's water supply wells.

Regulatory agency involvement

As part of the Phase I study, Engineering-Science interviewed federal, state, and local agencies' officials to obtain environmental data pertinent to the base. These agencies included the Oklahoma Geological Survey, the U.S. Geological Survey, the Oklahoma Water Resources Board, EPA, and Oklahoma University's Health Sciences Center.

PHASE II

The purpose of Phase II is to determine if environmental contamination has resulted from hazardous waste disposal practices. This phase includes an estimate of the extent of contamination, identification of the environmental consequences of migrating pollutants, and recommendations for additional investigations for sites identified in Phase I.

OEHL, the program manager for Phase II, drafted a statement of work for Phase II efforts. OEHL's Director of Technical Services Division and the Air Force Logistics Command Headquarters approved the statement of work.

OEHL contracted with Radian Corporation to do a portion of the Phase II investigation. The contractor made the initial Phase II site visit on September 29, 1983, with subsequent field work performed between November 1983 and October 1984. Radian issued its final report in October 1985. Its efforts under Phase II cost \$657,300. OEHL's technical contract monitoring activities included comparing detailed monthly status reports with the statement of work, verifying Radian's analysis methods, and visiting the contractor at Tinker at least once.

Study findings

Radian's Phase II investigation included 12 sites: 10 of the 14 sites identified in Phase I, building 3001 (including water supply wells 18 and 19), and four base streams grouped as one site. The 10 sites included 6 landfills, 2 industrial waste pits, and 2 of the 4 radioactive waste disposal sites identified in Phase II. All of these sites (except for the radioactive waste disposal sites and landfill number 1) had received high or moderate HARM scores. The four sites identified in Phase I but not included by Radian in Phase II were fire training area 1 and

radioactive disposal site 1030W, which had moderate HARM scores, and fire training area 2 and radioactive disposal site 62598, which had low HARM scores.

An Air Force monitoring program found the Garber Wellington Aquifer to be contaminated when it discovered trichloroethylene (TCE) in water supply wells 18 and 19 located in building 3001. Radian's investigation of well 18 revealed TCE as high as 4,600 parts per billion (compared to EPA's proposed standard of 5 parts per billion). The TCE contamination level in well 19 was 8.7 parts per billion.

These findings followed a study by the Oklahoma State Department of Health that revealed a TCE contamination level of 5.6 parts per billion in Tinker's drinking water. The samples used in the state study were taken from the base's central water supply where the water from all wells was mixed, thus diluting the contamination from well 18. Because it was possible for some people to drink the water from well 18 before it was mixed with water from the other wells, Tinker decided to stop using well 18 as a source of drinking water.

