To: NMED, Hazardous and Radioactive Materials Bureau

From: Judy Strawhecker, Industrial Hygienist, U.S. Army Corps of Engineers

Re: Request for Additional Information: Phase II RCRA Facility Investigation Report, Landfills Nos. 3 and 4.

Date: 29 April, 1997

NMED Comment #1, Section 1.2, Purpose and Scope of Report: The scope of the Report is limited to analysis of whether groundwater is impacted by the sites. However, no adequate eco-risk analysis has been done. The Phase I RFI Reports state that pesticides, herbicides, and PCB's and other bioconcentrators were released from the landfills, including up to 670 ppb DDT at 15 feet underneath Landfill No. 4, and that there is a potential exposure of wildlife to contaminants originating at the landfills via surface water flowing downgradient to the playa lake. An analysis must be completed to determine the probability of the contaminants, including DDT and its derivatives, at existing concentrations and depths being transported to the surface of the landfills by evapotranspiration, soil-dwelling animals or other mechanisms, and the probability of contaminant concentrations being transported to the playa lake via surface water run-off, shallow groundwater flow, or other mechanisms. Adequate analysis of transport of contaminants may require, among other things, additional sampling to more fully characterized existing concentrations and locations of contaminants, sampling or modeling to determine contaminant concentrations and surface water flow, and sampling of shallow groundwater to determine contaminant concentration levels and groundwater flow towards the lake.

Response to comment:

1. An assessment of the risk to Human Health and the Environment at Landfill No. 4 was addressed in a CAFB RCRA Facility Investigation (RFI) (informally refered to as "Phase I") Final Report, Landfill No. 4 (Radian February 1994) in which the following release media were addressed:

a. Release to and Transport in Groundwater: The travel time of soil moisture through unsaturated soil from the bottom of the landfill to the water table was estimated to be 173 years. Solutes that may be sorbed/desorbed on soil, such as metals and pesticides, are expected to migrate at a slower apparent velocity than the soil moisture and will require a longer period of time to reach the water table. The attenuation of organic species from biological, chemical, and physical degradation was estimated assuming a first-order decay mechanism. Given the extended time of travel, even the most persistent species for which data were available (2,4-D) is expected to be attenuated by a factor of more than 10^{-8}. Less persistent species are expected to be attenuated to a greater degree. Therefore, organic chemicals of potential concern are predicted to be reduced to near zero concentrations in the water table.

b. Surface Water: Most precipitation that falls in the Clovis area is lost to evapotranspiration and shallow infiltration before runoff occurs. Generally, drainage in the Landfill No. 4 area is to the south, toward the playa lake (Radian, 1986) which was chosen as the closest surface water receptor. Therefore, direct release of contaminants detected at the surface of the landfill to the playa lake is possible. (Perhaps with a 25-year storm event rain--Sanford Hutsell) The majority of the contaminants detected at Landfill No. 4 were pesticides which generally are slightly soluble in water. The transport of these compounds (pesticides) in runoff is primarily caused by transport of particulates to which these compounds are bound. Because these compounds are bound strongly to soil, they are likely to be subject of sedimentation. Therefore, erosion by surface water, which is unlikely because of the arid climate, would be required for transport of this contaminant to the playa lake.

Contaminant levels in the playa lake water may also be affected by the rate of groundwater discharge. However, the small concentration of contaminants estimated in the groundwater indicate that groundwater discharge to the playa lake is insignificant. (Groundwater discharge to the playa lake is nonexistent--Sanford Hutsell)

2. Concern that the playa lake was being impacted ecologically by surface water run-off from Landfill No. 4 has been previously addressed. The following text is a response to comment that resulted from a conference call with EPA Region VI, NMED, and Cannon AFB relative to the CAFB Draft Phase II RFI Report, Appendix II and III SWMUs (WCC April 1995), in the Spring of 1996. This report is still pending final.

a. Eco-Risk from Detected Pesticides: A simple exposure scenario was done for mallard ducks using the detected concentrations of pesticides from Phase II. The following text and accompanying table will be added to the Phase II RFI report for the Playa Lake.

