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Management of pesticide related soil contamination in Tulare County, California: Remediation and prevention options

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Management of Pesticide related soil contamination in Tulare County, California: Remediation and Prevention Options

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ABSTRACT

Site Background

The case study chosen for research is the Remedial Action Plan (RAP) summary report of Remedial Investigations of the Harmon Field contaminated site located near the town of Pixley, in Tulare County, California. "These reports were prepared in accordance with a directive from the California Environmental Protection Agency (Cal-EPA), formerly the California Department of Health Services (DHS). (Canonie, 1996).

Harmon Field is a hundred acre field located at 1494 South Airport Road. The airfield has been in full operation since 1952. The uses of the airport are all agriculturally related. The primary use is for crop duster operations. (Canonie 1996).

This thesis submittal will be written as an overview report of the specific remediation techniques and the chosen alternative.

I will conclude the thesis with an overview critique of the content covered in the report.

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INTRODUCTION

Pesticide Identification

Pesticides are used for a variety of purposes. A pesticide can be defined as an agent chemically designed to destroy unwanted target pests. Each pesticide is categorized in toxicity, specific effect, and application method. The selection of the best applicable pesticide for the job will directly depend on the actual site's environmental and soil conditions. Most pesticides after application will degrade to nontoxic compounds. Detection of residues in soil and surface water directly indicate that current pesticide practices are not keeping residues confined to their intended targets. Without proper knowledge and professional experience in the given job at hand, application of pesticides can lead to unwanted pesticide residue. The identification of pesticides to ensure the most efficient and highest production is imperative to manage a productive crop and control environmental quality. (Akana, 1996).

History of Uses

Pesticides use has been a common practice in the United States and around the world for approximately 60 years. Uses of these chemicals have varied from hygienical direct contact use to agricultural enhancement. In the early stages of practice, toxicity levels and the after life of the toxicity levels were not nearly understood enough to identify future contamination hazards. Today, much has been learned from research, mostly stemming from the study of impacts on the environment many years ago. To protect our country's health and continue the living standard we are accustomed to; federal law has been established for the direct control of pesticide contaminations of any kind. There seems to be extremists on both sides of the topic for and against the use of pesticides. The answer must be met in the middle stream. It seems to be at an equilibrium for the present time (Akana, 1996).

Agricultural Pest Management

In agriculture, pesticides are used as a tool to control unwanted pests. The implementation of these pesticides to control the health of a crop can bring high costs to the farmer and the environment. Expensive pesticides will limit a farmer's applied use of the additive. If the pesticide is applied without following labeled precautions, it can create devastating effects to the environment. These two factors work together in accomplishing a limit or medium to the use of the chemicals.

Ideally, pesticides after application degrade onsite to innocuous, nontoxic compounds. Detections of residues in ground and surface water indicate that current practices do not keep residues confined to their intended sites and that contamination is highly possible with poor pesticide management techniques. This is the main factor why a farmer will operate pesticide management application to meet economic thresholds. An economic threshold is the point where external cost meets benefits to form an equilibrium. This keeps the amount of pesticide application minimal and opens the door to other alternative pest controlling agents. The quality and quantity of the crop will remain high to meet state inspections. This type of farm management is an integrated pest management program (IPM). This type of program has been very successful in the Western United States, with more research will probably be the number one type of farm management. (Akana, 1996).

Pixley Case Study

The intent of this summary is to compile the main facts out of the Remedial Action Plan, summarize the different options of remediation and conclude with the remediation technique chosen. (Canonie, 1996).

Introduction

The remedial investigations undertaken at Harmon Field were performed to evaluate the horizontal and vertical extent of soil and groundwater contamination due to historical storage and handling of pesticides at the airfield. (Canonie, 1996).

SAMPLING

Sampling - Abstract/Focus

Obtaining a representative sample from the remedial site can be achieved in many ways. Each remedial site will be characterized according to local geology, environmental conditions (flora & fauna) and remediated material.

Samples can be taken deliberately nonrepresentative of the case study. The samples can be focused on the most obviously contaminated hot spot, hence will read a bias figure to the over-all possible contamination. The samples will establish the worst case concentration, but will not represent the average condition of which the remediation must cover. (Tidman, 1996)

In the direct opposite case, if samples are deliberately taken from the remedial site at locations far from known hot spots or in areas known to be most likely not contaminated, the represented average will not be accurate.

The heterogeneity of soil samples dictates the size and distribution of the sampling population, and the bias of the sampling and analysis methods. It is necessary to select a test sampling program that well represents the case study. Soil sampling devices should be chosen to account for the type of soil and mix of contaminants. Finally, between each successive extraction the sampling devices must be decontaminated according to environmental sampling specialists at Canonie Environmental. (Canonie, 1996)

Detectable Levels

Soil sampling is performed to characterize the extent of the contamination through mapping out migration patterns of the analytes of interest. Once the leachate is mapped out to certain soil depths, then the remediation team will have a focus on how to extract the contaminated soil. Detectable levels of analyte in the soil will define what degree of contamination we are dealing with and will determine the most cost efficient type of remediation. (Food &Agriculture, 1994).

Analysis and Technique

Once the level of contamination is determined across the site, then the methods for removal will be the next step in the remediation process of this type. At Pixley Airfield we are dealing with topsoil contamination only. Sampling devices used in surface or shallow depth (less than 15-30 cm.) were as simple as a shovel or scooper. A soil punch could also have been used. A soil punch is a thin-walled steel tube device. Pushing to the desired depth the device should produce well represented soil samples. (Lawrence, 1991).

Pixley Airfield - Case Study

A grid system will be established to set guidelines for soil testing frequency at the depth of excavation to confirm that the desired cleanup levels have been achieved. (Canonie, 1996)

Additionally, soil samples at the perimeter of the excavation shall be collected at specified intervals and tested to verify that the real extent of contamination meets clean up criteria. If the confirmation samples for these areas fail cleanup criteria, the excavation will be continued over that grid area an additional 0.5-foot deeper, or the perimeter will be expanded on the interval tested an additional 5 feet out laterally at the sample depth of the adjacent excavation. At the discretion of the field engineer, these additional volumes of excavated soil may be increased if significant concentrations of contamination were indicated by the confirmation analytical results or conditions noted in the field so warrant. Additional samples will be collected from the newly-excavated area and analyzed and evaluated in a similar manner. Soil sample collection, handling, and tracking protocol will be addressed in the Remedial Site RD Plan. (Canonie, 1996).

A limited number of soil samples will be collected from the edge of taxiway and runway areas to confirm that contaminated soils do not underlie these areas. The location of these samples will be selected to minimize any interference with runway and taxiway integrity. The runway material will be sampled to determine if pesticides have impregnated the runway similar to problems encountered at other airfields including the Green Acres airport in Visalia. (Canonie, 1996.)

