Attached are Appendices 9 and 10 to the Revised Draft Biological Opinion received from NMFS on May 13, 2011. These two appendices were omitted from the Revised Draft Biological Opinion provided to EPA by NMFS on May 13, 2011. Appendix 9 was received by EPA on May 20, 2011 and Appendix 10 was received by EPA on May 19, 2011.

Appendix 9 – per Term and Condition 2.b.

Allowable application windows to control invasive and exotic aquatic plant species with 2,4-D.

Species	ESU	Allowable Application Period
Chinook	Puget Sound	July 15 – August 31
	Lower Columbia River	July 15 – August 31
	Upper Columbia River Spring-Run	July 15 – August 31
	Snake River Fall-Run	September 1 – September 30
	Snake River Spring/Summer-Run	July 15 – August 15
	Upper Willamette River	July 15 – August 31
	California Coastal	July 15 – August 15
	Central Valley Spring-Run	Legal Delta only: June 15 – September 15; elsewhere consult with NMFS/PRD C. Valley Office.[1]
	Sacramento River Winter-Run	Legal Delta only: June 15 – September 15; elsewhere consult with NMFS/PRD C. Valley Office.[2]
Chum	Hood Canal Summer-Run	June 15 – August 15
	Columbia River	June 1 – August 31
Coho	Lower Columbia River	August 1 – September 15
	Oregon Coast	July 1 – August 31
	Southern Oregon / Northern California Coast	July 15 – August 15
	Central California Coast	July 15 – August 15
Sockeye	Ozette Lake	June 1 – September 30
	Snake River: Lakes: Red Fish, Alturas, Yellowbelly, Pettit, and Stanley	None. Consult with NMFS/HCD Idaho State Office on case-by-case application needs.[2]
Steelhead	Puget Sound	July 15 – September 30
	Lower Columbia River	August 1 – August 31
	Upper Willamette River	July 15 – August 31
	Middle Columbia River	August 1 – August 15
	Upper Columbia River	August 15 – August 31
	Snake River	August 1 – September 30
	Northern California	July 15 – August 15
	Central California Coast	July 15 – August 15
	California Central Valley	Legal Delta only: June 15 – September 15; elsewhere consult with NMFS/PRD C. Valley Office.[2]
	South-Central California Coast	Streams north of San Carpofora Creek: July 15 – August 15; elsewhere consult with NMFS/PRD Southern California Office on case-by-case application needs.[2]
	Southern California	None. Consult with NMFS/PRD Southern California Office on case-by-case application needs.[2]

[1] For description of Legal Delta, see p. 6 & & of link: http://baydeltaoffice.water.ca.gov/sdb/tbp/deltaoverview/delta_overview.pdf

[2] Contact Numbers: S. Calif. Office: 562-980-4020; Central Valley Office: 916-930-3600; For Idaho – 208-378-5696

Appendix 10 – Ecological Effects Data from EPA's Red Legged Frog BEs

Appendix F

Ecological Effects Data

Table F-1. Acute freshwater fish toxicity to 2,4-D							
Species	**% ai**	**96-hour LC50 (95% CI)**		**Measured/ Nominal Test Concentrations**	**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**				
2,4-D acid (PC Code: 030001)							
Rainbow trout *(Oncorhynchus mykiss)*	98.7	358	358	Measured	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
Bluegill sunfish *(Lepomis macrochirus)*	98.7	263	263	Measured	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
Fathead minnow (*Pimephales promelas*)	98.7	320	320	Measured	Practically non-toxic	411583-01, Alexander et. al., 1983	Supplemental
2,4-D Sodium Salt (PC Code: 030004)							
Rainbow trout *(Oncorhynchus mykiss)*	80	>100	>91	Nominal	Practically non-toxic	53986, McCann, 1973	Acceptable
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)							
Rainbow trout *(Oncorhynchus mykiss)*	73.1	>120	>81.6	Measured	Practically non-toxic	419751-05, Graves. et. al., 1991.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	73.1	>121	>82.3	Measured	Practically non-toxic	419751-04, Graves. et. al., 1991.	Acceptable
Fatahead minnow (*Pimephales promelas*)	73.1	344	234	Measured	Practically non-toxic	41975`-04, Graves, et. al, 1991	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	Not Reported	149	101	Measured	Practically non-toxic	0073-091-01, Sleight, B., 1971.	Supplemental
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)							
Rainbow trout *(Oncorhynchus mykiss)*	67.3	>1000	>830	Measured	Practically non-toxic	233350, Vilkas, A,G,, 1977.	Acceptable

