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PMC

Ms. Maria Martinez
USEPA Region VI
1445 Ross Avenue (6H-PN)
Dallas TX 75202-2733

and

Ms. Barbara Toth
State of New Mexico Environment Department
Hazardous and Radioactive Materials Bureau
2044A Galisteo Street
Santa Fe NM 87505

RE: Fort Wingate Depot Activity (FWDA)-Ecological Risk Assessment; Selection of receptors and exposure assumptions

Dear Ms. Martinez and Ms. Toth:

Program Management Company (PMC) at the direction of the U.S. Army Corps of Engineers (USACE), Fort Worth District and the Tooele Army Depot, Utah, submits this correspondence to address outstanding issues for the ecological risk assessment at FWDA in Gallup New Mexico. This correspondence is intended to follow up on discussions held 29 October 1997 and 2 December 1997 regarding the ecological risk assessment for FWDA. For reference purposes, a summary of our previous discussions has been provided for the following items: background screening levels for surface water and sediment, toxicity data for calculation of screening levels, and receptor selection. The proposed exposure assumptions for the receptors selected for the screening effort will also be presented.

1. *Background Screening Levels for Surface Water and Sediment*

Background surface water and sediment samples were collected from the Eastern Portion Pond during two sampling events. Surface water samples only were collected from this pond in 1993 during the same time period as the initial RI/FS data collection. Additional samples were collected in August 1997 in order to provide co-located sediment and surface water data. In neither instance were turbidity, total dissolved solids, or filtered samples collected. NMED expressed concern regarding the lack of turbidity data and the acceptability of the data collected for determining background concentrations. It was recommended that the Army investigate whether data contained in a report entitled: "*Water-Quality Assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas- Organic Compounds and Trace Elements in Bed Sediment and Fish Tissue, 1992-1993*" would provide an acceptable sediment and surface water background concentrations for FWDA. NMED further warned that we should expect difficulties regarding NMED concurrence associated with using background to screen the surface water and sediment data. It should be noted that background screening levels are only being proposed for use in the uncertainties assessment step of the ecological risk assessment and, therefore, may not play as pivotal a role in decision making for ecological risks as in the human health risk assessment where they were used in the initial screening step.

2. *Toxicity Data for Calculation of Screening Levels*

Maria Martinez called both A. Baines (PMC) and D. Ford (USACE, Fort Worth) on 23 December to inform the Army that she was not able to secure a list of toxicity data from USEPA Region VIII. She requested that the Army send the toxicity papers discussed during the 3 July and 29 October meetings. The toxicity papers were sent under separate cover on 7 January 1998. In addition, the table of toxicity values that was provided to the regulatory agencies on 20 June 1997 will be clarified so that the assumptions inherent in the selected NOAELs are clearer. A revised table of toxicity values with additional notes will be provided to the agencies.

3. *Receptor Selection*

Receptors for the screening level derivation were selected both during the 3 July meeting and the 5 December telephone conference. The following receptors have been selected: Gray fox, red-tailed hawk, American robin, deer mouse. The Army is proposing use of two terrestrial plants [sunflowers (Texas blueweed, *Helianthus ciliaris DC.*) and (Indian ricegrass, *Oryzopsis hymenoides*)] and a terrestrial invertebrate (creosote bush grasshopper, *Bootettix argentatus*) to balance the potential risks to the lower end of the food chain. Please reference the attached Figure 1 for the revised food web.

The proposed exposure assumptions for the selected receptors are presented on the attached Table 1. All values have been selected from the "Wildlife Exposure Factors Handbook- Volumes I and II" (USEPA, 1993) with the exception of the gray fox fraction of prey and forage in diet. The following equations will be used to derive the screening levels:

$$HQ = \frac{dose}{NOAEL} \qquad (1)$$

where:

HQ= hazard quotient

NOAEL= No observed adverse effects level (mg/kg/day) (USEPA, 1997)

dose= (mg/kg/day) this is based on the dose equation presented in USEPA, 1993.