TABLE 1

SOIL SAMPLING LOCATION DESCRIPTIONS

Identification Number	Original Designation	Sampling Area Description
SOIL BORINGS		
5	H1	Pixley Duster's mixing and storage area.
79	H2	Buried trash site Southeast of Pixley Hangar.
88	H3	Ponding area at end of drain pipe from Pixley's washdown pad.
97	H4	Beginning of open ditch near Earlimart Duster's washpad.
111	H5	Transient applicator mixing area west of Earlimart Dusters.
122	H6	Transient applicator mixing area at North end of taxiway.
139	H7	Ponding area at Northern end of open ditch.
148	H8	Runway area used for rinsewater disposal.
161	H9	Area of buried containers east of rinsewater pond.
27	H10	Drainage area South of Earlimart Duster's mixing area.
39	H11	Area of suspected buried trash Southeast of Earlimart Duster's storage area.
53	H12	Rinsewater pond Southeast of Earlimart Duster's mixing and storage area.
SURFACE SAMPLES		
56	H13	Earlimart Duster's storage yard.
58	H14	Stained runway area used for rinsewater disposal.
75	H15	Stained runway area used for rinsewater disposal near Sample Location 58.

CHEMICALS

Definition

Chemicals can be defined as substance (solid or aqueous), composed of two or more elements in definite proportion by weight, which are independent of its mode of preparation. (Webster, 1027).

Classifications

The classification of the pesticide is usually determined by the chemical constituent of the material. The two categories of pesticides are inorganic and organic. Inorganic meaning that it is composed by and compounded with a natural bond that has been altered to man's need. These pesticides include sulfur, lime sulfur, fluorides, coppers, and arsoricals. Organic meaning that it is composed and compounded by unnatural bonds primarily to eradicate pests from fruit trees. Organic pesticides can be subdivided into oils, botanicals, and synthetics. Oils are derived from petroleum. Botanical are derived from plants, including materials such as nicotine, cube rotenone, pyrethrum, sabadilla, and ryania. The synthetic organic pesticides are the most commonly used in today's agriculture. (E.P.A., 1996).

Associated Problems/Chemical Control

Pesticides are toxic materials and need to be treated as such. Most negative pesticide happenings are a direct result of human error or poor judgement. There are four points where I found the Pixley Airfield to be at fault. In particular it seems that (1) careless mixing and filling of sprayers or dusters; (2) excessive drift and runoff from wash pads; (3) visible residues on the airfield that were overlooked; and (4) improper storage of materials, were the major areas that workers here are guilty of. (E.P.A., 1996).

Toxicities

Pesticides can vary in their toxicities to mammals and other nontarget organisms in and around a target site. Toxicities are determined on the acute oral toxicity, acute dermal toxicity, inhalation toxicity and chronic feeding toxicity. These are accomplished by experiments on mice, rats, rabbits, fish, birds and occasionally dogs. Acute oral and dermal toxicities are expressed in terms of Ld50, the theoretical dose required to kill 50 percent of the test animals. The Ld50 is then put into a ratio of milligrams of toxicant per kilogram of body weight (mg/kg) of the testee. In addition to toxicity, several other factors must be recognized, such as teratogenicity, oncogenicity and genetic effects. The relative toxicity and hazard levels of a insecticide are indicated on the labels as "poison," "warning," or "caution." (Tidmen, 1986).

TABLE II

CHEMICALS OF POTENTIAL CONCERN
LIST OF CHEMICAL NAMES

1. Benoyml
2. a-BHC
3. b-BHC
4. o-BHC
5. 2,4-D
6. ΣDDT
7. DEF
8. Diazinon
9. Dicamba
10. Difocal
11. Dieldrin
12. Dimethoate
13. Dinoseb
14. Diphenamid
15. Disulfoton
16. Diuron
17. E-Endosulfan
18. E- Endrin
19. Ethion
20. Ethylbenzene
21. Lead
22. Malathion
23. Methoxychlor
24. Methyl Parathion
25. Ethyl Parathion
26. Phosmet
27. Toxaphene
28. Trifluralin
29. Xylenes

TABLE III

INSTITUTIONAL CONTROLS
PRELIMINARY COST ESTIMATE

Item	**Cost**
Fencing (7,750 LF @ $5.30/LF)	$41,075
Synthetic Liner (3,000 SF @ $2.60/SF) (former pond area only)	$7,800
Surface Stabilization (400,000 SF @ $.18/SF) (if required, partial area)	$72,000
Security and Maintenance	$22,540
Subtotal	$143,415
Contingency Factor (25 percent)	$35,854
Total	$179,269

Notes:

1. LF designates lineal feet.

2. SF designates square feet.

PIXLEY AIRFIELD - CASE STUDY

The suite of chemicals detected during remedial investigations have been reduced during evaluation for the risk assessment (WEHA, 1992) to a list of 29 chemicals of potential concern (Table II). Two of these chemicals, ΣDDT and toxaphene, have been selected as the indicator chemicals because they are the most widespread and due to their relative toxicity. The established remedial action cleanup goal from the health-based risk assessment is 1.0 ppm for the potential chemicals of concern. (Canonie, 1993).

The majority of the contamination was generally limited to surface soils (upper 2 feet). The potential remediation areas represent a conservative areal estimate of the extent of contamination. In the potential remediation area, contamination extends to a depth of approximately 5 feet in three localized areas: the surface impoundment area; the suspected buried trash area; and the Earlimart Dusters storage yard. Institutional controls can be used to control the study area. (Canonie, 1993).

SOILS

Definition

A soil can be defined as the superficial unconsolidated, weathered part of the mantle; upper layer of the earth's crust where minerals and organic compounds can develop and take hold to support organic life. (Webster, 1121)

Textural Classes/Function Of

The texture of a soil will directly control the permeability factor. Permeability is the measurement of the downward movement of water. For my purpose, I will refer to permeability as the infiltration of surface water through the top soil layer to the watertable below. These application rates are labeled on each pesticide container to provide a general description of the qualities of leaching-vulnerable soil, so that the application of the pesticide on the field does not leach down to soil levels that were not targeted. Application rates of many soil-applied pesticides must be adjusted according to texture and organic carbon content of soils to ensure efficient and safe use of the chemical. (Akana, 1996).

