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1996

EPA Superfund
Record of Decision:

DOVER AIR FORCE BASE
EPA ID: DE8570024010
OU 07
DOVER, DE
09/24/1996

RECORD OF DECISION
DECLARATION OF THE SELECTED REMEDY

Site Name and Location

Landfill D-10 Golfcourse (Site LF18), Area 9, South Management Unit, Dover Air Force Base, Kent Country, Delaware.

Statement of Basis and Purpose

This record of decision (ROD) presents the selected remedial action for Site LF18, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. The U.S. Air Force, the lead agency, as he owner/operator of the base, prepared this decision based on the Administrative Record for the site. The U.S. Environmental Protection Agency (EPA) Region III and the Delaware Department of Natural Resources and Environmental Control (DNREC) provided support.

The state of Delaware and the U.S. Environmental Protection Agency concur with the selected remedy. The Information Repository for the Administrative Record contains the information supporting this remedial action decision and is at the Dover Public Library, Dover, Delaware.

Assessment of the Site

Dover AFB identified free waste oil and residual soil contamination in an area immediately downgradient of the former LF18 landfill. They developed a ROD in 1992, along with WP14, to address the free phase waste. Based on additional data developed, this ROD supersedes the 1992 ROD for LF18. Dover AFB will address WP14 in a future decision document. Hazardous substances detected in the oil include fuel constituents, chlorinated solvents, and pesticides. The base identified the oil-impacted soil as a source are for hazardous constituents being leached to groundwater. This area of oil-impacted soil, downgradient of the landfill, is the area addressed in this ROD.

There is a risk assessment for Site LF18, but not specifically for the portion of LF18 addressed in this ROD. However, the total lifetime excess cancer risks (LECRs) associated with exposure to LF18 groundwater as a whole under hypothetical commercial/industrial and residential use scenarios are 7 x 10-6 and 4 x 10-5, respectively. The total LECRs associated with exposure to soil under future hypothetical commercial/industrial and residential use scenarios are 1 x 10-5 and 2 x 10-4, respectively. Since these values are within or above the 1 x 10-4 to 1 x 10-6 range, it is appropriate to consider risk reducing action at the site.

Actual or threatened releases of hazardous substances from this site, of not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

Description of Selected Remedy

The selected remedy consists of the excavation of soil contaminated with waste fuel constituents, chlorinated solvents, and pesticides; and the off site treatment of the excavated soil by recycling as an asphalt aggregate. Final evaluation of the performance of this interim remedy, remediation of contaminated groundwater beneath the site, and compliance with applicable or relevant and appropriate requirements will occur in the final basewide ROD.

Statutory Determinations

The selected remedial action satisfies the remedial selection process requirements of CERCLA and the NCP. As required under CERCLA, the selected remedy provides the best balance of trade-offs among the nine evaluation criteria. The selected action provides protection of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the action, and is cost effective.

This remedy utilizes permanent solutions and alternative treatment technology to the maximum extent
practicable, and satisfies the statutory preference for remedies that employ treatment which reduce toxicity, mobility, or volume as a principal element.

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JOHN B. SAMS, JR. Date
Lieutenant General, USAF
Air Mobility Command
Chairperson, Environmental Protection Agency
Protection Committee

THOMAS C. VOLTAGGIO Date
Hazardous Waste Management
Division Director

Region III

RECORD OF DECISION
SITE LF18
SOUTH MANAGEMENT UNIT
DOVER AIR FORCE BASE, DOVER, DELAWARE

August 1996

DECISION SUMMARY FOR THE RECORD OF DECISION
SITE LF18, SOUTH MANAGEMENT UNIT
DOVER AIR FORCE BASE

INTRODUCTION

Dover Air Force Base (DAFB) recently completed an Engineering Evaluation and Cost Analysis (EECA) that addressed an area of contaminated soil in the immediate vicinity of the Landfill D-10 Golfcourse (LF18) that is located along its southern boundary at DAFB, Delaware. LF18 is a former landfill in the South Management Unit, and is located at the Base golf course.

The EECA was undertaken as part of the U.S. Air Force's (USAF) Installation Restoration Program (IRP). The basis for the EECA was the draft South Management Unit Remedial Investigation (RI) report dated July 1995, which characterized contamination and evaluated potential risks to public health and the environment. This was supplemented by a subsequent soil investigation conducted by the U.S. Army Corps of Engineers (USACE), Kansas City District in August 1995, and
by EECA fields activities in October and November 1995.