ECOTOXICOLOGICAL SCREENING OF SEDIMENT OCP CONCENTRATIONS IN PLAYA LAKE

Approach and Methods

A brief toxicological screening was conducted of organochlorine concentrations in sediments of the Playa Lake at Cannon Air Force Base. The Playa Lake occupies approximately 13 acres, is 4 to 5-ft deep at its greatest depth, and provides open water and wetland habitat for a variety of ducks and wading birds. No threatened or endangered birds have been recorded at the lake. Fish are not thought to be present in the lake due to the poor water quality and anoxic conditions. Wading birds at the lake may be feeding on aquatic insects, invertebrates, and amphibians. A more detailed ecological description of the Playa Lake and wildlife in the area was provided in previous ecological risk assessments (WCC February 1994). Sediment concentrations were evaluated with respect to the hazard they pose for waterfowl populations at the lake. Mallards were selected as the surrogate receptor for the following toxicological screening.

Sediment concentrations for the following organochlorine pesticides (OCPs) were detected:

Dieldrin	2.4 μg/kg
Endrin	2.6 μg/kg
DDE	3.6 μg/kg
DDT	2.4 μg/kg
Chlordane	2.4 μg/kg

The Dieldrin and Endrin concentrations in Playa Lake are below EPA's draft freshwater sediment quality criteria (SQC) of 52 μg/kg and 20 μg/kg, respectively (criteria reported in EPA's January 1996 ECO-Update, Vol. 3., No. 2). The SQC is derived from the chronic ambient water quality criterion using an equilibrium partitioning approach and a total organic carbon content of 1 percent.

The DDT slightly exceeds the effects-range low (ERL) sediment benchmark of 1.6 μg/kg (EPA 1996, ECO-Update, Vol. 3, No. 2). The ERL is based on effects levels from a variety of studies on estuarine sediments and is considered a benchmark below which effects are very unlikely. Due to the manner in which ERL values were developed, slight exceedances of this benchmark do not necessarily mean adverse effects are occurring or are likely to occur to aquatic benthic organisms.

A screening toxicity assessment was conducted for waterfowl using a hazard quotient approach and mallards as the surrogate receptor. Benchmarks for each OCP were obtained from the following sources:

OCP	Literature value	Benchmark Dose (mg/kg-bw/d)	Reference
Dieldrin	dietary NOAEL of 0.3 mg/kg for mallard duckling	0.08	Nebeker et al. 1992
Endrin	chronic NOAEL for mallard	0.3	Opresko et al. 1994
DDE	chronic LOAEL of 0.58 mg/kg-bw/d for mallard and 0.1 uncertainty factor	0.058	EPA 1993a
DDT	chronic NOAEL for mallard	0.58	EPA 1993a
Chlordane	chronic NOAEL for blackbird	2.14	Opresko et al. 1994

Input values (e.g., body weight, percent sediment ingestion) to calculate hazard quotients for sediment and food ingestion were obtained from EPA's (1993b) Wildlife Exposure Factors Handbook. The mallard's food intake rate was assumed to be 20 percent of the mallard's body weight, which is in keeping with measured values for other aquatic-feeding birds (Newell et al. 1987). The sediment intake rate was set at 2 percent of the food intake rate (EPA 1993b).

A bioaccumulation factor of 50, from sediment to food, was estimated, although with considerable uncertainty. Bioaccumulation values from sediment to mallard plant food items are not readily found in the literature. Bioaccumulation of pesticides was investigated in two relatively small lakes in Amsterdam with different levels of contamination (Van der Oost et al. 1990). Ratios between contaminant concentrations in organisms (including fish) and sediments ranged from 0.1 to 41.7. Other literature values were found for bioaccumulation factors from soil to plants, insects, and invertebrates and bioconcentration factors from surface water to aquatic plant, insects and invertebrates. For Dieldrin, literature bioaccumulation factors from soils range from 0.5 for terrestrial plants (ESE 1986) to 5 for earthworms (Korschgen 1970) and 10 for insects (Thorne et al. 1979). Bioconcentration factors for Dieldrin in surface water range from 450 for aquatic plants to over 5,000 for aquatic insects (chironomids) (Rosenlund et al. 1986).