General Soil Textural Classes Found Common in Central California are the following:

I. Sandy soils - course textured soils
  - A. Sands
  - B. Loamy sands

II. Loamy soils - medium textured soils
  - A. Moderately coarse textured soils
    - 1. Sandy loam
    - 2. Fine sandy loam
  - B. Medium textured soils
    - 1. Very Fine sandy loam
    - 2. Loam
    - 3. Silt loam
    - 4. Silt
  - C. Moderately fine textured soils
    - 1. Clay loam
    - 2. Sandy clay loam
    - 3. Silty clay loam

III. Clayey soils - fine textured soils
  - A. Sandy clay
  - B. Silty clay
  - C. Clay

(U.S.D.A. Soil Conservation Service, 1975)

Leaching of a pesticide in soil occurs when water moves pesticide residues downward through layers of soil. Ground water contamination results when deep percolating water eventually recharges ground water aquifer. The amount of deep leaching will depend on 1) soil permeability and 2) amount and frequency of irrigation or rain events. The aspect of timing a pesticide application in relation to irrigation or heavy rainfall is crucial.

Pixley Airfield - Case Study

In the case study at Pixley Airfield, there was not any known infiltration of water besides the wash pads found on site. In the samples taken, leaching did not pose the threat that it could have. (Canonie, 1996).

Control/Remediation

Health Risk Assessment Results

A Baseline Health Risk Assessment Report (HRA) was prepared for Harmon Field by Western Environmental Health Associates (WEHA) and Canonie. The HRS was performed to assess the potential human health impacts due to the contaminants known to be present at the airfield. The HRA was developed using U.S.D.A. EPA guidelines, and modeling assumptions and methods approved by Cal-EPA. (Canonie, 1996)

The HRA focused on 29-chemicals of potential concern which were detected primarily in near-surface soils at Harmon Field (see Table II). Assessment of potential health risks were evaluated under three scenarios.

* Current land use (baseline) -- Assuming continued cropduster operations;

* Future hypothetical land use No. 1 -- Assuming residential land use and "hot spot" remediation;

* Future hypothetical Land use No. 2 -- Assuming cropduster operations are discontinued and access controls are implemented.

For all scenarios, both carcinogenic and noncarcinogenic health risks were evaluated. The HRA determined the carcinogenic risk for the on-site worker and off-site residential receptor under the current-use scenario to be 5.7 X 10^4 and 7.3 X 10^4 respectively. The carcinogenic risk for the off-site residential receptor for the future use No. 2 scenario was estimated to be 6.6 X 10^4 (the on-site worker was not considered since site access would be restricted). The risks associated with these scenarios exceed the 10^4 to 10^6 range, which Cal-EPA considers to be protective of human health. The carcinogenic risk for the on-site residential receptor for the future use No. 1 scenario was 1.3 X 10^6 (under this same scenario, off-site considerations are negligible), which is within Cal-EPA's acceptable range. (Canonie, 1996)

The HRA concluded that the future-use No. 1 scenario presents no significant carcinogenic or noncarcinogenic risks. Under this scenario, the areas of maximum pesticide contamination are assumed remediated such that concentrations of carcinogens are reduced to < 1ppm. (Canonie, 1996).

To realistically achieve constituent levels less than 1.0 ppm during any required field verification sampling, Canonie feels indicator chemical(s) should be selected for verification sampling to determine if the limits of the contaminated soil are identified in the field following cleanup activities. The chemicals toxaphene and ΣDDT are recommended to be used as indicator chemicals since they are, by a large margin, the most widespread chemicals of concern found at the site. These chemicals were found in all areas identified to be remediated. In addition, these chemicals, with the addition of dieldrin, contributed the greatest to the calculated carcinogenic risk. Dieldrin has not been included as an indicator chemical since it was only detected in 10 to 248 samples analyzed and somewhat skewed the estimate due to a "hot spot" of 1,800 ppm. This "hot spot" would be remediated within an area identified with proposed indicator chemicals. The high value for dieldrin wad detected during the Phase I investigation and was a surface sample taken in the rinse water pond area. The rinse water pond was active at the time and the general vicinity had a great amount of activity surrounding it, with two mixing areas, two suspected buried waste areas, and an airfield taxiway all nearby. (Canonie, 1996)

Extraction Methods/Remediation

(All cited directly from Remediation Plan). (Canonie, 1996).

Remedial Technology Identification

A review of available technologies was conducted to identify accepted methods for treatment of pesticide-contaminated soils.

All of the technologies identified, with the exception of incineration, may be considered as both on-site and off-site treatment technologies. Brief descriptions of the treatment technologies follow.

Bioremediation

Bioremediation is a process which treats soil using indigenous or introduced bacterial with the addition of nutrients to enhance the microbial degradation of contaminants. Bioremediation may be performed in-situ under some conditions.

In-Situ Vitrification

In-situ vitrification is a process that applies high voltage to electrodes placed in the ground and raises the temperature high enough to liquefy the soil mass. Upon cooling, the soil becomes a glass-like matrix which effectively immobilizes nonvolatile contaminants.

Thermal Desorption

Thermal desorption is a method that employs a transportable treatment unit to heat-process organic contaminants. The resultant gas is then passed through a carbon absorption device, after burner, or other pollution control system. This technology would enable clean treatment soils to remain on-site.

Pyrolysis

Pyrolysis is a high temperature thermal treatment involving the destruction of organic material in an oxygen deficient environment to reduce the toxic organic constituents to elemental gas and water. This process usually employs a transportable treatment unit.

Soil washing

Soil washing is a process that generally uses a transportable treatment unit to extract contaminants from soil matrices using an aqueous-based medium. This process, while typically applied for metals removal, may be used for a variety of contaminants. The fluid for soil washing is tailored to the contaminant to be removed. This process does not treat the contaminant itself but rather reduces the volume of material affected.

Fixation/Stabilization

Fixation/stabilization is a treatment process that immobilizes the contaminants by changing the constituents into immobile forms by binding them in an insoluble matrix and/or encapsulating them in an insoluble matrix, minimizing the material surface exposed to leaching.

Incineration

Incineration is a process which uses very high temperatures to effectively destroy organic contaminants. Incineration may be considered an off-site technology only, due to the costs associated with permitting in the State of California. Incineration is expected to be the best demonstrated available technology (BDAT) to meet treatment standard concentration levels for the contaminants found at Harmon Field now that land disposal restrictions (LDRs) for contaminated soil are final.

General Response Actions

Four potential remediation areas were identified. Remediation of the carcinogenic chemicals of concern in the upper two feet of soils within these areas is believed to effectively eliminate known potential health risks. The estimated volume of these surficial soils is approximately 29,000 cubic yards. Due to the multi-contaminant environment and sporadic nature of deposition, the HRA provides the most rational method of defining the volumes to be remediated.

Screening of Technologies

(All cited directly from RD plan)(Canonie, 1996).

This section discusses the elimination of some technologies from further consideration due to their doubtful effectiveness as applied to the site-specific conditions and/or contaminants identified at the Harmon Field Site. The rationale for elimination of process technologies from further evaluation for remedial action is provided below.

Bioremediation

In 1989 and 1990, Tulare County in association with the University of California at Davis, performed a biological treatment test program. The program found that Bioremediation of the soils on-site was not effective and the RAO was amended by Cal-EPA to eliminate further evaluation of this technology.