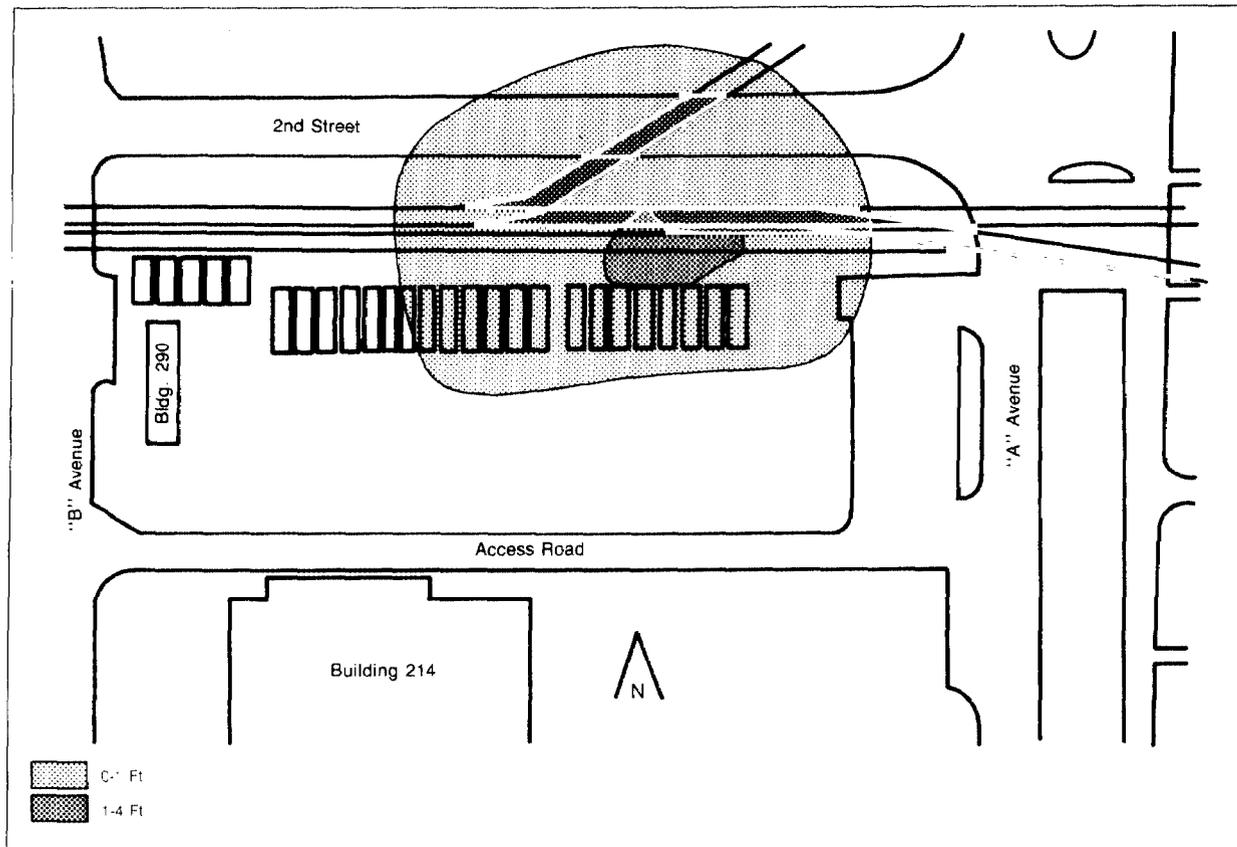
Radian recommended further investigations at landfill 5 and the buried pits and tanks below building 3001, which may be the source of the TCE contamination in wells 18 and 19. Radian also recommended monitoring programs for landfills 1 through 4. To ensure that TCE was not contaminating other base water supply wells, Radian also recommended that all drinking water wells be monitored.

Remedial actions were recommended for landfill 6 and water wells 18 and 19. However, Radian believed that no further investigations were necessary for the industrial waste pits, base streams, and the radioactive waste disposal sites.

Corps of Engineers

The number of sites with possible contamination has grown from 14 identified in Phase I to 17, including the base streams (grouped as 1 site) as identified by the Corps of Engineers. The base streams and building 3001 were added to the investigations in Phase II. The Corps has now added a new site, the fuel farm area, which is an underground fuel storage area. Due to leaking fuel tanks, the aquifer beneath the site is contaminated with fuel and other petroleum products. The groundwater contamination under the fuel farm area, shown in figure II.1, is estimated to be up to 4 feet deep, contain 40,000 to 50,000 gallons of fuel, and cover 150,000 square feet.

Figure II.1: Groundwater Contamination Under the Fuel Farm Area



Remedial actions to pump out the fuel have been designed and will be performed soon.

In addition, the Corps has completed a base-wide groundwater assessment, including off-base wells, which indicated that no contamination is now moving off base. The Air Force continues to test the base's water supply wells for contamination on a quarterly basis.

The Corps is investigating the six landfills, building 3001, and the fuel farm area. Investigations have been scheduled for the base streams, two fire training areas, and radioactive disposal sites 1030W and 201S. Due to Radian's findings, the Corps does not plan to investigate the two industrial waste pits and radioactive waste disposal sites 1022E and 62598.

Regulatory agency involvement

State and federal regulatory agencies reviewed the Air Force's statement of work, and Air Force officials told us that their comments had been incorporated as necessary before the Phase II investigation began in 1983. The regulatory agencies continued their involvement during Phase II activities through participation in the Technical Review Committee and Technical Working Group meetings at Tinker.

EPA has identified two Tinker sites to be included on its National Priorities List--building 3001 and the Soldier Creek portion of the base streams.