Results

Table 1 presents the results of the hazard quotient and hazard index (sum of hazard quotient) calculations for the mallard. A hazard index of 0.0004 was obtained based on the mallard's sediment ingestion pathway and a hazard index of 1.06 was obtained based on the mallard's food ingestion pathway. The hazard index of 1.06 from food ingestion was largely due to the DDE hazard quotient of 0.62 and the Dieldrin quotient of 0.3. Hazard index values less than 1 are generally interpreted as the risk is negligible; values between 1 and 10 should be interpreted with caution, and values greater than 10 are interpreted as an indication of likely risk. It would appear that potential risk for the mallard, given the hazard index of 1.1, resides in the assumption that the mallard's regular diet is composed of food items from Playa Lake that have accumulated OCPs to a concentration substantially (50 times) greater than that in the sediment.

An additional risk calculation was performed based on the Dieldrin sediment concentration and a recently proposed screening level wildlife criterion (SLWC) of 0.1 μg/L for Dieldrin, based on the mallard (Nebeker et al. 1992). Using the sediment concentration for Dieldrin of 2.4 μg/kg, an equilibrium approach, a K_{oc} value of 1.78E+05 (Hull and Suter 1994) and a value of 10 for total organic carbon (TOC) in sediment, results in a water concentration of 0.0013 μg/L, which is well below the SLWC.

$$\text{Sediment Concentration}\left(\frac{\mu\text{g - chemical}}{\text{kg - sediment}}\right) \div \text{TOC}\left(\frac{\text{gOC}}{\text{kg - sediment}}\right) = \text{Sediment Criterion}\left(\frac{\mu\text{g - chemical}}{\text{gOC in sediment}}\right)$$

$$\left[\text{Sediment Criterion} \div \text{Unit Conversion}\left(\frac{1\text{ kg - OC}}{1{,}000\text{ OC in sediment}}\right)\right] \div K_{oc}\left(\frac{\text{L}}{\text{kg}}\right) = \text{Surface Water Cocentration}\left(\frac{\mu\text{g - chemical}}{\text{L} - \text{water}}\right)$$

Using this same approach for DDT, and a K_{oc} value of 2.40E+05 results in a surface water concentration of 0.001 μg/L. The freshwater chronic ambient water quality criterion (AWQC) for DDT is 0.001 μg/L. Given the conservative nature of the AWQC, chronic effects are not considered likely, based on this approach.

Kirby, R.E., J.H. Riechmann, and L.M. Cowardin. 1985. Home Range and Habitat Use of Forest-Dwelling Mallards in Minnesota. Wilson Bulletin 97: 215-219

Korschgen, L. 1970. Soil-Food Chain-Pesticide Wildlife Relationships in Aldrin-Treated Fields. Journal of Wildlife Management 34: 186-189.

Opresko, D., B. Sample, and G. Suter. 1994. Toxicological Benchmarks for Wildlife: 1994 Revision. Oak Ridge National Laboratory. ES/ER/TM-86/R1.

Nebeker, A., W. Griffis, R. Stutzman et al. 1992. Effects of Aqueous and Dietary Exposure of Dieldrin on Survival, Growth, and Bioconcentration in Mallard Ducklings. Environmental Toxicology and Chemistry, Vol. 11, pp. 687-699.

Newell, A., D. Johnson, and L. Allen. 1987. Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife. Technical Report 87-3, Division of Fish and Wildlife, Bureau of Environmental Protection, New York State Dept. of Environmental Conservation.

Rosenlund, B., S. Jenning, B. Karey et al. 1986. Contaminants in Aquatic Systems at the Rocky Mountain Arsenal-1984. USFWS Final Report.

Thorne, D. J. McBride, C. Legros et al. 1979. Biological Monitoring of Pesticides, Heavy Metals, and Other Contaminants at Rocky Mountain Arsenal. Phase I. Dept. of the Army, RMA, Commerce City, CO. Microfilm RMA076, Frame 1736.

Van der Oost, R., H. Heida, et al. 1991. Bioaccumulation of organic micropollutants in different aquatic organisms: Sublethal toxic effects on fish. Aquatic Toxicology and Risk Assessment: Fourteenth Vol. ASTM., Philadelphia, PA. pp. 166-180.