In-Situ Vitrification

In-situ vitrification is a technology that is currently receiving heavy scrutiny regarding its ineffectiveness in actual field applications. This process is being proposed to be abandoned at a Houston, Texas, Superfund Site. Because of questions concerning application of this process in other than ideal conditions, it is not a recommended alternative at this time.

Fixation/Stabilization

Fixation/Stabilization is a process that is typically used for inorganic contaminants. The inorganic contaminants found at Harmon Field did not contribute significantly to any health risks. This method does not provide an ultimate solution, but rather is a means of immobilizing a waste. Further, the effect of long-term environmental weathering of any processed waste left on-site is not known.

Development of Site-Specific Alternatives

Alternatives were developed based on consideration of site specific conditions including the media affected, distribution of contaminants, and remedial action goals. For remediation of the site, the only affected media to be considered will be soils, since groundwater has not been impacted and remediation of soil will effectively eliminate air quality issues.

The distribution of chemicals in the soil is at fairly low concentrations; the contamination is due to multiple events of short duration (spills, mishandling, formerly accepted operating methods) with a wide variety of chemicals. As such, no significant high concentration (source) areas, which may exist, for example, with a leaking underground storage tank, were identified which could be remediated in a different manner than the low concentration areas. Similarly, the four identified potential remediation areas are all characterized by multiple contaminants. That is, none of the areas are characterized by a single contaminant that would suggest applying an applicable or relevant and appropriate requirement (ARAR) for that one chemical. Therefore, the HRA methods for establishing remedial cleanup goals is useful and, in fact, necessary.

The alternatives developed considered containment or treatment of the upper two feet of soil within the potential remediation areas. The proposed volume of soils is approximately 29,000 cubic yards. The actual volume of soils to be remediated may differ from this amount; however, this amount may be considered representative of the scale of activities and has been used as the basis to estimate costs herein.

No Action

The no action alternative provides a scenario against which other scenarios may be compared. The no action alternative allows for evaluation of the effects that will occur without remedial action. The HRA similarly established a no action scenario to establish the risk to human health and the environment posed by continued use of the airfield with no remedial action.

Institutional Controls

The institutional controls alternative would isolate the contaminated area by restricting access to the site. All flight operations would be discontinued to reduce airborne migration of contaminants. A stabilizing agent would be applied to surface soil to prevent wind erosion. Additionally, the former rinse water pond area, where a "hot spot" was identified, may be covered with a synthetic liner. The perimeter of the airfield would be fenced to restrict public access, and warning signs would be posted along the fence line. Periodic site visits should be performed to ensure the integrity of fencing and identify any site maintenance requirements. Institutional controls cannot be employed as a long-term measure, and a temporary deed restriction may be placed on the airport to restrict use of the contaminated areas (see Table III).

Capping

One method of achieving the risk levels specified in the HRA is to block the migration pathways for the contamination. In addition to removal and treatment of the soil, capping provides another option for meeting the specified risk levels. Since all of the contamination migration pathways specified in HRA are predicated on either contact with the soil or airborne emissions, a cap would obstruct this pathway and allow the site to meet the 10^{6} risk levels stipulated by the regulations set by Cal-EPA.

Two very different capping options can be proposed for the site. These two options are in-place capping and development of an on-site landfill. The primary design criteria for both caps are:

* Surface water collection and removal;
* Stability and durability;
* Puncture resistance;
* Subsidence
* Climate effects (i.e., freeze-thaw).

The ability of the designed cap to meet the design criteria is important in both the short term and long term to prevent migration of chemicals from soil to groundwater. The two options will be discussed below.

In-Place Capping

The option that least disturbs the contaminated soil is an in-place cap. This cap will not be possible if the future land use is designated as agricultural residential. However, if the future land use selected is general use aviation, then an in-place cap would be appropriate. The in-place cap would consist of the following items from bottom to top:

* Contaminated subgrade
* One foot compacted clay layer (permeability of 10^{-6} cm/sec);
* 20-mil high density polyethylene (HDPE) synthetic membrane;
* HDPE geonet drainage layer;
* Filter fabric;
* One-foot compacted soil layer;
* Five-inch asphalt layer.

In addition to the change in the potential future use of the site, the remaining ground in the vicinity of the proposed cap would have to be raised to level the runway area. All existing buildings, runways, and auxiliary structures would have to be replaced upon completion of the regrading activities.

On-Site Landfill

A second way of capping the site would be to excavate the contaminated material, place it in a stockpile on-site, and cap the stockpile. This alternative, for all practical purposes, would create an on-site landfill. The landfill would require a much smaller cap because the areal extent of the landfill is estimated to be approximately 2.5 acres. This area would not be used as an agricultural residential area, but the remainder of the site would. The on-site landfill cap would consist of the following items from bottom to top:

* Clean subgrade;

* Eight-foot contaminated soil layer;

* One-foot compacted clay layer (permeability of 10.6 cm/sec);

* 20-mil high density polythylene (HDPE) synthetic membrane;

* HDPE geonet drainage layer;

* Filter fabric;

* l-foot vegetated soil layer.

This option introduces fewer restrictions to future land use at the site and provides a much smaller area to monitor. Selection of either cap option would lead to long-term maintenance and monitoring requirements for the site to eliminate any future migration of the contaminated soil.

Thermal Treatment

Incineration, thermal desorption, and pyrolysis are all effective treatment technologies in the destruction of organic compounds in soil. A description of these processes is presented below. Implementation of some of these processes would require laboratory analyses, bench scale, and/or pilot scale testing.

Off-Site Incineration

The incinerator most commonly used for commercial waste treatment is the rotary kiln. A typical rotary kiln incinerator is constructed with a refractory- lined cylindrical shell mounted at slight incline to the horizontal. The speed of rotation is used to control residence time and mixing with combustion air. Combustion temperatures range from 1,600 to $3{,}000^{0}$ F. Rotary kilns have been used to incinerate solids, sludges, and slurries, and the kiln design eliminated the need to pretreat the waste feed. If properly designed and operated, this type of system will destroy organics within allowable limits.

A negative aspect of rotary kiln is that flue gas cleanup is necessary and usually includes particulate removal and acid gas scrubbing. Although off-site and on-site incineration could be accomplished, off-site incineration at an existing facility is the most common and will be the type of incineration considered here.

The implementation of off-site incineration would include the excavation of soil from the four potential remediation areas to a depth of 2 feet, transportation to a commercial incinerator out of State (currently there are no commercial incinerators in California), incineration of the material, proper disposal of any residuals, import of clean fill, and regrading of the site. Upon completion of the excavation and transportation, on-site surface soil risks would permanently meet the risk assessment standards. There is, however, some small risk of contaminant release during transport due to accidents or uncontrollable acts. Also, it should be noted that off-site incinerators have a limited capacity and may require shipping of the soil over a prolonged period of time.