Findings from the RI indicated that free phase was present in monitoring well situated in the southern portion LF18 downgradient of the former landfill. The free phase was analyzed and found to contain volatile fuel constituents, chlorinated solvents, semivolatile organic compounds, pesticides, and possibly polychlorinated biphenyls (PCBs). Distinct groundwater plumes of the volatile fuel constituents-benzene, toluene, ethylbenzene, and xylene (BTEX)--originate from this source area. Other detected groundwater constituents that appear to be contributed by this source are methylene chloride and several pesticides including 4,4'-DDE, alpha-BHC, beta-BHC, gamma-BHC, and delta-BHC. The USACE, Kansas City District and the EECA investigations focused on delineating the extent of the source area; remediation of the source area was the subject of the EECA. Remediation of other source areas in the vicinity of LF18 and groundwater contamination will be addressed in the South Management Unit Feasibility Study.

This Record of Decision (ROD) addresses the petroleum-based source of potentially hazardous constituents present in LF18 soil that was evaluated in the EECA. This ROD summarizes the EECA, describes the remedial alternatives that were evaluated, identifies the remedial alternative selected by DAFB, and explains the reasons for this selection. The U.S. Environmental Protection Agency (EPA) and the State of Delaware concur with the remedy selected in this ROD.

As an aid to the reader, a glossary of the technical terms used in this Proposed Plan is provided at the end of the summary.

PUBLIC PARTICIPATION

The Proposed Plan for this site was issued on June 20, 1996. The public comment period on the Plan was open through July 22, 1996. Documents comprising the information repository for the Administrative Record for the site are available at the Dover Public Library. No public comments were received.

SITE BACKGROUND

DAFB is located in Kent County, Delaware, 3.5 miles southeast of the city of Dover (Figure 1) and is bounded to the southwest by the St. Jones River. DAFB comprises approximately 4,000 acres of land, including annexes, easements, and leased property (Figure 2). The surrounding area is primarily cropland and wetlands.

DAFB began operation in December 1941. Since then, various military services have operated out of DAFB. The present host organization is the 436th Airlift Wing. Its mission is to provide global airlift capability, including transport of cargo, troops, equipment, and relief supplies.

DAFB is the U.S. East Coast home terminal for the C-5 Galaxy aircraft. The Base also serves as the joint services port mortuary, designed to accept casualties in the event of war. The C-5 Galaxy, a cargo transport plane, is the largest aircraft in the USAF, and DAFB is one of a few military bases at which hangers and runways are designed to accommodate these planes.

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The portion of DAFB addressed in this ROD--IRP site LF18--is located within Area 9 of the South Management Unit. The South Management Unit is one of four Management Units into which the Base has been divided (Figure 3). Area 9--one of three associated areas identified in the South Management Unit--extends from approximately US Route 113 to the Golf Course Tributary and the Base boundary (Figure 4). LF18 is the site of a former landfill that underlies the DAFB golf course and is next to the Base boundary along the southern edge of Area 9.

DAFB is relatively flat, with elevations ranging from approximately 10 to 30 feet above mean sea level (msl). The ground surface at the golf course is covered almost entirely by carefully maintained grass turf. Surface water runoff at the Golf Course is directed to a small creek on the south side of the site which discharges to the golf course tributary and subsequently to the St. Jones River.

The Columbia Formation is the shallowest water-bearing unit and holds the water table aquifer. Deeper aquifers are protected by the extensive upper clay of the Calvert Formation. The upper portion of the Columbia Formation is finer grained and contains more silt and clay lenses that the deeper portions. The deeper portion of the Columbia Formation typically consists of fine to coarse grained sand with occasional lenses of fine to medium sand discontinuous gravel lenses interpreted as channel lag deposits. The thickness of the Columbia Formation at LF18 is
approximately 50 to 60 feet. The water table is generally encountered at a depth of 8 to 10 feet below ground surface (gbs) at LF18 and shallows to within a few feet of the surface near the golf course tributary. The groundwater elevations of both the shallow and deep portions of the Columbia Aquifer range from approximately 5 feet msl at LF18 to less than 3 feet msl near the Golf Course tributary.