Table F-1. Acute freshwater fish toxicity to 2,4-D							
Species	**% ai**	**96-hour LC50 (95% CI)**		**Measured/ Nominal Test Concentrations**	**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**				
Bluegill sunfish (*Lepomis macrochrus*)	73.1	>121	>100	Measured	Practically non-toxic	419751-04, Graves, et. al., 1991.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	67.3	250	207.5	Measured	Practically non-toxic	411583-11, Alexander, et. al., 1983.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	51.1 9TEP)	>1000	>830	Measured	Practically non-toxic	234027, Vilkas, A.G., 1978.	Supplemental
Fathead minnow (*Pimephales promelas*)	67.3	318	264	Measured	Practically non-toxic	419751-04, Graves. et. al., 1991.	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)							
Rainbow trout (Oncorhynchus mykiss)	48.7 (TEP)	2840	2244	Measured	Practically non-toxic	01338869, 1983.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	48.7 (TEP)	1700	1343	Measured	Practically non-toxic	01338869, 1983.	Acceptable
Fathead minnow (*Pimephales promelas*)	48.7 (TEP)	2180	1722	Measured	Practically non-toxic	01338869, 1983.	Supplemental
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)							
Rainbow trout (Oncorhynchus mykiss)	69.2	300	162	Measured	Practically non-toxic	413538-03, Mayes, et. al., 1989.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	69.2	401	217	Measured	Practically non-toxic	413538-04, Mayes, et al., 1989	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)							
Rainbow trout *(Oncorhynchus mykiss)*	97.4	2.09	1.44	Measured	Moderately toxic	413538-01, Alexander, et. al, 1983.	Acceptable

Table F-1. Acute freshwater fish toxicity to 2,4-D							
Species	**% ai**	**96-hour LC50 (95% CI)**		**Measured/ Nominal Test Concentrations**	**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**				
Rainbow trout *(Oncorhynchus mykiss)* static	77.5	0.65 (56-hour LC50)	0.45	Measured	Highly toxic	00050674, Pitcher, F.G., 1974.	Supplemental
Bluegill sunfish *(Lepomis macrochirus)*	Not reported	1.2	0.828	Measured	Moderately toxic	400980-01, Mayer, 1986.	Supplemental
Bluegill sunfish *(Lepomis macrochirus)*	97.4	0.62	0.428	Measured	Highly toxic	413538-01, Alexander, et. al, 1983.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	29.0 (TEP)	>100	0.69	Measured	Practically non-toxic	400980-01, Mayer, 1986 J.A.,1969	Supplemental
Fathead minnow (*Pimephales promelas*)	97.4	2.60	1.79	Measured	Moderately toxic	413538-01, Alexander, et. al, 1983.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)							
Rainbow trout *(Oncorhynchus mykiss)*	66.9 (TEP)	4.82	3.2	Measured EHE	Moderately toxic	417373-03, Mayes, et. al., 1990.	Acceptable
Rainbow trout *(Oncorhynchus mykiss)*	92	22	14.5	Nominal	Slightly toxic	45068, Buccafusco, R.J., 1976.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	92	18	11.9	Nominal	Slightly toxic	45069, Buccafusco, R.J., 1976.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)							
Rainbow trout *(Oncorhynchus mykiss)* static	98.2	0.69	0.58	Measured	Highly toxic	439331-01, Drottar, et. al., 1996.	Acceptable

