Appendix E.

Ecotoxicity Information

Freshwater Fish Acute Toxicity Data.					
Common Name	**%AI**	**Study parameters**	**Test Results**	**MRID**	**Classification/ Category**
Bluegill sunfish *Lepomis macrochirus*	100	96 hour study 10 fish/treatment Static study.	96-h LC_{50} = 0.710	43249501	Acceptable/ Highly toxic
Rainbow trout *Onchorhynchus mykiss*	100	96 hour study 10 fish/treatment Static study.	96-h LC_{50} = 0.450	43249502	Acceptable/ Highly toxic

Freshwater Invertebrate Acute Toxicity Data					
Common Name	**%AI**	**Study parameters**	**Test Results**	**MRID**	**Classification/ Category**
Water flea *Daphnia magna*	N/A	48-h flow-through study Nominal treatments: 110, 180 ,310, 510 and 850 µg/L.	**48-h EC_{50}: 0.640 mg a.i./L** **NOAEC: 0.280 mg a.i./L**	42356101	Acceptable/ Highly toxic

Avian Acute Oral Toxicity			
Species	**Toxicity Value Used in Risk Assessment [1]**	**Citation MRID # (Author & Date)**	**Comments**
Northern bobwhite quail (*Colinus virginianus)*	**LD_{50} = 258 mg a.i./kg-bw[2]**	41513101	Acceptable/Highly Toxic

[1] birds were observed for 30 days after dosing
[2] all mortality (28 of birds dosed) occurred within 5 days

Avian Subacute Dietary Toxicity			
Species	**Toxicity Value Used in Risk Assessment [1]**	**Citation MRID # (Author & Date)**	**Comments**
Northern bobwhite quail (*Colinus virginianus)*	**5-day LC_{50} = 56 mg a.i./kg-diet[2]**	41513102	Acceptable/Highly Toxic
Mallard duck (*Anas platyrhynchos*)	**5-day LC_{50} = 172 mg a.i./kg-diet[3]**	41513103	Acceptable/Highly Toxic

Secondary Exposure Toxicity to Birds							
Predator/ scavenger (p/s)	**Prey offered to p/s**	**No. prey offered daily per p/s**	**No. days p/s exposed**	**No. p/s exposed**	**No. p/s dead**	**No. survivors with signs of chlorophacinone toxicity[a]**	**Reference**
Barn owl (*Tyto alba*)	rats fed choice of 0.005% bait or untreated bait for 5 days	1-2	10	2	0	0	Mendenhall and Pank 1980
Black-billed magpie (*Pica hudsonia*)	rats fed 0.005% bait for 5 days	ad lib.	5	20	0	0	Baroch 1997
American kestrel (*Falco sparverius*)	voles fed 0.01% bait until dead	1 1 every 3 days	21 61	10 10	0 0	10 (eb/ih) 10 (eb/ih)	Radvanyi et al. 1988
Red-tailed hawk (*Buteo jamaicensis*)	voles fed 10 g 0.005% bait daily for up to 9 days	2	6	5	0	0	Askham and Poché 1992
Great horned owl (*Bubo viriginianus*)	voles fed 10 g 0.005% bait daily for up to 9 days	2	6	1	0	0	Askham and Poché 1992
Red-tailed hawk	voles fed 0.005% bait for up to 9 days	2	6	5	0	0	Askham 1988
Great horned owl	voles fed 0.005% bait for up to 9 days	2	6	1	0	0	Askham 1988
Tawny owl (*Strix aluco*)	mice fed 0.0075% bait[b]	ad lib.	10	4	0	(ct)	Riedel et al. 1991[c]

Secondary Exposure Toxicity to Birds							
Predator/ scavenger (p/s)	**Prey offered to p/s**	**No. prey offered daily per p/s**	**No. days p/s exposed**	**No. p/s exposed**	**No. p/s dead**	**No. survivors with signs of chlorophacinone toxicity[a]**	**Reference**
Eurasian buzzard (*Buteo buteo*)	mice fed 0.0075% bait[b]	ad lib.	7 10 5+5+5[d] 40	4 6 3 3	0 0 0 0	(ct) (ct) (ct) (ct)	Riedel et al. 1991[c]
Eurasian buzzard	mice fed 0.0075% bait[b]	4	7	4	0	0	Anonymous 1978[c]
Carrion crow (*Corvus corone*)	mice fed 0.0075% bait[b]	ad lib.	10	4	0	(ct)	Riedel et al. 1991[c]
Carrion crow	mice fed 0.0075% bait[b]	3-4	3 5	12 12	0 0	0 0	Sterner 1978[c]
White stork (*Ciconia ciconia*)	mice fed 0.0075% bait[b]	ad lib. (treated /untreated)	3 14	3 3	0 0	1 or 2 (ct) 1 or 2 (ct)	Sterner 1981[c]

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

[b] ground squirrels were fed no-choice for 3 days followed by 3 days in which they had a choice of bait or untreated laboratory chow