LF18 consists of a former landfill and the area immediately downgradient (south) of the landfill. The landfill was used in the mid-1950s for the disposal of general refuse, drums of waste solvents, and other shop wastes. The disposal area (40 by 600 feet) consisted of four trenches that were reportedly filled with refuse to depths of 10 to 15 feet bgs. Information on the exact locations of these trenches is not available. Based on interviews with personnel familiar with site operations, the trenches were dug below the level of groundwater and backfilled with waste material. When disposal activities ceased in 1959, the landfill was covered with several feet of local soil and seeded with grass. The site was subsequently converted to a portion of the DAFB golf course in 1960.

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The area immediately downgradient of the landfill was also used for the disposal of waste materials. The type of waste disposed of in this location was a substance having the appearance of waste oil. Previous investigations in this area have identified the presence of soil contamination and noted the presence of a free oil phase. This contaminated source area located immediately downgradient of the landfill is the subject of this ROD (Figure 5).

The area downgradient of the landfill was studied during the Basewide RI because of the known presence of free phase in MW07j. A sample of the free oil phase was collected and analyzed for Target Compound List volatile organic, semivolatile organic, and pesticide/PCB compounds, and Target Analyte List metals. The results of this analysis are presented in Table

1. Detected constituents included BTEX, chlorinated solvents, and several pesticides. Groundwater samples were collected from wells and groundwater probe locations in and downgradient of the area of the free oil phase. The total concentrations of BTEX are plotted and contoured in Figure 6. This figure illustrates that elevated BTEX in groundwater approaches the Base boundary.

In August 1995 the USACE, Kansas City District, conducted and investigation at the southern end of LF18 to help delineate the extent of free phase near MW07j. This investigation involved the use of the Site Characterization and Analysis Penetrometer System (SCAPS) coupled with a laser-induced fluorescence (LIF) device. Figure 7 presents the SCAPS-LIF data, and indicates the thickness of contaminated soils that registered a fluorescence intensity of greater than 10,000
counts. The presence of high fluorescence counts at and above the approximate depth of the water table most likely indicates residual hydrocarbon saturation in the interval of groundwater fluctuation.

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TABLE 1

Constituents in Free Phase Sample from MW07j

		L(a)	V(b)	
VOCs (:g/kg)				
Benzene		1,400,000		J
Ethylbenzene		1,800,000		J
Methylene Chloride		50,000	BJ	J
Toluene		3,100,000		J
Xylene (total)		6,200,000	E	J
SVOCs (:g/kg)				
2-Methylnaphthalene		150,000		
Acenaphthene		16,000	J	
Acenaphthylene		20,000	J	
Di-n-butyl phthalate		19,000	J	
Dibenzofuran		24,000	J	
Fluoranthene		16,000	J	
Fluorene	49,000	J		
Naphthalene	530,000			
Phenanthrene		70,000	J	
Pyrene		18,000	J	
Pesticides/PCBs (:g/kg)				
4,4'-DDD	6,700	PCD	J	
4,4'-DDE	40	JP	J	
Alpha-BHC	62	P	J	
Beta-BHC	1,400	D		
Chlordane-alpha		97	P	J
Delta-BHC	13,000	CD		
Dieldrin	45	JP	J	
Endrin aldehyde		97	JP	J
Endrin ketone		7.1	JP	J
Gamma-BHC	28	J		
PCB 1260	15,000	YD		

TABLE 1 (cont'd)

		L(a)	V(b)	
Metals (:g/L)				
Aluminum	31.6	B		
Arsenic		1.7	B	
Barium		36.8	B	
Calcium		64.8	B	
Copper		2.6	B	
Iron	26.4			
Lead	65.9			
Magnesium	24.8	B		
Sodium		112		B
Vanadium	1.1	B		
Zinc	2.7	B		

(a) Laboratory Flags:

ORGANICS

B- Analyte found in associated blank as well as in the sample.

C- Identification confirmed by gas chromatography/mass spectrometry (GC/MS).

D- Compound identified in the analysis at a secondary dilution factor.

J- Value is estimated.

P- Greater than 25% difference in analyte concentration between primary and confirmation analysis. Lower concentration assorted.

Y- Analyte was not identified during confirmatory GC/MS analysis.

INORGANICS

B- Reported value is greater than the instrument detection limit but less than the contract-required detection limit.

(b) Validation Flags:

J- Analyte was positively identified; the associated numerical value is the approximate concentration.