The following equations explain how equation (1) will be used to estimate the receptor-specific risk based concentration (RBC). Because the dose term of the equation differs for each group of receptors, dose and RBC equations for each group of receptors will be presented.

The RBCs for invertebrates and the two plant species will be based on the concentration in soils that could result in toxicity to the receptor. The HQ equation for invertebrates and plants is:

$$HQ = \frac{C_s}{NOAEL\left({}^{mg}\!/_{kg}\right)} \tag{2}$$

where:

C_s = Concentration of a constituent in soil (mg/kg)

NOAEL = No Observed Adverse Effects Level in the units of a concentration (mg/kg)

HQ =Hazard quotient (set to 1)

To derive the RBCs for plants and invertebrates from eqn (2), the equation is solved for C_s which becomes the RBC. The RBC equation is:

$$RBC_{plant\ or\ invertebrate} = NOAEL\left({}^{mg}\!/_{kg}\right) x\ HQ \tag{3}$$

where:

$RBC_{plant\ or\ invertebrate}$ = Risk based concentration specific to plants or invertebrates(mg/kg)

The RBCs for the remaining receptors (avian and mammalian species) will be based on the following two equations. A RBC for the soil ingestion pathway only for each receptor is presented in eqn (4). And, the RBC in soil that takes into account constituent concentrations in food is presented in eqn (5). The lowest of these RBCs for all the receptors will be selected as the RBC; in this manner a conservative RBC will be attained for each constituent.

$$RBC_{soil} = \frac{HQ\ x\ NOAEL}{FS\ x\ NIR_{total}} \tag{4}$$

$$RBC_{soil-diet} = \frac{RBC_{soil}}{MF} \tag{5}$$

where:

HQ = Hazard quotient (set to 1)

FS = Fraction of soil in diet

NIR_{total}=Food ingestion rate for total diet normalized to body weight

RBC_{soil} = Risk based concentration for soil ingestion pathway only for soil (receptor specific)

$RBC_{soil\text{-}diet}$ = Risk based concentration for both soil and dietary ingestion pathways (receptor specific)

MF = Modifying factor (for TAL metals, TCL VOCs, TCL SVOCs, or explosives a value of 10 will be used; for pesticides and PCBs a value of 100 will be used)

In reference to eqn (5), the following text explains the use of the modifying factor of ten to take into account the contribution of constituents in food for TAL metals, TCL VOCs, TCL SVOCs, Explosives; the pesticides and PCBs have higher bioaccumulation potential so a factor of 100 will be used. If only the soil ingestion pathway is considered when estimating the acceptable RBC_{soil}, risk will be underestimated. The amount by which risk is underestimated depends primarily on two factors:

- The propensity for the chemical to bioaccumulate in biological media, which is represented by the bioaccumulation factor for the chemical (BAF), and
- The size of the soil fraction relative to the remaining dietary fraction.

BAFs vary widely for different analytes. The BAFs for organochlorine pesticides are very large (>100) because they are not only lipophilic but very stable physiologically, whereas the BAFs for most metals are less than 1. The higher the BAF, the greater the chance of underestimating risk when using only the soil ingestion pathway to establish screening-level RBCs.

The fraction of soil ingested relative to the total diet is very small for most receptors, typically <10%. This leaves 90% or more of the total daily diet unaccounted for when only the soil ingestion pathway is evaluated. If the BAFs are very small (<0.01), this would become insignificant. However, if the BAFs are 1 or greater, underestimation becomes more pronounced.