On-Site Thermal Desorption

Thermal desorption is frequently an on-site system which processes contaminated soil through a pug mill or rotary drum system where it is heated to a temperature of 400^0 to 800^0 F. An induced airflow conveys the desorbed organic compound/air moisture through a carbon absorption unit or combustion afterburner for the destruction of the organics. The airstream is then discharged. Process residuals include processed soil and ash from the afterburner or spent carbon. System rates of approximately 25-45 tons per hour have been achieved on similar waste streams, although the actual rate will depend on chemical concentrations and types, moisture content, and soil particle size.

The implementation of on-site thermal desorption would include the assembly of a modular thermal desorption unit, excavation of the soil from the four potential remediation areas to a depth of 2 feet, soil treatment using the thermal desorption unit, replacement of treated soil to the established clean-up level, regrading of the site, and disposing of carbon by thermal regeneration at an approved facility. Upon completion of these tasks, on-site soil risks would permanently meet the risk assessment standards.

On-site Pyrolysis

Pyrolysis is an on-site system which processes contaminated soul or sludges through a series of thermal zones which separate out components of the input based on volatization temperatures, allowing for the removal of contaminants and their subsequent recycling, destruction as fuel, or disposal. Pyrolysis refers to the reaction zone where oils and volatiles are removed at temperatures of 700^0 to $1,100^0$ F under anaerobic conditions. The remaining solids are cooled for discharge by heating incoming waste in the first thermal zone by thermal conduction. System rates of 3 to 25 tons per hour have been achieved, but actual rates will depend on chemical concentrations and types, moisture content, organic content, and soil particle size. Although pyrolysis should theoretically work on waste streams containing pesticides, it has not been tested on this type of waste stream.

Off-Site Landfilling

Under this alternative, contaminated soil at the site would be excavated, transported, treated, and disposed of at an off-site hazardous waste facility. Since the national capacity extension expired

May 8, 1992, land disposal restrictions (LDRs) are now being imposed for contaminated soil. The LDR treatment standards for the indicator chemicals ΣDDT and toxaphene are based on concentration levels (0.087 and 1.3 mg/kg, respectively). To achieve these low concentrations, incineration is likely the only final treatment method available off-site. While incineration is either the specified technology, or, as in the site-specific case, the only treatment that can achieve LDR treatment levels for many waste streams, the increase in national capacity has not been commensurate with the demands LDRs have created. For this reason, the full impact of the May expiration of the national capacity extension is unknown.

On-Site Soil Washing and Off-site Residual Disposal

This alternative would involve excavation of the potential remediation areas, processing the contaminated soil on-site by soil washing with a transportable treatment unit, backfilling the clean treated soils, and off-site treatment and disposal of the contaminated residuals. The Harmon Field Site is well suited for on-site processing due to the available land for staging operations.

Soil washing may be viewed as a method to reduce chemical concentrations in treated soils. While removal of all contaminants may not be achieved, the reduction in concentrations should eliminate any potential risk to human health or the environment. Further, since the Harmon Field Site is predominated by sand to clay silt and sand, the reduction of contaminated material should be approximately 60 to 70 percent. Bench scale testing should be performed to demonstrate the effectiveness of soil washing if this alternative is chosen for remediation.

Residual contaminated fines generated from soil washing would be transported off-site to a hazardous waste landfill for treatment and disposal. Since the May 8, 1992, deadline has passed, no further national capacity variances exist and treatment will be required prior to land disposal. The treatment method is expected to be incineration (see Table V).

Screening of Alternatives

(All sited directly from RD plan)(Canonie, 1996)

This section discusses elimination of some alternatives from further consideration. The remaining alternatives will form the basis for comparison of select alternatives in the following section. The rationale for elimination of alternatives from further evaluation for remedial action is provided below.

Off-site Incineration

Off-site incineration will not be eliminated from consideration but will be combined with off-site landfilling. Due to permitting constraints and LDRs, these two options appear to be inseparable.

TABLE V

**ON-SITE SOIL WASHING AND
OFF-SITE RESIDUAL DISPOSAL
PRELIMINARY COST ESTIMATE**

Item	Cost
Soil Washing (43,500 TN @ $70.00/TN)	$3,045,000
Transportation of Residuals (14,355 TN @ $15.00/TN)	$215,325
Disposal of Residuals (14,355 TN @ $60.50/TN)	$868,478
Subtotal	$4,128,803
Contingency Factor	$1,032,201
Total	$5,161,004

Notes:

1. WK designates weeks.

2. TN designates tons.

On-Site Pyrolysis

Pyrolysis will not be considered for detailed comparison at this time since it has not been proven to be effective on treatment of pesticide-contaminated soil.

Comparison of Select Alternatives

The detailed analysis provided in this section evaluates each alternative on the basis of the following criteria:

1. Overall protection of human health and the environment;
2. Short term and long term effectiveness and permanence;
3. Reduction of toxicity, mobility, or volume;
4. Implementability;
5. Public acceptance;
6. Cost.

These criteria are intended to provide sufficient comparison of alternatives to develop rationale for selection of the final remedy.

No Action

The no action alternative with continued use of the airfield was found in the HRA to present both a carcinogenic and noncarcinogenic health risk. Many of the chemicals detected at the site are persistent and would continue to pose long-term risks.

Institutional Controls

This temporary alternative would effectively reduce the potential migration of chemicals. For the short term, this alternative is highly effective since it can be implemented quickly, does not require specialized technologies or hardware, and can be performed at a relatively low cost. This option is only a temporary measure, however, since it does not meet the regulatory requirements for closure.

Future risks would essentially be negligible at the airfield as long as institutional controls are maintained. Since this alternative is essentially a quarantine which does not offer any ultimate solution to the contamination left in-place and requires long-term maintenance, this alternative by itself is not a solution. It can only be implemented with another alternative

The estimated cost to implement institutional controls is $179, 269.

In-Place Cap

This alternative would cap all of the identified potential remediation areas, eliminating all contamination migration pathways, and therefore would meet the criteria for protection of human health and the environment. For the short term, the alternative would be limited only by the time to implement remedial action, with the actual construction duration estimated at three months. The change in future land use and the ongoing maintenance and monitoring will have negligible long-term effects. The fact that the contamination of the site will not be eliminated may make this alternative unpalatable to the public. Additionally, future flexibility regarding the land use becomes very limited. However, if the site is changed into a general use aviation airport, the convenience of the facility may assist in reducing this negative response.

The estimated cost to implement in-place capping is $8,522,596.