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The SCAPS study suggests that petroleum-contaminated soil is present in an area directly downgradient of the landfill, and that potential exists for free phase to be present over a greater area than just the localized vicinity of MW07j. Hence, an EECA investigation was designed to evaluate the presence of contamination in subsurface soil including petroleum; to determine the presence or absence of free phase at the southern end of LF18; and to determine if the area of potential free phase coincides with the former waste trenches. The solubility of the hazardous constituents present are much higher in petroleum than they are in water, and hence
petroleum can be used as an indicator of the potential presence of these constituents.

Soil samples collected within the delineated SCAPS area during the EECA study contained elevated total petroleum hydrocarbons (TPH)-diesel range organics (DRO). Hand auger samples indicated that the edge of the LF18 trenches are northeast of the petroleum-contaminated soil and do not coincide with this area of interest.

Six monitoring wells were installed as part of the EECA investigation in areas where the SCAPS data suggested the existence of residual saturation. Although the newly installed wells at LF18 indicate that the areal extent of free phase is more limited than that interpreted from the SCAPS data, the data sets support each other with respect to delineation of contaminated soil. Based on the absence of free phase in the EECA wells, which is more definitive that the screening-level SCAPS data, the high SCAPS-LIF levels (>10,000 counts) most likely represent residual soil contamination. Residual soil contamination results from free phase coming into contact with and adsorbing onto soil particles. Residual contamination is not referred to as free phase because it does not flow under gravitational influences.

Figure 8 illustrates the minimum and maximum areas of contaminated soil based on the SCAPS and EECA data. The in-place volume of contaminated soil is estimated to be 1,170 cubic yards at a minimum. This estimate assumes that the average thickness of contaminated soil within a 6,300-square-foot area is 5 feet. The depth at which contaminated soil is first encountered varies from 5 to 8 feet, and the contamination extends to the depth of the seasonal low water table elevation. The estimated maximum volume is approximately 2,340 cubic yards.

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SUMMARY OF SITE RISKS

The purpose of the Risk Assessment (RA) is to determine whether exposure to site-related contaminants could adversely affect human health and the environment. The focus of the baseline RA is on the possible human health and environmental effects that could occur under current or potential future use conditions in the event that the contamination is not remediated. The risk is expressed as lifetime excess cancer risk (LECR) for carcinogens, and hazard index (HI) for noncarcinogens. For example, an LECR of 1 x 10-6 represents one additional case of cancer in one million exposed population, whereas a hazard index above one presents a likelihood of noncarcinogenic health effects in exposed populations.

The EECA investigation focused on the collection of data to determine the extent of free phase present in the vicinity of MW07j and to delineate the extent of contaminant-impacted soil. The type of chemical data collected during the EECA investigation, TPH (DRO), is not useful from a risk assessment standpoint because a TPH (DRO) result represents the concentration of an amalgam of compounds for which the toxicity is unknown. Nevertheless, some qualitative observations regarding the portion of LF18 assessed during the EECA investigation can be made. The contaminated soil contributes volatile organic and pesticide constituents to groundwater, including BTEX constituents. The BTEX concentrations in shallow groundwater are illustrated in Figure 6. The detected concentrations of all four BTEX constituents in groundwater exceeded their respective MCLs in at least one of the samples collected during the RI in the vicinity of the soil source area. The soil source area is located in close proximity to the Base boundary and a groundwater discharge point to the golf course tributary. Hence, the potential exists for the future off-Base migration of constituents with groundwater.

The baseline RA, performed as as part of the Basewide RI, considered hypothetical future groundwater use from the Columbia Aquifer under commercial/industrial and residential scenarios. Similar scenarios were used for current and future soil exposure.

The total lifetime excess cancer risks (LECRs) for the hypothetical commercial/industrial and residential exposures to groundwater are 7E-06 and 4E-05, respectively. The cancer risk from future industrial exposure to groundwater is primarily attributable to the pesticide beta-BHC and trichloroethene. The groundwater at DAFB is not currently used and the risk numbers represent a hypothetical future groundwater use scenario. The total LECRs for current and future industrial exposure to soil are 8E-07 and 1E-05, respectively. The risk from future industrial exposure to
soil is primarily attributable to benzo(a)pyrene. The total LECR for a future residential exposure to soil is 2E-04. Benzo(a)pyrene, benzo(b)fluoranthene, and benzo(a)anthracene are the primary contributors to soil cancer risk.