PHASE III

The Air Force Engineering and Services Center is cooperating with EPA in a research effort to develop a biological treatment for TCE. The Center is currently contracting out the on-site demonstration project at Tinker to demonstrate this technology using the TCE-contaminated groundwater under building 3001.

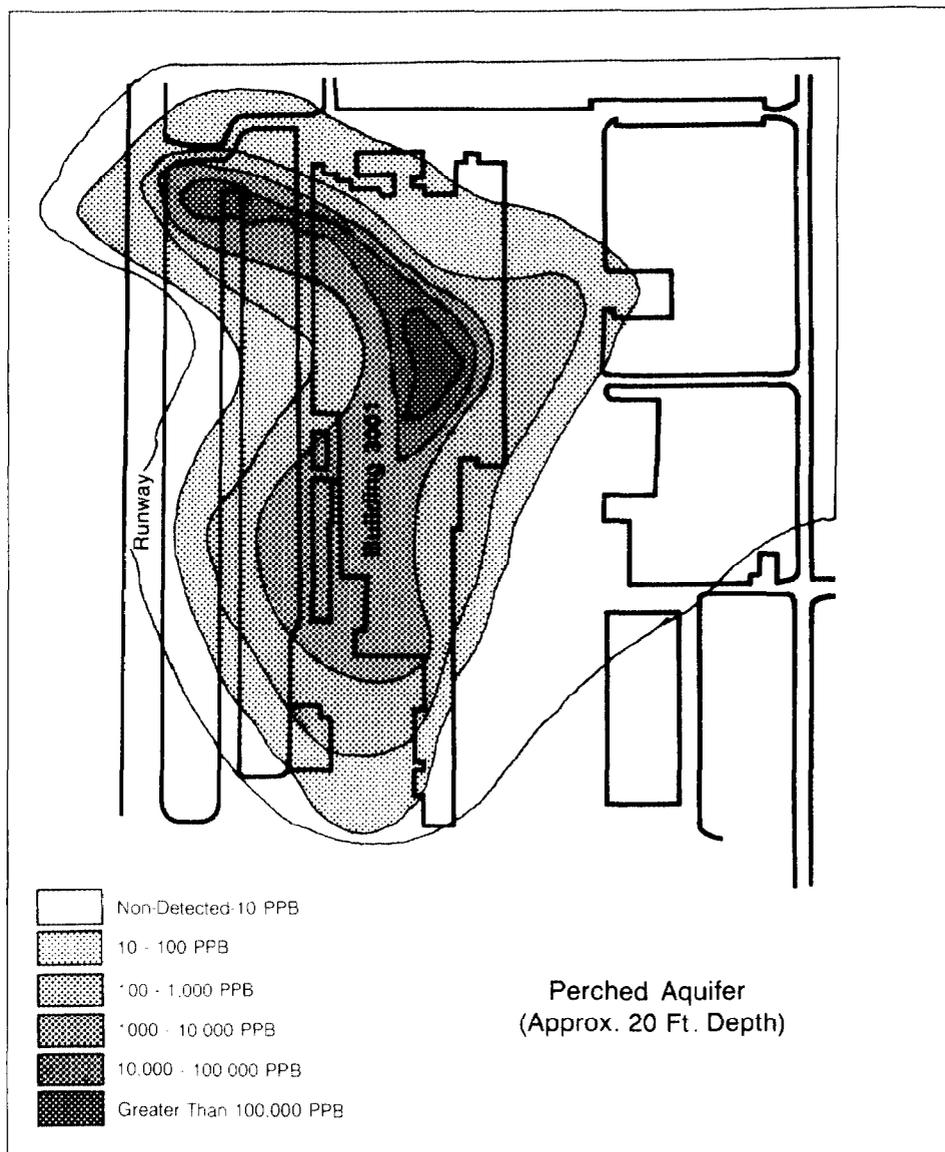
PHASE IV

Tinker has undertaken cleanup actions at several sites on base including the Soldier Creek Lagoon, the drainage ditch west of building 3001, landfill 6, and former water supply wells 18 and 19 in building 3001.