On-Site Landfill

On-site landfilling would remove contaminated soil from all of the identified potential remediation areas and encapsulate them in a monitored facility. This will eliminate the contamination migration pathways and would meet the criteria for protection of human health and environment. For the short term the alternative could be implemented very expeditiously and would meet remedial action goals. The stringent land disposal restrictions (LDRs) may require that a variance be obtained, and the site will remain with limited potential long-term liability. Additionally, public opposition to creation of an on-site landfill may prove to be a problem, but the fact that this is the most affordable alternative should help diminish the outcry.

The estimated cost to implement on-site landfilling is approximately $3,068,156.

On-Site Thermal Desorption

This alternative would treat all of the identified potential remediation areas and therefore would meet the criteria for protection of human health and the environment. For the short term the alternative would be limited only by the time to implement remedial action, with the actual field processing period duration estimated at nine months. The on-site treatment of soils and the off-site treatment of soils and the off-site treatment of carbon by regeneration would be final and have negligible long-term effects.

Thermal desorption of the relatively low concentrations of chemicals found at the Harmon Field site combined with off-site regeneration of carbon would yield nearly non-detectable concentrations in treated soils. For the purposes of estimating any further risks, treating the soil by this alternative may be considered a complete reduction of toxicity. Due to the complete recovery of soils treated by this method and the essentially no-risk results achieved, the thermal desorption alternative should be favorable accepted by the public.

The estimated cost to implement on-site thermal desorption and off-site treatment and disposal of carbon and residuals is $5,003,125.

On-Site Washing and Off-Site Residual Disposal

This alternative would treat all of the identified potential remediation areas and therefore would meet the criteria for protection of human health and the environment. For the short term the alternative would be limited only by the time to implement remedial action, with the actual field processing period duration estimated at six months. The on-site treatment and off-site treatment of residuals to LDR standards with subsequent disposal would be final and have negligible long-term effects.

Soil washing of the relatively low concentrations found at the Harmon Field Site combined with off-site incineration and disposal of residuals would yield nearly non-detectable concentrations of treated soils. For the purposes of estimating any further risks, treating the soils by this alternative may be considered a complete reduction of toxicity. Due to the soil volume that may be recovered by this method and the essentially no-risk results achieved, the soil washing alternative should be accepted favorably by the public.

The estimated cost to implement on-site soil washing and off-site residual disposal is $5,161,00. An itemized breakdown of estimated costs is provided in Table IX.

Off-Site Landfilling

Off-site landfilling would remove contaminated soil from all of the identified potential remediation areas and therefore would meet the criteria for protection of human health and the environment. For the short term the alternative could be implemented most expeditiously of all alternatives that meet remedial action goals. The stringent LDR treatment standard concentration levels with subsequent disposal would have limited potential long-term liability. Long-term effects on-site may be considered negligible. While landfilling and also incineration can be perceived negatively by the public, again the treatment concentration standards for ΣDDT and toxaphene are very low and the negative aspect of long term liability for disposed treated residuals should be minimal (see Table VI).

TABLE VI

OFF-SITE LANDFILLING
PRELIMINARY COST ESTIMATE

ITEM	**COST**
Fixed Overhead (lump sum)	$15,000
Variable Overhead (8 wk @ $10,000/wk)	$80,000
Mobilization (lump sum)	$25,000
Excavate & Load (29,000 CY @ $4.60/cy)	$133,400
Transportation (43,500 TN @ $15.00/TN)	$652,500
Disposal (43,500 TN @ $15,00/TN)	$2,631,750
Compact Backfill (29,000 CY @ $3.00/CY)	$87,000
Import Backfill (43,500 TN @ $9.75/TN)	$424,125
Subtotal	$4,048,775
Contingency Factor (25 percent)	$1,012,194
Total	$5,060,969

Notes:

1. WK designates weeks.

2. CY designates cubic yards.

3. TN designates tons.

4. Cost estimate does not include incineration.

The estimated cost to implement off-site landfilling is approximately $5,060,696. An itemized breakdown of estimated costs is provided in Table X. Note that this estimate is based on prices available prior to LDRs. Considering incineration as the specified BDAT, this price would increase greatly due to the limited number of incineration facilities available nationwide.

Recommended Remedial Alternative

Of the selected alternatives reviewed, several achieve acceptable health based goals at a relatively low cost but do not actually clean up the site. Since the County has indicated that a permanent solution is preferred, these alternatives -- institutional controls, in-place capping, and on-site landfilling -- are not recommended by themselves. Further, the no action alternative is not acceptable due to continued health risks, and off-site landfilling is expected to be excessively costly if incineration is required. Elimination of the above alternatives leaves only the on-site alternatives of thermal desorption and soil washing with residual disposal.

The recommended remedial alternative is thermal desorption since it offers a proven technology that will return the land to full use and will effectively eliminate long-term liability. Thermal desorption is considered more efficient than soil washing since contaminants are removed from the soil rather than merely reducing the volume of contaminated material. Thermal desorption offers a complete reduction of contaminated soils, and through this process, all associated health risks will be completely removed. Finally, thermal desorption is competitive in cost with soil washing.

Since the funding is not presently available to the County to begin full-scale treatment of contaminated soil, the use of institutional controls is proposed as an interim measure to allow time for generation of a remediation fund. The use of institutional controls as an interim measure also offers the most expeditious means of protecting human health and the environment during the inherent time-lag for permitting and beginning any full scale on-site treatment. The projected time period for use of institutional controls is five years. During this period, the County has indicated that it will contribute approximately $1 million to $1.5 million per year to the remediation fund. It is expected that some of this money will be recovered from potentially responsible parties at the airfield. The interim period would also allow the County time to coordinate the departure of airfield tenants and ensure that tenant buildings and storage facilities are properly cleaned and the petroleum underground storage tanks (USTs) and pesticides rinseate sumps are properly closed and decontaminated.

The use of institutional controls may be implemented immediately upon regulatory approval. The proposed controls re as follows:

1. Discontinue all flight operations at the airfield to reduce generation of dust.

2. Fence the perimeter of the airfield and post appropriate warning signs.

3. Place a synthetic liner over the former rinse water pond area where a "hot spot" was identified during the phased remedial investigations. (The intent of this liner is to reduce the potential for infiltration as well as wind erosion in this area.)

4. Apply a surface stabilizing agent to select potential remediation areas as required.

5. Establish a watch schedule for County personnel to periodically inspect the site for security and maintenance requirements.