[c] baits registered in the U.S. are either 0.005% or 0.01% ai

[d] individual was sacrificed but considered 'dead' based on coagulation index

Mammal Acute Toxicity			
Species	**LD50, mg a.i./kg-bw (95% CI)**	**LC50, mg a.i./kg-diet (95% CI)**	**Citation MRID # (Author & Date)**
Laboratory rat (*Rattus norvegicus*)		1.14 (1.02-1.36) 1.14 (0.98-1.35) 1.26 (1.11-1.47) 1.26 (0.97-1.64)	EPA unpublished data[a]
Laboratory rat (*Rattus norvegicus*)	6.2 3.1 (1.5-6.7) 11.0 (6.5-18.5)		41875301
Laboratory rat (*Rattus norvegicus*)	0.95 (5-day dose @ 0.19/day)		Jackson and Ashton 1992
Norway rat (wild)	0.80 (5-day dose @ 0.16/day)		Jackson and Ashton 1992
House mouse	1.0 6		Hone and Mulligan 1982[b]
Laboratory mouse	5.95 (5-day dose @ 1.19/day)		Jackson and Ashton 1992
Deer mouse	0.49		Clark 1994
Deer mouse	1.0-3.75[c]		Schafer and Bowles 1985
Norway rat	5.0		Clark 1994
Pine vole	14.2 (11.4-17.6)		Byers 1978
Roof rat	15.0		Clark 1994
Dog	50-100		Labe and Lorgue 1977

[a] the 5 dietary tests for brodifacoum and 4 dietary tests for bromadiolone were conducted at EPA's former Toxicology Unit, Beltsville, MD; methodology follows that described in McCann et al. 1981

[b] cited in Hyngstrom et al. 1994

[c] an approximate lethal dose (ALD); the ALD is estimated from an acute oral test that uses too few concentrations and test animals to statistically derive an LD50

Secondary Exposure Toxicity to Mammals							
Predator/ scavenger (p/s)	**Prey offered to p/s**	**No. prey offered daily per p/s**	**No. days p/s exposed**	**No. p/s exposed**	**No. p/s dead**	**No. survivors with signs of chlorophacinone toxicity[a]**	**Reference**
Mongoose (*Galidictis sp.*)	rats fed 0.005% bait for 5 days	1	1 3 5 6 7 9 10	1 1 2 1 1 1 1	0 1 2 1 1 1 1	nr no survivors no survivors no survivors no survivors no survivors no survivors	Pank and Hirata 1976
Coyote (*Canis latrans*)	ground squirrels fed 15 g of 0.01% bait for 6 days[b]	1	5	7	3	0	Marsh and Howard 1986
Red fox (*Vulpes vulpes*)	mice fed 0.0075% bait[c]	20 total	4	1	1[d]	no survivors	Bachhuber and Beck 1988[e]
European ferret (*Mustela putorius*)	rats fed 0.005% bait for 5 days	ad lib.	5	20	11	nr	Ahmed et al. 1996
European ferret	prairie dogs fed 25 g of 0.0025% bait daily for 6 days[c]	4 (1 every other day)	8	6	5	nr	Fisher and Timm 1987
European ferret	voles/mice fed 0.0075% bait[c]	5 total	4	2	1[f]	(ct)	Bachhuber and Beck 1988[e]
European ferret	muskrats fed 0.005% bait	ad lib.	4 8	2 1	0 1	1 (bl) no survivors	Jobsen 1978[e]
European ferret	voles fed 0.0075% bait[c]	ad lib.	3	4	0	(ct)	Anonymous 1983[e]
Weasel (*Mustela erminea*)	mice fed 0.005% bait	ad lib.	90	4	3	0	Anonymous 1981[e]

[a] eb = external bleeding; ih = internal hematoma; bl = bleeding (unspecified); ct = increased blood coagulation time; nr = not reported

[b] ground squirrels were fed no-choice for 3 days followed by 3 days in which they had a choice of bait or untreated laboratory chow

[c] baits registered in the U.S. are either 0.005% or 0.01% ai

[d] individual was sacrificed but considered 'dead' based on coagulation index

Terrestrial and Simulated Field Tests				
Common Name	**%AI**	**Nontarget kill**	**MRID**	**Classification/Category**
California Ground Squirrel (*Spermophilus beecheyi)*	0.01% and 0.005% grain baits	Poisoning confirmed in 14/15 mice and 2/2 woodrats examined on 5 0.01% bait plots and 9/13 mice and 3/3 wood rats on 5 0.005% bait plots	43922201	Supplemental[2]
California Ground Squirrel	Bait station with 0.005% grain bait	poisoning confirmed in 3/3 mice examined on 2 bait plots[1]	43922202	Supplemental[2]
California Ground Squirrel	0.005% pelleted bait	Poisoning confirmed in 2 dead rabbits (residue levels of 0.011 and 1.16 ppm in GI tract)	41649301	Supplemental[2]
Pine vole (*Microtus pinetorum*)	1 ground spray at 0.3 lb/ac	No mortality or adverse affects were observed in six captive opossums exposed for 14 days to sprayed ground vegetation in an orchard	234579	Supplemental[3]

[1]poisoning was indicated by blue-dyed bait in the GI tract, blue stain in fatty tissues, subdermal hematomas, and/or
internal hemorrhaging
[2]the study was an efficacy test that provided some information on nontarget hazards
[3]sample size (6 opossums) was small

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