REMEDIAL ACTION OBJECTIVE

The remedial action objective (RAO) is the reduction of contaminant concentrations in soils to the Delaware's Department of Natural Resources and Environmental Control (DNREC) regulatory levels of 1,000 mg/kg TPH and 10 mg/kg total BTEX. DNREC's regulatory levels are considered applicable or relevant and appropriate requirements (ARARs) for this site. These levels are not strictly "applicable" because they originate from DNREC's Underground Storage Tank (UST) guidance and there is no UST at LF18. However, they are still "relevant and appropriate" as the site is a petroleum source. Remediation of the contaminated soils to these levels will correspondingly significantly reduce residual concentrations of chlorinated solvents and pesticides/PCBs associated with the petroleum.

Concentrations of TPH (DRO) detected in this area ranged up to 9,600 mg/kg. Reduction of TPH and BTEX concentrations to the 1,100 mg/kg and 10 mg/kg levels, respectively, will substantially reduce the leaching of constituents to groundwater. Elimination of this source area is important because BTEX and other constituents are being transported by groundwater in the general direction of the Base boundary and toward groundwater discharge points to surface water. Remediation of the source area will significantly reduce further leaching to groundwater.

The remedial action is scheduled to be implemented during the winter months of 1996-1997. LF18 is located within a frequently used recreation area that will be affected by remedial construction activities. Performance of the remedial action during the winter months when the golf course is less frequently used will minimize disruptions to Base personnel.

The remediation should be completed within a period of 5 years or less. Until remediation is completed, hazardous constituents will be available in the soil to leach into groundwater. Five years is considered a reasonable upper boundary to allow remedial activities to be completed. Completion of remedial activities in less than this 5-year maximum is considered desirable.

SUMMARY OF ALTERNATIVES

Two of the most common engineering technologies applicable to remediating contaminated soil were evaluated in the EECA--excavation and removal, and bioventing. These two technologies, along with no action, formed the basis for the alternatives developed in the EECA as identified below:

Alternative 1--No Action.
Alternative 2--Excavation of TPH-Contaminated Soil and Offsite Treatment.
Alternative 3--Bioventing.

These three remedial alternatives are described below. In addition, the capital, annual operation and maintenance (O&M), and present worth costs of each alternative are provided.

Alternative 1

	LF18
Capital Cost	$000
Annual O&M Cost	$000
Present Worth	$000

The no action alternative is evaluated in order to establish a baseline for comparison against other alternative. Under this alternative, no efforts are undertaken to reduce the soil concentrations of TPH or BTEX at LF18.

Alternative 2

	LF18
Capital Cost	$203,000*
Annual O&M Cost	$000
Present Worth	$203,000*

*Assumes minimum area of excavation and non-hazardous soil disposal.

Alternative 2 consists of the physical removal of the TPH and BTEX-contaminated soils delineated during the EECA investigation through excavation, offsite treatment, and reuse. The area to be excavated encompasses an estimated minimum of 6,300 square feet; but may encompass an estimated maximum of 12,600 square feet. The excavation depth will extend to the seasonal low depth of the water table, which is approximately 19 feet bgs. The EECA and SCAPS investigation data indicates that contaminated soils are first encountered at an approximate depth of 5 feet bgs. The overlying layer of uncontaminated soil equals approximately 1,170 in-place cubic yards, and the zone of contaminated soil approximately equals another 1,170 in-place cubic yards.

The excavation will be performed in a manner that allows uncontaminated soils to be segregated from contaminated soils. Uncontaminated soils will be stockpiled on the site and saved for use as backfill. Contaminated soils will be excavated and placed either in dump trucks or rolloff boxes that can be loaded onto flatbed trucks. Existing data indicates that the soils to be excavated are nonhazardous. This is based on the Toxicity Characteristic Leaching Procedure (TCLP) analysis that was conducted on a soil sample during the EECA field investigation. However, samples from the excavated contaminated soil will be analyzed using the TCLP to determine whether any unanticipated hazardous characteristics are exhibited. Confirmatory soil samples will be collected from the bottom and walls of the excavation to confirm the complete compliance with the RAO. These samples will be analyzed for TPH-gasoline range organics (GRO), TPH (DRO), and BTEX.

Because the excavation must extend down to the seasonal low depth of the water table, it is likely that the last 1 to 2 feet of excavation depth will be below the water table. This is because of the anticipated difficulty of predicting and scheduling the precise time to perform the remediation so that it coincides with the seasonal water table low. For estimating purposes, 2,000 gallons of groundwater are assumed to be dewatered from the minimum-sized excavation and 4,000 gallons from the maximum possible excavation. Removed groundwater will be tested for RCRA
characteristics and transported to an appropriate offsite treatment, storage, and disposal (TSD) facility for treatment in conformance with all state and Federal regulations.