6. Implement a community awareness program to advise the public of site conditions and proposed action.

Following formal approval of this RI/FS summary, these interim measures should commence. A proposed project schedule for the interim period will be reviewed by Canonie Environmental. The schedule, as proposed, allows for a technology review to evaluate any new technologies that may be identified and to ensure that the selected alternative remains viable. A treatability study will then be performed and the results will be incorporated into an addendum to the RAP. Remediation at the airfield is expected to begin in mid-1997. (Canonie, 1996)

<u>Selected Remedy</u>

(All cited directly from RD plan) (Canonie, 1996)

The selected remedy for treatment of contaminated soils at the field is thermal desorption. As discussed further herein, while this RAP is prepared for implementing a thermal desorption process, due to the interim period delay to accumulate a remediation fund, a review of new technologies will be performed near the end of the interim period and prior to preparation of the Remedial Design Report to review and select a final remedy. This will allow the opportunity to implement an emerging alternative that is identified during the interim period that may offer equivalent performance.

Alternative remedy bench-and pilot-scale testing, including bioremediation test photos (*sic*), may occur as part of this RAP. Prior to any field activities associated with alternative remedy testing, a work plan discussing the proposed testing will be submitted to the DTSC for approval.

The thermal desorption process is a treatment method that has been demonstrated to remove pesticides from soils at relatively low temperatures. Various patented thermal desorption processes have been used to successfully remediate hazardous waste sites. A description of the typical components of a thermal desorption process is provided in this section. The components are addressed in general terms, because a more precise identification is contingent upon selection of a remediation contractor and is proprietary in nature. The Remedial Design and Implementation (RD) Plan will cover specifics following final selection of remedial alternatives.

The thermal desorption process, in general, uses a materials dryer, or other like mechanism, to heat the contaminated soils. Through this heating process, the hazardous constituents are desorbed/vaporized, and the gases generated are routed for further treatment. No further treatment of soils is required. The soils are then stockpiled and chemically tested to confirm the desired removal efficiency has been achieved.

The hot air/gas stream is then treated to remove organics and particulates. This treatment may include granulated activated carbon treatment and a filtration process. Following treatment, the airstream may be discharged to the atmosphere. The spent carbon is sent to a vendor for regeneration.

A typical process diagram for thermal desorption treatment is shown on Table VII.

Conceptual Remedial Action Plan

Full-scale remediation of the contaminated surface soils at the site is expected to commence in mid-1997. This remedial action plan is predicated on the selection of thermal desorption as the selected remedial alternative. Because the selection of this alternative is to be reviewed in the future, this RAP is conceptual in nature, and the detailed work plan for implementation of the final remedy will be presented in the RD Plan.

Site Preparation

Site security will be enhanced during the course of remediation activities. All use of the site will cease 30 days prior to mobilization of the remediation activities. All persons visiting the site will be required to sign in at the office trailer. Delivery personnel will be restricted from active areas at the site.

The site is located on essentially flat terrain. Other surface features within the areas to be remediated include paved taxiways and runways, paved working areas, concrete pads, and monitoring wells. Prior to mobilization to the site, the staging areas will be cleared and grubbed to remove debris and vegetation. The sealed remediation areas should be relatively free of vegetation.

Facilities for the coordination and operation of a full-scale thermal desorption process will include an office trailer, a decontamination trailer, and remediation process equipment. An on-site mobile laboratory may be used for timely verification of constituent concentration levels. A support area will allow space for subcontractor parking, equipment/supply delivery, and the location for on-site laboratory (if applicable), office and lunch trailers.

The specific placement of equipment and proposed sequence for remediation of specific areas will be presented in the RD Plan. This sequence will optimize equipment efficiency (minimizing travel required for earth-moving equipment), minimize spillage of contaminated material onto clean soils, as well as allowing continued operations by tenant cropdusters. Care will be taken to keep haul routes for pesticide-impacted soil and treated soil separate to the greatest extent practicable.

Survey Control

Survey control will be maintained relative to established benchmarks for horizontal and vertical datum. Tulare County, or its subcontractor, may survey the remediation areas to provide preliminary information on the boundaries of these areas. The remediation subcontractor will be responsible for surveying the progress of the excavation to document work performed.

Air Monitoring

Air monitoring and sampling will be conducted during remediation activities to evaluate potential airborne dust and pesticide emissions. The primary chemicals of concern for this project are ΣDDT and toxaphene. There are no direct-reading instruments capable of detecting airborne emissions of these chlorinated pesticides.

A direct-reading particulate monitor will be used to measure total dust emissions during excavation and soil treatment operations. Background measurements for total dust will be performed upwind and downwind of the work area before each day's work begins. Monitoring for total dust will be performed in the immediate work area during excavation and treatment operations. Additional dust monitoring will be performed at one upwind and two downwind locations near the work site perimeter. If work area or perimeter readings exceed action levels for total dust, additional dust controls will be implemented.

Quantitative Air Sampling and Analytical Methods

Quantitative air sampling for ΣDDT and toxaphene will be performed at the work site perimeter using EPA method T010. This method requires sample collection with personal sampling pumps and polyurethane foam (PUF) cartridges. Perimeter air samples will be shipped for analysis by gas chromatography at a state of California certified laboratory.

Perimeter sampling will be performed at one upwind and two downwind locations before on-site work begins. These samples will provide background concentrations for ΣDDT and toxaphene. Subsequent perimeter sampling will be conducted during excavation and soil treatment operations.

Employee exposures to ΣDDT and toxaphene will be evaluated by quantitative sampling using NIOSH Method 5510. This method requires sample collection with personal sampling pumps equipped with .08-micron cellulose ester filters and Chromosorb 102 adsorption tubes. Employee exposure samples will be shipped for analysis by gas chromatography at a laboratory certified in industrial hygiene sample analysis by the American Industrial Hygiene Association.

Excavation

The estimated initial limits of excavation will be documented. Chemical data was reviewed to estimate the extent of excavation required within the remediation areas. The initial depth of excavation will be 0.5 for most areas. Areas where no further excavation is anticipated, will be sampled using a grid system to determine the frequency of sample collection.

The estimated volume of contaminated soils from the conceptual excavation plan is approximately 14,000 cubic yards. This volume may increase if confirmation samples do not meet cleanup goals, thereby requiring additional material removal.

Excavation of contaminated soils may begin prior to or concurrent with mobilization of the remediation process equipment to the site. Excavation will be accomplished primarily with front-end loaders. A backhoe may be used to excavate the areas deeper than 2 feet or any areas of limited areal extent. Excavated contaminated soils will be fed through a mechanical screen and stockpiled on plastic sheeting. The screening criteria will be established by the remediation contractor. The screen will be mobile and may be placed close to the excavation or near the treatment process equipment. The plastic sheeting will serve as a marker to indicate the depth limit of the contaminated material when the final lifts are removed for processing.

To the greatest extent practicable, areas will be excavated at the ends furthest from the processing equipment first. This will allow excavated soil to be transported over areas to be excavated and, in doing so, minimize travel over clean soils.

Upon completion of excavation of soils from all areas to be remediated, the soil from haul routes for impacted soils will be scraped to remove spillage. This soil will be treated through the remediation equipment train. Spillage of impacted soil in any other handling areas will be treated in a similar manner.