The perched aquifer, a portion of the Garber Wellington Aquifer under building 3001, has been contaminated with TCE and other synthetic organic chemicals. This contamination is the result of an accumulation of wastes from 30 years of industrial operations. The contamination is primarily confined to the upper levels, which are not used for drinking water. However, water supply wells 18 and 19 in building 3001 served as conduits, allowing the TCE to enter the lower levels of the aquifer from which Tinker's drinking water is obtained.

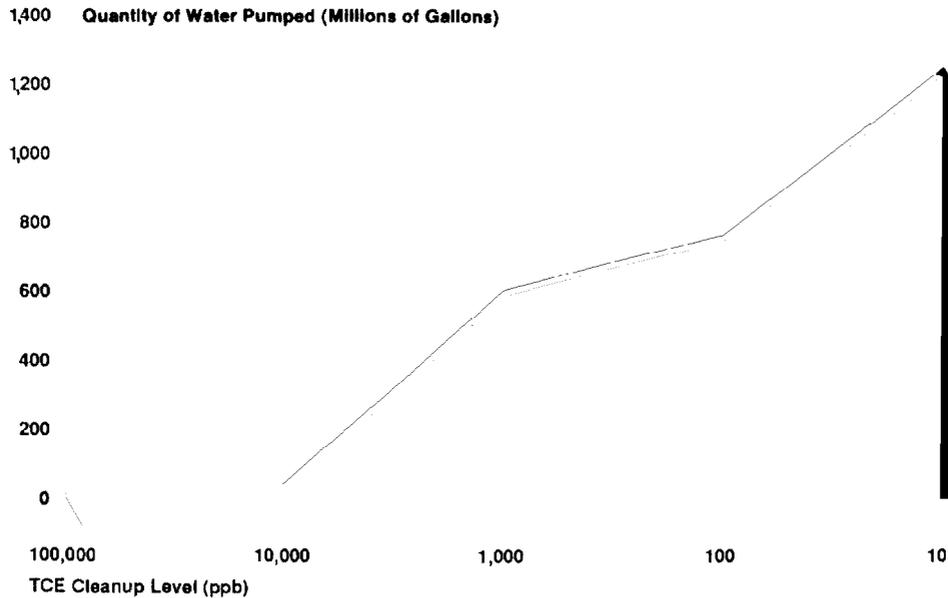
Water supply wells 18 and 19 were taken out of service in the latter part of 1983 and permanently plugged in September 1986 to prevent further contamination to the aquifer. Sample results, as depicted in figure II.2, indicate severe contamination in the upper levels of the aquifer, as high as 330,000 parts of TCE per billion. As stated earlier, EPA's proposed standard for drinking water is 5 parts per billion. The Corps of Engineers is currently designing the plans and specifications to remove the contaminated groundwater.

Figure II.2: Trichloroethylene Contamination Under Building 3001



The cost of removing TCE from the groundwater increases dramatically as target cleanup levels of TCE decrease. Figure II.3 shows the number of gallons required to be pumped out, treated, and returned to the aquifer to reduce TCE contamination to various levels. The Garber Wellington aquifer covers over 2,200 square miles and contains 22.8 trillion gallons of water. The desired level of TCE contamination has yet to be determined by the Technical Review Committee.

Figure II.3: Quantity of Trichloroethylene-Contaminated Water to Be Pumped at Various Cleanup Levels



In 1983, the Oklahoma State Department of Health found that a private well was contaminated with synthetic organic chemicals and, because of landfill 6's location, it was considered a possible source of contamination. To help prevent possible contaminant migration, the landfill was capped with 18 inches of clay and 10 inches of topsoil. Also, four additional monitoring wells were installed to detect contaminant migration away from the landfill. As part of the base-wide groundwater assessment, the Army Corps of Engineers took samples in July 1986, which showed no organic contaminants in the private well where they had been detected previously.

DISPOSAL OF WASTE FROM
A REMEDIAL ACTION PROJECT

Between November 1985 and May 1986, in response to Oklahoma Water Resources Board concerns, Tinker dredged 9,254.5 cubic yards of contaminated sediment from Soldier Creek and the drainage ditch west of building 3001. The portion of Soldier Creek dredged included Soldier Creek Lagoon. Soldier Creek Lagoon is a sediment pond created by a low-water dam above the discharge points from the waste water treatment plants. Water from Soldier Creek Lagoon is diverted through an oil and grease trap known as Prices Pond.