The method of treatment and disposal for the contaminated soil is dependent upon the chemical characteristics of the contaminants. However as indicated above, the TCLP analysis conducted on a soil sample during the EECA investigation confirmed that the soil appears to be nonhazardous. If this nonhazardous status of the soil is confirmed during remediation as expected, the soil will be recycled as an aggregate/petroleum feed in a local asphalt processing plant. In the asphalt recycling process, volatile organics are desorbed and combusted while nonvolatile constituents are fixed into the asphalt mix. This is the anticipated method of treatment for the LF18 soils.

A minimal potential exists that hazardous constituents may be encountered in the excavated soils due to the heterogeneous nature of landfill disposal. This is considered a low probability because the removal site is not directly in the fill and testing has not detected them previously. However, in the unlikely event the excavated soil is found to exhibit hazardous characteristics, the soil will be sent to a RCRA-permitted TSD facility where it will likely be landfilled. If hazardous waste is sent out of Delaware for disposal, appropriate acknowledgement and approval will be obtained from the receiving state prior to the transfer.

The uncontaminated soil that is excavated and stockpiled to allow access to the contaminated soil will be replaced in the excavation and compacted. Fill material will be brought from an offsite borrow source to complete closure of the excavation. The area will then be regraded and landscaped to restore the golf course.

Implementation of this alternative will be between the months of November and February when the golf course is infrequently used. Re-sodding would occur in the following spring. The actual excavation work can be performed in a matter of weeks. The present worth costs estimated for Alternative 2 range between $203,000 and $363,000 depending on the volume of soil removed, assuming nonhazardous soil recycling. In the unanticipated event that the soil is found to exhibit hazardous characteristics, the present worth costs range between $437,000 and $831,000 depending on volume for disposal at a RCRA-permitted landfill.

Alternative 3

	LF18
Capital Cost	$128,000
Annual O&M Cost	$79,000(a)
Present Worth	$207,000(b)

(a)First year O&M cost. Refer to text.
(b)Assumes 5 years of operation.

Alternative 3 consists of the in situ treatment of soil using a bioventing technology. Bioventing is a process which delivers oxygen to contaminated vadose zone soils in order to stimulate the aerobic in situ biodegradation of contaminants. Bioventing equipment uses a relatively low air flow rate that is intended to minimize volatilization and transport of constituents, while providing sufficient quantities of oxygen to the aerobic bacteria present in the soil to stimulate contaminant biodegradation. The natural biodegradation of petroleum contaminants is frequently limited by the available of oxygen in the contaminated zone. Bioventing provides a mechanism for replenishing this rate-limiting chemical.

Bioventing has produced encouraging results when the degradation of light, aromatic hydrocarbon compounds such as BTEX is examined. Results are much less positive when examining the degradation of heavier, more complex compounds. Because much of the petroleum contamination found at the southern portion of LF18 is comprised of DRO compounds containing from 10 to 28 carbon atoms per molecule, there is some concern as to the effectiveness of bioventing when used for this application.

Based on the air permeability test conducted as part of the EECA investigation, the radius of influence of the bioventing wells will be approximately 30 feet, with estimates of air permeability ranging from 84 to 149 darcys. The horizontal wells will be placed with a spacing of approximately 50 feet. Based on this parameter, the system of wells will consist of one injection well surrounded by six extraction wells.

The time required to achieve the RAO will be dependent on the biodegradation rate achieved during bioventing operations, and is estimated to be between 1 and 50 years. The large range in the estimated time reflects uncertainty in the biodegradation rates. The present worth cost for this alternative, based on 5 years of operation, is $207,000.

EVALUATION OF ALTERNATIVES

The selected alternative for remediating the soil contamination at LF18 is Alternative 2-excavation and offsite treatment by recycling. Based on current information, this alternative provides the best balance of trade-offs among the alternatives with respect to the nine criteria that are required to be evaluated under CERCLA. This section profiles the performance of the selected alternative against the nine criteria and explains how it compares to the other alternatives under consideration.