Backfilling

After confirmation sampling, the treated soil will be backfilled in the excavations. Debris generated during excavation activities, such as concrete and rocks, will be backfilled in excavated areas deeper than 2 feet. These areas are anticipated to be the surface impoundment area (at Borings 53 and 55), at the suspected buried trash area (Boring 39), and at the Earlimart's Dusters storage yard.

Decontamination

Decontamination of equipment leaving the exclusion area will be accomplished by pressure-washing at the decontamination pad. A boot-wash, wash bash (*sic*), and emergency eye wash station, will be located in this area. Personal protective equipment will be collected in drums or roll-off boxes for temporary storage, profiled, and appropriate disposal.

Remediation Closure

Canonie Environmental Corporation feels confident of the success thermal absorption will have at Harmon Field during the course of the remediation project.

Reporting

Weekly progress letter reports will be prepared for Tulare County. The reports will document areas excavated, material processed, treated backfill placed, and analytical reporting. The reports will facilitate the tracking of contaminated soils, treatment, and subsequent placement. (Akana 1996)

Final Report

After completion of material treatment, a final report will be prepared to document all site remediation activities. This report will report completed closure of the site, if applicable. The report will be certified by a registered engineer or geologist in the State of California (Canonie, 1996).

New concepts in Environmental Remediation leads to the birth of inventive minds combining with technologically advanced equipment. These remedial options lead to a more cost-efficient and effective means of clean-up.

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OVERVIEW/CRITIQUE

This thesis submittal is purposely written as an overview report of the remedial action plan of the Harmon Airfield site in Pixley, CA. The remedial action plan (RAP) was prepared by Canonie Environmental who were contracted out by the County of Tulare. The RAP was written in September of 1993 in direct response from the California Environmental Protection Agency (Cal- EPA), formerly the California Department of Health Services (DHS). The Cal-EPA mandated that efforts be made towards remediating the site. It was not stated in the report as to what type of authority the Cal-EPA demonstrated when advising the County of Tulare to begin remediation efforts. From what I gather the soil contamination of pesticides at Harmon Airfield has been a known fact for years. As to what level of contamination they were creating, no one had a clue.

As to the concerns of the County of Tulare, they knowingly did not have near the budget to complete such a job. This RAP was basically created to comply with the Cal-EPA, yet did not complete any type of remediation.

We must take into account that industrialized farming is a very political business in the San Joaquin Valley. More importantly, the location of the Harmon Field site is very convenient for the surrounding corporate farms who depend on this airfield for their cropdusting applications. I'm sure the fact that Walt Disney Incorporated farms a substantial amount of the surrounding farmland, played an important role as to why this report was accepted by County officials.

In the efforts to cover all the bases, so to speak, Canonie Environmental did not complete the job. I believe if one wanted to pick this (RAP) apart, writing of unclear methodologies or "things that should have been done," I could write another report.

The following are three factors I feel Canonie might want to review in the 1997 review:

1. The Harmon field investigations found the most widespread contamination to be the persistent organoclorines, DDT and it's metabolites (ΣDDT), and toxaphene. If there was ΣDDT soil contamination exceeding threshold limits calling for remediation, how can Harmon Field Airport continue operations. The RD Plan states that the County of Tulare was given a five-year interim period until further studies are made, yet allowing further use of the Harmon Field Site with no revision or limitations (stated in the RD Plan), as to its uses.

2. The RAP also stated that no infiltration of water around the wash pads was found. At Harmon field, it has been a common practice to wash the planes on these pads for years, with no catch drain. The pads were listed as a "potential hot spot." They should go back and take additional samples to reinforce this claim.

3. The RAP went on listing a variety of remediation techniques which made the bulk of the report. All but one technique could be used at the site. Then, because of the cost of the selected remedy, full-scale remediation of the contaminated surface soils are to commence mid-1997. Being that thermal desorption is the selected remedy, the alternative must be reviewed before implemented in the future. Canonie further stated

that this RAP is conceptual until further studies are made. The final remedy and RD plan will not be known or stated until the studies are continued. Canonie then states that until the County of Tulare can budget such a remediation effort, they are exempt from further remediation efforts, meaning that until the monetary capabilities of the County of Tulare can provide further remedial investigations, Tulare County will be given a grace period. Tulare County is responsible to log and maintain an inspection every six months (on what, not clearly identified). Canonie basically stating, until the final RD plan is complete, there is no more they can do. Nowhere in the RD Plan was it stated as to what legal right the County of Tulare exercised when they conducted the five-year grace period.

This is the "biggest mistake" that Canonie made. In my opinion, if Tulare County cannot afford full remediation, then some kind of restrictions or mandates should apply towards the pesticides handled at the site, until full remediation is capable.

In compliance with the Cal-EPA, Tulare County failed in any type of reduction of contamination at the Harmon Field site. Business can simply go on as usual. Canonie Environmental seemed to conclude the studies with nothing but a promise to continue after Tulare County's grace period is through. There should have been a more solid answer or more definite " long range " plan as to the completion of the Harmon Airfield remediation project.

It is true, I do not know the complete picture and its externalities. There must be good reason for the RAP conclusion at the Harmon Field site. I am hopeful it is not all political as it appears to me.

Updated Progress

Following a valuable instructional thesis advisory meeting with Dr. Paul Richitt**,** (UNLV Environmental Staff), I decided to inquire into the progress of the 1997 review of the Pixley Airfield RAP to answer the questions raised in my Overview/Critique.

The following are listed outcomes of my updated research on the Pixley Airfield RAP:

1. In compliance with question #1, I found that when the County of Tulare turned the RAP into the Cal-EPA Department of Toxic Substance Control, it was not satisfactory. After two years of revision, the RAP of Pixley Airfield was completed in February, 1995. The Airfield was shut down in May, 1995. County officials then proposed a new schedule for remediation dates. Cal-EPA officials accepted this new schedule with one provision: That Pixley Airfield will be shut down and institutional controls be implemented on the site to control contamination.

   The 1995 schedule calls for another five-year interim period, followed in the year 2001 by an RAP review. Remediation is set to commence in the year 2003, as long as the findings of the RAP review in 2001 agrees with the chosen remediation alternative according to effectiveness and feasibility. (Canonie, 1997.)

2. In compliance with question #2, no further sampels were taken near or around the vicinity of the washpad area.

3. In compliance with question #3, I found that a total of a ten-year interim period was given to Tulare County to allow for budgeting remediation costs. The County of Tulare did not know the legalities involved when granted a ten-year interim period by Cal-EPA. The County stated that the Cal-EPA Department of Toxic Substance Control handled all doings of the RAP at Pixley Airfield and they (County of Tulare) do not know how the interim period was legally formed, just that they were able to postpone remediation until the RAP is reviewed in 2001.