EPA requires disposal sites receiving hazardous waste from sites being cleaned up in accordance with CERCLA to meet stricter standards than sites complying with the Resource Conservation and Recovery Act. Tinker's records indicate that 2,579 cubic yards of contaminated sediment dredged from Soldier Creek was disposed of at Rollins Environmental Services' landfill near Houston, Texas. Rollins Environmental Services' landfill did not meet these stricter standards because of groundwater contamination problems. In July 1986, subsequent to Tinker's disposal of the sediment at Rollins, DOD verbally agreed with EPA that hazardous waste removed during IRP cleanup projects would be disposed of at CERCLA-approved sites.

FUTURE PROJECTS PLANNED

The Corps of Engineers plans to perform a complete investigation of the streams on base, and according to Oklahoma Water Resources Board officials, it is very important that the source of contamination in these streams be cleaned up before any further cleanup actions are taken. If the contamination going to the streams is not stopped, the streams might have to be cleaned more than once. For example, the cost of dredging the visible contamination from a relatively small area in Soldier Creek was \$2.3 million, but core samples taken after the dredging continue to show high levels of heavy metals. The heavy metal found in these core samples, taken to a depth of 24-inches, did not diminish with depth.

The high cost of this type of cleanup has resulted in consideration of alternatives to dredging, such as using microbes to treat the contamination. Water samples taken from base streams by EPA and the Oklahoma Water Resources Board continue to indicate that streams are receiving contamination. Tinker's personnel have corrected hundreds of misconnected drains that feed these streams and expect to continue finding problems of this nature.

STATUS OF INSTALLATION RESTORATIONPROGRAM SITES AT TINKER AIR FORCE BASE

<u>Site/Area</u>	<u>HARM Score</u>	<u>Phase I</u>	<u>Phase II</u>	<u>Current status</u>
Landfill 1	45	Low potential for contaminant migration. Landfill used for disposal of general refuse burned to reduce volume. Only small amounts of chemicals and industrial wastes were disposed of here. No further monitoring recommended.	Waste trenches have settled, collecting rainwater. Monitoring wells were installed and sampled. Samples indicate a limited impact on groundwater quality. Recommend quarterly sampling for 1 year to verify and quantify seasonal variation.	Soil and vegetation now cover the landfill. The Corps of Engineers (COE) has sampled selected trenches and monitoring wells. A draft remedial action plan is scheduled to be published by January 1988.
Landfill 2	65	High potential for contaminant migration as a pond is located nearby. General refuse and small amounts of industrial waste were disposed of here. A small pond was built over the landfill. Recommend a geophysical survey and groundwater monitoring. Sample and analyze leachate streams and drain the pond to reduce possible contaminant migration.	Trenches have settled, collecting rainwater. Water overflows into a nearby pond and eventually enters Crutch Creek. Samples taken from monitoring wells indicate only limited impact on groundwater quality. Samples taken from the pond did not show any elevated levels of contamination. Recommend quarterly sampling for 1 year to verify and quantify seasonal variations.	Soil and vegetation cover the landfill, and the pond has been breached to remove the water. COE has sampled selected trenches and monitoring wells. A draft remedial action plan is scheduled to be published by January 1988.
Landfill 3	68	Moderate potential for contaminant migration. General refuse and small quantities of industrial wastes were disposed of here. Recommend geophysical survey to define boundaries and geology under the landfill. Recommend additional groundwater monitoring and analysis of any leachate plumes.	Monitoring wells installed and sampled. Samples indicate a limited impact on groundwater quality. Recommend quarterly sampling for 1 year to verify and quantify seasonal variation.	Topsoil now covers the landfill. COE has sampled selected trenches and monitoring wells. A draft remedial action plan is scheduled to be published by January 1988.
Landfill 4	73	High potential for contaminant migration. Leachate observed containing mercury, phenols, oil, and grease. Recommend geophysical survey and groundwater monitoring. Also, sample and analyze leachate streams.	Surface runoff flows into Crutch Creek. Leachate and monitoring well samples indicate a limited impact on groundwater quality. Recommend quarterly sampling for 1 year to verify and quantify seasonal variation.	Soil and partial vegetation cover the landfill. COE has sampled selected trenches and monitoring wells. A draft remedial action plan is scheduled to be published by January 1988.
Landfill 5	51	Moderate potential for contaminant migration. Small seepage streams were observed. Recommend geophysical survey to define boundaries and geology under the landfill. Also recommend groundwater monitoring and sampling of leachate streams.	Surface depressions are holding rainwater. A monitoring well was installed and sampled. Data collected does not provide evidence of groundwater contamination. Surface of landfill has been disrupted by current construction activities. Recommend continuing review when construction is completed.	Soil and vegetation now cover the site. COE has sampled selected trenches for waste characterization and selected other trenches will also be sampled. The COE has also installed and sampled 9 monitoring wells. Currently awaiting results. If nothing shows up on the test results, this investigation will be complete. A clay cap will be placed on the landfill by early 1988.
Landfill 6	56	Moderate potential for contaminant migration. General refuse and small quantity of industrial waste materials were disposed of here. Recommend geophysical survey to define boundaries and geology under the landfill. Also, recommend additional groundwater monitoring.	Monitoring well samples confirm presence of chlorinated organic compounds. As a result, it is a possible source of contamination of a private, off-base well. Additional monitoring wells were installed and sampled, indicating the landfill is releasing synthetic organic chemicals. Recommend additional monitoring wells be installed to test impact on the aquifer.	Landfill was capped with clay and topsoil. COE recently found six uncapped trenches and sampled them for waste characterization. The COE has also installed and sampled 19 monitoring wells. If nothing shows up on the test results, investigation will be complete. A contract to complete the clay cap will be awarded in September 1987.