Overall Protection of Human and the Environment

Overall protection is a composite of other evaluation criteria, especially short-term effectiveness, long-term effectiveness, and compliance with ARARs. Because Alternative 1 (no

action) provides no method of soil remediation, it is not protective of human health and the environment. Alternative 3 (bioventing) provides an uncertain degree of overall protection of human health and environment, since it is unclear as to how effective this remedial action will be on the constituents present at LF18. Leaching of constituents will continue to occur while bioremediation is ongoing, which is a concern if the time required by Alternative 3 to achieve the RAO is extensive. Alternative 2 (excavation) will completely remove the contaminated soil from the site within weeks of beginning the action and thus, will be protective of human health and the environment.

Compliance With ARARs

Alternative 1 (no action) provides no means of reducing petroleum constituents in soil. As a result these constituents will continue to be available to leach into groundwater. Soil concentrations of TPH and BTEX exceed DNREC's UST program action levels and BTEX concentrations in groundwater exceed MCLs.

The soil excavation of Alternative 2 will be conducted in accordance with the Delaware Erosion and Sedimentation Act (7 Delaware Code Annotated Chapter 40). Uncontaminated soil will be stockpiled while contaminated soil will be placed directly into trucks or roll off boxes. Offsite transport and recycling of the contaminated soil will be in compliance with the Delaware Regulations Governing Solid Waste. This remedial action will reduce TPH and BTEX concentrations in soil to below the respective 1,000 mg/kg and 10 mg/kg standards typically applied by DNREC to petroleum-contaminated soil. The asphalt recycling facility will operate in compliance with its State's environmental permitting requirements. Restoration of the site will be conducted in compliance with "Office of the Federal Environmental Executive; Guidance for Presidential Memorandum on Environmentally and Economically Beneficial Landscape Practices on Federal Landscaped Grounds," Federal Register Volume 60, Number 154.

The bioventing system of Alternative 3 is anticipated to operate within the Delaware Regulations Governing the Control of Air Pollution and requirements for land treatment under Delaware Regulations Governing Hazardous Waste (DRGHW) Part 264, Subpart M. It is uncertain, however, that bioventing is capable of reducing TPH (DRO) concentrations to below the 1,000 ppm standard.

Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion primarily considers the magnitude of residual risk that remains after the implementation of an alternative, and the adequacy and reliability of the instituted controls. Under Alternative 1 (no action), TPH contamination in the soil is left in place and hence, offers no long-term effectiveness or permanence. Alternative 2 (excavation) results in the complete removal of contaminated soils from the site. Excavation, removal, and offsite recycling is an extremely effective and permanent solution to the contamination. The long-term effectiveness of Alternative 3 (bioventing) on TPH (DRO)-contaminated soil is uncertain. In addition, because the entire contaminated zone is not always exposed due to seasonal fluctuations in the height of the water table, recontamination of soils through smearing may occur.

Reduction of Toxicity, Mobility, and Volume

Alternative 1 (no action) will not result in any reductions of contaminant toxicity, mobility, or volume. Alternative 2 (excavation) includes the offsite treatment of contaminated soil by recycling at an asphalt plant. In this process, the volatile constituents will be desorbed and combusted while the nonvolatile constituents will be immobilized as an aggregate mix in the asphalt. Alternative 3 (bioventing) will result in reductions in contaminated soil toxicity as the concentration of contaminants are reduced over time.

Short-Term Effectiveness

Alternative 1 has no short-term effectiveness considerations associated with it. Neither Alternative 2 nor Alternative 3 are expected to have adverse impacts on construction workers or the surrounding community. Alternative 2 will rapidly achieve the RAO, though the time required for Alternative 3 to achieve the RAO is uncertain.

Implementability

Three main factors are considered under implementability--technically feasibility, administrative feasibility, and availability of services and materials. Both of the action alternatives are administratively feasible, and required services and materials are readily available. Alternatives 2 and 3 are technically feasible. No technical feasibility considerations are associated with Alternative 1.

Cost

No direct costs are associated with the implementation of Alternative 1. Of the action alternatives, the estimated capital cost of Alternative 2 (assuming non-hazardous disposal) ranges between $203,000 and $363,000 depending on the volume of soil removed. The capital costs for installation and startup of bioventing (Alternative 3) is estimated to be $128,000. Annual O&M costs for Alternative 3 are estimated to be approximately $20,200. Because the time required to achieve the remedial action objective is unknown, present worth costs are provided for three
different operating periods. Using a discount rate of 9 percent, the present worth costs of Alternative 3 for scenarios of 1, 5, and 50 years of operation are $148,000, $207,000, and $369,000 respectively.