Conclusions

The hazard index for waterfowl from food and sediment ingestion based on the maximum concentrations detected in sediment is 1.1. As each of the pesticides was detected in only 1 of 10 samples (Phase I and Phase II), the hazard index would be well below 1.0, if a more reasonable maximum exposure (RME) scenario were used. Waterfowl are not expected to spend all their time feeding in the one location at Playa Lake where the one (maximum) value was detected, so risk to waterfowl populations at Playa Lake are considered negligible. Comparison of a water concentration for Dieldrin (0.0013 µg/L), derived through partitioning from sediment (2.4 µg/kg) against a screening wildlife criterion of 0.1 µg/L also indicates a negligible potential risk for waterfowl for Dieldrin. Although the DDT sediment concentration slightly exceeds the ERL sediment criterion for the protection of benthic organisms, adverse effects to aquatic populations in Playa Lake are considered unlikely as DDT was detected in only 1 of 10 sediment samples.

Additionally, the exposure scenario used to calculate the HI assumed that the Playa Lake accounted for 100 percent to the mallards' home range. A mallard's home range varies markedly based on the time of year and the sex of the bird. Females in spring May have the smallest home range (94 acres to 593 acres; averages of 274 acres) (Dwyer 1979), while adult males have a much larger and variable home range (173 acres to 2,816 acres; average of 1,531 acres) (Kirby 1985). The Playa Lake is approximately 130 acres. If the average home range for a female in lay is 274 acres, the HI at the Playa Lake is likely overestimated by a factor of 2, and the actual potential for adverse effects closer to 0.011 than 1.1. Therefore, the potential for adverse health effects to waterfowl at the Playa Lake from the detected pesticides is likely minimal and would more likely pertain to an individual than to the Playa Lake population as a whole.

References

Dwyer, T.J., G.L. Krapu, and D.M. Janke. 1979. Use of Prairie Pothole Habitat by Breeding Mallards. Journal of Wildlife Management 43: 526-531.

EPA. 1993a. Proposed Great Lakes Water Quality Initiative Documents for the Protection of Wildlife. Office of Water. PB93-154722.

EPA. 1993b. Wildlife Exposure Factor's Handbook. Office of Research and Development, Washington, D.C. EPA/600/R-93/187a

Environmental Science and Engineering, Inc. (ESE). 1989. Rocky Mountain Arsenal, Biota Remedial Investigation, Final Report. Prepared for Office of Program Manager, Rocky Mountain Arsenal Contamination Cleanup. Commerce City, Colorado. 89173R02.

Hull, R. and G. Suter. 1994. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1994 Revision. Oak Ridge National Laboratory, Environmental Restoration Program. ES/ER/TM-95/R1

TABLE 1

HAZARD INDEX CALCULATION FOR DUCKS FROM OCP INGESTION IN FOOD AND SEDIMENT

Food	Dieldrin	Endrin	DDE	DDT	Chlordane	
Food Intake Rate (kg/day)(20%*BW)	0.24	0.24	0.24	0.24	0.24	
Body weight (kg)	1.2	1.2	1.2	1.2	1.2	
Sediment Concentration (mg/kg)	0.0024	0.0026	0.0036	0.0024	0.0024	
Bioaccumulation Factor (food/sediment)	50	50	50	50	50	
Food Concentration (mg/kg)	0.12	0.13	0.18	0.12	0.12	
Dose (mg/kg/d)	0.02	0.03	0.04	0.02	0.02	
Screening Value (mg/kg/d)	0.08	0.3	0.058	0.58	2.14	
Hazard Quotient	0.30	0.09	0.62	0.04	0.01	1.06
Sediment	**Dieldrin**	**Endrin**	**DDE**	**DDT**	**Chlordane**	
Food Intake Rate (kg/day)	0.24	0.24	0.24	0.24	0.24	
Body weight (kg)	1.2	1.2	1.2	1.2	1.2	
% Sediment in Diet	0.02	0.02	0.02	0.02	0.02	
Matrix effect	1	1	1	1	1	
Sediment Intake (kg/day)	0.0048	0.0048	0.0048	0.0048	0.0048	
Concentration (mg/kg)	0.0024	0.0026	0.0036	0.0024	0.0024	
Dose (mg/kg/d)	0.00001	0.00001	0.00001	0.00001	0.00001	
Screening Value (mg/kg/d)	0.08	0.3	0.058	0.58	2.14	
Hazard Quotient	0.0001	0.00003	0.0002	0.00002	0.000004	0.0004
Hazard Index	0.30	0.09	0.62	0.04	0.01	1.06