For example, knowing that the BAF times the soil concentration results in an estimate of tissue concentration, and all other parameters being constant (i.e., soil concentration, dietary ingestion rate normalized to body weight, soil fraction in diet), a comparison of the importance of the dietary and the soil ingestion pathways can be made. Dose due to soil ingestion is simply concentration times the soil ingestion rate; dose due to diet is the predicted concentration in biota (Cbiota times the dietary ingestion rate). The following equations show this relationship:

$$C_{biota} = C_{soil}\ x\ BAF \tag{6}$$

$$NIR_{total} = NIR_{soil} + NIR_{food} \tag{7}$$

$$Dose_{soil} = NIR_{soil}\ x\ C_{soil} \tag{8}$$

$$Dose_{food} = NIR_{food}\ x\ C_{biota} \tag{9}$$

where:

C_{biota} = Concentration of a constituent in biota (mg/kg)

NIR_{soil} = Food ingestion rate for soil in diet normalized to bodyweight

NIR_{food} = Food ingestion rate for food in diet normalized to bodyweight

In Table 2, C_{soil} is assumed to be one, and BAF is varied to demonstrate the effect on C_{biota}. NIR_{total} (the total daily dietary ingestion rate) was assumed to be 0.25, and the fraction of soil in diet 10%. This yields a NIR_{soil} of 0.025. The NIR_{soil} is subtracted from the NIR_{total} to yield the NIR_{diet}. Dose due to diet is estimated with eqn (8) and dose due to soil is estimated with eqn (7).

When the BAF is 0.1, the dose is nearly equal for both pathways. When the BAF is 1 (as presented on Table 2), the dose is 10 times higher for the dietary pathway than the soil ingestion pathway. As long as the BAF is 0.1 or less, dividing the RBC_{soil} by a factor of 1 would be sufficient. However, it is more conservative to assume that BAFs will be at least 1. Therefore, reducing the RBC_{soil} by a factor of 10 should be sufficient to account for the dietary ingestion pathway except in the case of organochlorine pesticides and PCBs. As presented on Table 2, reducing the RBC_{soil} by 100 should be sufficient to take into account the higher BAFs for the pesticides and PCBs.

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A screening level will be derived using the equations (4 and 5) presented above for each of the selected avian and mammalian receptors. Concentrations in soil that result in adverse effects for plants and invertebrates will be used for the lower trophic receptors (eqn 2). The lowest of all of these levels (e.g., RBC_{plant}, $RBC_{invertebrate}$, RBC_{soil}, $RBC_{soil\text{-}diet}$) will be selected as the screening level for each constituent.

We would like to discuss all of these items during our upcoming conference call on 17 February at 1 p.m. Mountain time. Toxicity studies should have already arrived under separate cover to your both and evaluation of surface water regulations is ongoing. As always, should you have any questions or require further information, please call Mr. Dwayne Ford- USACE Fort Worth at (817) 978-9924 ext. 1644.

Sincerely,

Ann Baines

Ann Baines
Risk Assessment Task Manager

USEPA, 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. EPA/540/R-97/006

USEPA, 1993. Wildlife Exposure Factors Handbook, Volumes I and II. EPA/600/F-93/187a

AAB
enclosures
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S. Egnaczyk
MJ. Stell

Table 1
RME Exposure Assumptions
for Ecological Receptors
Fort Wingate Depot Activity
Gallup, New Mexico

			Terrestrial Receptors			
		Units	American Robin	Deer Mouse	Red Tailed Hawk	Gray Fox*
Dietary Ingestion Rate	NIR	kg/kg-day	0.890	0.190	0.112	0.069
Water Ingestion Rate	WIR	kg/kg-day	0.140	0.600	0.059	0.086
Soil Fraction in Diet	FS	unitless	0.104	0.020	0.028	0.028
Prey Fraction in Diet	FRp	unitless	0.553	0.636	1.000	0.600
Forage Fraction in Diet	FRf	unitless	0.448	0.367	0	0.400
Body Weight	BW	g	63.5	20.4	957	3269
Body Weight	BW	kg	0.635	0.0204	0.957	3.269

Notes and Sources:

Robin bodyweight is based on observed maximum body weights for male birds collected in Wisconsin (Jung, 1992 found in USEPA, 1993)

Robin dietary ingestion rate is based on a maximum fruit consumption during a two day feeding trial (Skorupa and Hothem, 1985 found in USEPA, 1993)

Robin water ingestion rate is estimated (USEPA, 1993).