Table F-1. Acute freshwater fish toxicity to 2,4-D							
Species	**% ai**	**96-hour LC50 (95% CI)**		**Measured/ Nominal Test Concentrations**	**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**				
Rainbow trout *(Oncorhynchus mykiss)* static	45.8 (TEP)	0.78	0.66	Measured	Highly toxic	439332-01, Drottar, et. al., 1996.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)* static	98.2	0.31	0.26	Measured	Highly toxic	439307-01, Drottar, et. al., 1996.	Acceptable
Bluegill sunfish *(Lepomis macrochirus)*	45.8 (TEP)	0.31	0.26	Measured	Slightly toxic	439103-01, Drottar, et. al., 1996.	Acceptable

Table F-2. Chronic (early life cycle) freshwater fish toxicity to 2,4-D						
Species	**% ai**	**Toxicity Value (mg ae/L)**		**Most sensitive endpoint**	**MRID No. Author/Year**	**Study Classification**
		NOAEC	**LOAEC**			
2,4-D acid (PC Code: 030001)*						
Fathead minnow (*Pimephales promelas*)	96.1	63.4	102	Larval survival	417373-04, Mayes, et. al.,1990.	Acceptable
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)*						
Fathead minnow (*Pimephales promelas*)	73.8	19.8	66.6	Larval survival	420183-04, Graves, et. al., 1991.	Acceptable
2,4-D Dimethylamine (DMA)Salt (PC Code: 030019)*						
Fathead minnow (*Pimephales promelas*)	66.5	14.2	23.6	Length	417677-01, Dill, et. al., 1990.	Acceptable

* No early life cycle freshwater fish studies using forms of 2,4-D other than acid, DEA, and DMA were submitted to the Agency.

Table F-3. Chronic (full life cycle) freshwater fish toxicity to 2,4-D						
Species	**% ai**	**Toxicity Value (mg ae/L)**		**Most sensitive endpoint**	**MRID No. Author/Year**	**Study Classification**
		NOAEC	**LOAEC**			
2,4-D Ethylhexyl Ester (EHE) (PC code: 030063)*						
Fathead minnow *(Pimephales promelas)*	94.7	0.0792	0.1452	Larval fish survival	417373-05, Mayes, et. al., 1990.	Supplemental

* No full life cycle freshwater fish studies using forms of 2,4-D other than EHE were submitted to the Agency.

Table F-4. Acute freshwater invertebrate toxicity to 2,4-D							
Species	**% ai**	**96-hour LC50 (95% CI)**		**Measured/ Nominal Test Concentrations**	**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**				
2,4-D acid (PC Code: 030001)							
Waterflea *(Daphnia magna)*	98.7	25	25	Measured	Slightly toxic	411583-01, Alexander et. al., 1983	Acceptable
2,4-D Sodium Salt (PC Code: 030004)							
No data							
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)							
Waterflea *(Daphnia magna)*	71.3	>100	>68	measured	Practically non-toxic	419751-06, Graves, et. al., 1991.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)							
Waterflea *(Daphnia magna)*	51.1 (TEP)	774.5	642.8	NA	Practically non-toxic	232630, Vilkas, A.G., 1977.	Acceptable
Waterflea (*Daphnia magna*)	67.3	184	153	NA	Practically non-toxic	411583-11	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)							
Waterflea *(Daphnia magna)*	48.7	583	461	NA	Practically non-toxic	00138869, Alexander et. al., 1983.	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)							
Waterflea *(Daphnia magna)*	69.2	630	340.2	measured	Practically non-toxic	413538-05, Mayes, 1989	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)							

Table F-4. Acute freshwater invertebrate toxicity to 2,4-D							
Species	**% ai**	**96-hour LC50 (95% CI)**		**Measured/ Nominal Test Concentrations**	**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**				
Waterflea *(Daphnia magna)*	97.4	7.2	4.97	measured	Moderately toxic	413538-01, Alexander, et. al, 1983.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)							
Waterflea *(Daphnia magna)*	92	18	11.88	Measured	Slightly toxic	67328, Kuc, W.J., 1977.	Acceptable
Waterflea *(Daphnia magna)*	96.2	5.2	3.4	measured	Moderately toxic	411583-06, Alexander, et. al., 1983.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)							
Waterflea *(Daphnia magna)*	98.2	2.6	2..2	Measured	Moderately toxic	439306-01, Drottar, et.al., 1996.	Acceptable
NA = Not available							