Site/Area	HARM Score	Phase I	Phase II	Current status
Industrial waste pit 1	61	Moderate potential for contaminant migration. Recommend sampling and analysis program that includes obtaining soil borings in and around waste pit. Also, recommend a geophysical survey to define the site boundaries and identify any leachate plumes.	Performed geophysical survey, soil sampling, and monitoring well sampling. Results show little or no migration of waste contaminants away from the site. No additional work required.	A "No Action" plan has been submitted to the state, but no response to date. Oklahoma Water Resources Board officials say it is likely the contaminants disposed of in this pit seeped into Elm Creek; thus only trace contamination remains at the site.
Industrial waste pit 2	68	High potential for contaminant migration. Did not have an impermeable liner while in operation. Recommend a sampling and analysis program to obtain soil borings in and around the waste pit and a geophysical survey.	Performed geophysical survey, soil sampling, and monitoring well sampling. Results indicate the waste is not migrating from the site. Unless surface is disturbed or disrupted, significant contaminant migration is unlikely. No further work is considered necessary.	A "No Action" plan has been submitted to the state, but no response to date. Oklahoma Water Resources Board officials say it is likely that contaminants from this pit seeped into Elm Creek; thus only a trace of contamination remains at the site.
Fire training area 1	55	Moderate potential for contaminant migration. While in operation this pit was unlined. Recommend sampling and analysis program that includes obtaining soil borings in and around the area. Also conduct geophysical survey to define boundaries and identify any leachate plumes.	Not included in Phase II.	No investigation to date. COE plans to install 2 monitoring wells and take 3 to 4 soil borings by July 1987.
Fire training area 2	47	Low potential for contaminant migration. This site was used infrequently as a temporary training area. No further monitoring.	Not included in Phase II.	COE made six borings and found no contamination. Nothing further will be done.
Radioactive waste disposal site 1030W	59	Moderate potential for contaminant migration. Site is believed to be located in the pond over landfill 2. Low-level radioactive material disposed of here may have been removed in 1955. Recommend draining the pond and sampling and analyzing water and surface area for radiation levels.	Not included in Phase II.	No investigations have been performed to date. However, records were found that indicate the site had been cleaned up in the early 1950's.
Radioactive waste disposal site 1022E	49	Low potential for contaminant migration. Site was used to dispose of containers of low-level radioactive material. Recent studies show no harmful levels of radioactivity. No further monitoring.	Geophysical survey was performed to locate and identify the site. The area was marked with metal stakes. No further investigation.	No further investigations planned.
Radioactive waste disposal site 62598	37	Low potential for contaminant migration. Contains low-level radioactive material. It is believed the material may have been removed. No increased radioactivity near the site. No further monitoring.	Geophysical survey found no indication of the location of the site. It is very probable the material was removed. No follow-on investigations are recommended.	No further investigations planned.