Robin prey and forage fraction in diet is based on an annual averagedistribution for the western US (Wheelwright, 1986 found in USEPA, 1993)

Robin soil ingestion fraction is based on the American woodcock (Table 4-4, USEPA, 1993)

Deer mouse weight is based on the average observed in high altitude desert in Nevada (Hayward 1965 found in USEPA, 1993)

Deer mouse dietary ingestion rate is based on the highest average rate for nonbreeding laboratory mice (Millar, 1979 found in USEPA, 1993)

Deer mouse water ingestion rate is based on the maximum rate presented for the same species as the body weight (Ross, 1930 found in USEPA, 1993)

Deer mouse prey and forage in diet are based on observed diet during the summer in Montana sage brush grass lands (Sieg, et.,al., 1986 found in USEPA, 1993)

Deer mouse soil fraction in diet is based on an estimate for the white footed mouse (Table 4-4, USEPA, 1993).

Red tailed body weight is based on an average for adult males in Southwest Idaho (Steenhof, 1983 found in USEPA, 1993)

Red tailed dietary ingestion rate is based on the average for an adult male during the winter in south Michigan (Craighead & Craighead, 1956 found in USEPA, 1993).

Red tailed hawk water ingestion rate is an estimated value (pg. 2-82, USEPA, 1993).

Red tailed soil ingestion fraction is based the Red fox because they are in the same feeding guild.

* All gray fox exposure assumptions are based on information for the red fox.

Gray fox body weight is based on the minimum spring weight for females for Illinois farm land (Storm, 1976 found in USEPA, 1993)(Spring was selected because the animals were the leanest in this season).

Gray fox dietary ingestion rate is based on a mean for nonbreeding red foxes in North Dakota (Sargent, 1978 found in USEPA, 1993).

Gray fox water ingestion rate is an estimated value (pg. 2-225, USEPA, 1993)

Gray fox prey and forage ingestion fractions are based on the gray fox prey ingestion rate for the southwest (Fitzgerald, James, Carron Meany, and David Armstrong, 1994. Mammals of Colorado. University Press of Colorado.).

Gray fox soil ingestion fraction is based on estimates for the red fox (Table 4-4, USEPA, 1993).

Table 2
BAF Impacts on Dose Estimates
Fort Wingate Depot Activity
Gallup, New Mexico

Csoil (mg/kg)	**BAF** (unitless)	**Cbiota** (mg/kg)	**NIRtotal** (kg/kg bw/day)	**NIRsoil** (kg/kg bw/day)	**NIRfood** (kg/kg bw/day)	**Dose(food)** (mg/kg/day)	**Dose(soil)** (mg/kg/day)
1	0.01	0.01	0.25	0.025	0.225	0.00225	0.025
1	0.1	0.1	0.25	0.025	0.225	0.0225	0.025
1	1	1	0.25	0.025	0.225	0.225	0.025
1	10	10	0.25	0.025	0.225	2.25	0.025