State Acceptance

The State of Delaware concurs with the selected remedy for Site LF18.

Community Acceptance

No comments were received during the public comment period and no community opposition to the proposed remedy was noted.

CONCLUSION

Based on the evaluation of the alternatives using the nine criteria, Alternative 2 - Excavation and Offsite Treatment of TPH-Contaminated Soil is selected. Alternative 2 is protective of human health and the environment, complies with all ARARs, represents a permanent remedy that reduces soil toxicity and contaminant mobility, and is cost effective. The selected alternative utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Actual or threatened releases of hazardous substances from this Site, if not addressed by the selected alternative, may present a current or potential threat to public health, welfare, or the environment.

ABBREVIATIONS AND GLOSSARY

Aquifer - A geologic formation capable of yielding water to wells and springs.

ARARs - Applicable or Relevant and Appropriate Requirements. Criteria set forth by Federal and state regulations that must be considered in the evaluation remedial alternatives.

bgs - Below ground surface

BTEX - Benzene, toluene, ethylbenzene, and xylene

Biodegradation - The breakdown of organic constituents by microorganisms into less complex compounds.

Bioventing - A treatment process that delivers oxygen to contaminated vadose zone soils to stimulate the aerobic in situ biodegradation of contaminants.

Capital Cost - Cost incurred for the construction and startup of a facility.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act. Federal law creating the Superfund program.

DAFB - Dover Air Force Base

DNREC - Department of Natural Resources and Environmental Control

DRO - Diesel Range Organics. This term is used to describe a TPH analysis that measures a total hydrocarbon concentration for organics in the No. 2 Fuel range which have hydrocarbon chains from C10 to C28.

EECA - Engineering Evaluation/Cost Analysis

EPA - U.S. Environmental Protection Agency

GRO - Gasoline Range Organics. This term is used to describe a TPH analysis that measures a total hydrocarbon concentration for organics in the more volatile range that DRO (pentane to naphthalene).

Groundwater - Surface water residing in a zone of saturation.

HI - Hazard Index. An indicator of the noncarcinogenic health risk associated with exposure to a chemical.

In Situ - In the original location (in the ground for this report).

IRP - The U.S. Air Force Installation Restoration Program.

Leach - The solubilization and transport of constituents in soil through the percolation of surface water to groundwater.

LECR - Lifetime excess Cancer Risk. The probability of the carcinogenic health risk associated with exposure to the chemicals of concern.

LIF - Laser-induced fluorescence. This is the process whereby ultraviolet light is emitted into the surrounding subsurface formation and the resulting fluorescence of organic material, such as hydrocarbons, is measured.

Light Non-Aqueous Phase Liquid (LNAPL) - An organic liquid with a low water solubility and density lower than that of water. LNAPLs retain their physical and chemical properties when in contact with water and tend to float on an aquifer when released to groundwater.

Maximum Contaminant Levels (MCLs) - Federal drinking water standards.

mg/kg - Milligrams per kilogram

msl - Mean seal level

O&M Cost - Annual cost incurred for operation and maintenance of a facility.

PCB - Polychlorinated biphenyl

Plume - A recognizable distribution of constituents in groundwater.

RA - Risk assessment

RCRA - Resource Conservation and Recovery Act

RI - Remedial Investigation

SCAPS - Site Characterization and Analysis Penetrometer System

RAO - Remedial Action Objective. Cleanup goal established for the remediation.

TCLP - Toxicity Characteristics Leaching Procedure. An analytical procedure which measures the level of organic leachate from a soil sample. This method is commonly used to determine whether soil to be disposed of is hazardous.

TPH - Total Petroleum Hydrocarbons. This analytical parameter is a measure of total hydrocarbons, often within a particular petroleum weight range (see DRO and GRO).

TSD - Treatment, storage, and disposal

USACE - U.S. Army Corps of Engineers

UST - Underground storage tank

Vadose Zone - Soil zone above the water table.

:g/L - Micrograms per liter

Responsiveness Summary

No comments were received during the 30-day public comment period beginning June 23, 1996 and ending July 23, 1996. In addition, as offered in the press release printed in the June 23, 1996 edition of the Delaware State News, no verbal or written request was received by Dover Air Force Base or EPA requesting that a public meeting be held.