<u>Site/Area</u>	<u>HARM Score</u>	<u>Phase I</u>	<u>Phase II</u>	<u>Current status</u>
Radioactive waste disposal site 221S	35	Low potential for contaminant migration. Site used for the burial of low-level radioactive material. Recent radiological monitoring has not identified any increased radioactivity near the site. No further monitoring.	Not included in Phase II.	No investigation to date. The State of Oklahoma has indicated that it will not approve any type of site remediation short of removal and disposal at an approved site. Records indicate the presence of a "still" buried at the site and surface radioactivity measurements confirm this. A contract through Brooks APB to remove and dispose of the still as well as test adjacent soil is scheduled to be initiated in October 1987.
Base streams	--	Recommend a comprehensive sediment sampling program on base streams to characterize sediments and define any pollutant migration. Also, recommend water quality sampling in the streams.	Collected and analyzed 27 samples from 24 sediment sampling stations. The analysis showed no evidence of elevated levels of industrial contaminants. No follow-on action deemed necessary.	A section of East Soldier Creek has been dredged, removing 8,481 cubic yards of sediment. COE plans to sample and test Crutcho, Khulman, and Elm Creeks by March 1988.
Building 3001	--	Not included in Phase I study.	Limited contaminant leakage moving downward in vicinity of wells 18 and 19. Seven monitoring wells were installed and sampled with two showing high levels of TCE. The contamination is not a single, defined source but is confined to the shallow levels of the aquifer, indicating other wells in the vicinity are clean. An inspection of active and inactive underground storage tanks and pits was made because they were considered possible sources of the contamination under the building. Recommended remedial action is to pump and treat the contamination. Also recommend entering, inspecting, and sampling selected pits and tanks for solvents.	Base water supply wells 18 and 19 were plugged in September 1986. COE has installed and sampled 31 monitoring wells in and around building 3001, but the extent of the contamination plume has not been defined. Two additional monitoring wells have recently been installed and sampled, and COE is awaiting the results. Abandoned pit locations have been located in the south part of the building, and 4 pits have been recommended for removal. COE should complete the action plan design by August 1987.
Fuel farm	--	Not included in Phase I study.	Not included in Phase II study.	The perched aquifer beneath the fuel farm area is contaminated with fuel from underground fuel tanks. The fuel plume is a maximum of 4 feet thick and contains 40,000 to 50,000 gallons of fuel. A plume of benzene, toluene, and xylene surrounds the fuel. Immediate measures are being taken to remove the contaminants. Two recovery wells have been installed to pump out the fuel and water separately. Procurement of a pump is in process. About 500 gallons of water and 150 gallons of fuel will be pumped daily. The remedial action report is due by July 1987.

OBJECTIVE, SCOPE, AND METHODOLOGY

The objective of this review was to evaluate the actions the Air Force has taken at Tinker AFB to identify abandoned hazardous waste sites and to clean them up where necessary.

We reviewed the reports of the Phase I and Phase II investigations at Tinker. These investigations began in 1981 and continue to date. To further evaluate Tinker's program, we interviewed officials at the Environmental Management Directorate, Tinker; Environmental Protection Agency; Oklahoma State Department of Health; Oklahoma Water Resources Board; Garber Wellington Aquifer Association, made up of users of the aquifer; Occupational and Environmental Health Laboratories; Air Force Engineering and Services Center; and the U.S. Army Corps of Engineers. We also toured the facilities at Tinker and observed several IRP sites. We attended and obtained minutes from the Technical Review Committee and Technical Working Group meetings.

Much of our work for this report was based on work we had previously done at Tinker Air Force Base and discussed in our report entitled Hazardous Waste Management at Tinker Air Force Base--Problems Noted, Improvements Needed, GAO/NSIAD-85-91, July 19, 1985.

Our work was performed in accordance with generally accepted government auditing standards.

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