NIRtotal = NIRsoil + NIRfood

Figure 1-Revised
Food Web of Fort Wingate Depot Activity
Gallup, New Mexico

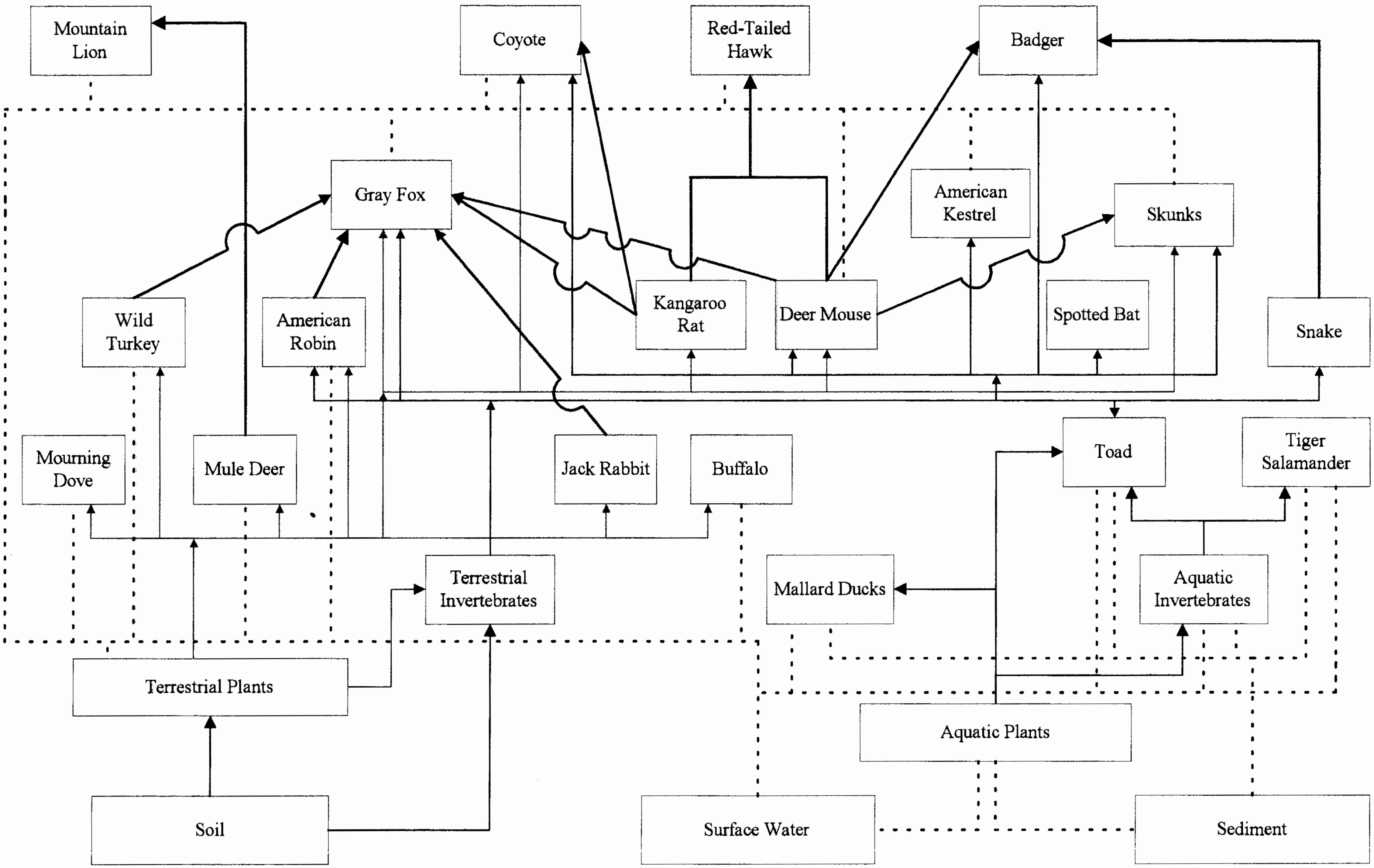

Figure 1-Revised
Food Web of Fort Wingate Depot Activity
Gallup, New Mexico

Notes:
Blue Lines: Aquatic food web
Dashed Black Lines: Food web involving exposure to surface water
Dashed Red Lines: Food web involved in exposure to sediment
Black Lines: Food web involved in exposure to soil
Green Lines: Food web involved in exposure to terrestrial plant material
Thin Red Lines: Food web involving exposure to lower trophic level prey
Thick Red Lines: Food web involving exposure to upper trophic level prey
Shaded boxes represent selected receptors for risk evaluation