Table F-5. Chronic (life cycle) freshwater invertebrate toxicity to 2,4-D						
Species	**% ai**	**Toxicity Value (mg ae/L)**		**Most sensitive endpoint**	**MRID No. Author/Year**	**Study Classification**
		NOAEC	**LOAEC**			
2,4-D acid (PC Code: 030001)*						
Waterflea *(Daphnia magna)*	91.3	79	151	No of young	418352-11, Ward T.J. et.al., 1991	Acceptable
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)*						
Waterflea *(Daphnia magna)*	73.8	16.05	25.64	Survival & Reproduction	420183-03, Holmes, et. al., 1991	Acceptable
2,4-D Dimethylamine (DMA)Salt (PC Code: 030019)*						
Waterflea *(Daphnia magna)*	66.8	LC50=75.7	N/A	Survival (NOAEC not established)	418352-10, Ward, S. C., 1991.	Supplemental
2,4-D Butoxyethyl (BEE) Ester (030053)*						
Waterflea *(Daphnia magna)*	96	LC50>0.869 NOAEC = 0.20	0.483	Survival and reproduction	413538-02, Gersich, et. al.,, 1989.	Acceptable

* No full life cycle freshwater invertebrate studies using forms of 2,4-D other than acid, DEA, DMA, and BEE were submitted to the Agency.

Table F-6. Acute freshwater amphibian toxicity to 2,4-D							
Species	**% ai**	**96-hour LC50 (95% CI)**		**Measured/ Nominal Test Concentrations**	**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**				
2,4-D acid (PC Code: 030001)*							
Leopard frog tadpoles *(Rana pipiens)*	97.5	359	359	Measured	Practically non-toxic	445173-07, Palmer, S.J. et. al., 1997.	Supplemental
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)*							
Leopard frog tadpoles *(Rana pipiens)*	67.3	337	278	Measured	Practically non-toxic	445173-06, Palmer, S.J. et. al., 1997.	Supplemental

* No acute freshwater amphibian studies using forms of 2,4-D other than acid and DMA were submitted to the Agency.

Table F-7. Non-vascular aquatic plant toxicity to 2,4-D (Tier 1 studies)						
Species	**% ai**	**Tested Concentration**		**Percent Response (inhibition)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**			
2,4-D acid (PC Code: 030001)*						
Green algae *Selenastrum capricornutum*	96.1	26.4	26.4	24	414200-01, Hughes, 1990	Acceptable
Blue-green algae *Anabaena flos-aquae*	96.9	>2.02	>2.02	0.488	433079-01, Hughes, 1994	Acceptable
Freshwater diatom *Navicula pelliculosa*	96.9	>2.13	>2.13	24	433079-02, Hughes, 1990	Acceptable
Marine diatom *Skeletonema costatum*	96.9	2.08	2.08	-10	433079-03, Hughes, 1990	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)*						
Green algae *Selenastrum capricornutum*	98.2		0.13	-11 %	437680-01, Hughes, et. al., 1995.	Acceptable

* No Tier I non-vascular aquatic plant studies using forms of 2,4-D other than acid and IPA were submitted to the Agency.

Table F-8. Non-vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	**% ai**	**EC50 / NOAEC**		**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**		
2,4-D acid (PC Code: 030001)					
No data					
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Green Algae *Selnastrum capricornutum*	73.8	11/ 0.50	7.48/ 0.34	427122-05, Thompson et. al., 1993.	Acceptable
Marine diatom *Skeletonema costatum*	73.8	>95/ 95	>64.6/ 64.6	427122-01, Thompson et. al., 1993	Acceptable
Freshwater diatom *Navicula pelliculosa*	73.8	>97/ 97	>66/ 66	427122-02, Thompson et. al., 1993.	Acceptable
Blue-green algae *Anabaena flos-aquae*	73.8	>96/ 96	>65.3/ 65.3	427122-03, Thompson et. al., 1993.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Green Algae *Selnastrum capricornutum*	66.7	51.2/ 19.2	42.5/ 16	414200-02, Hughes, J.sS, 1990.	Acceptable
Marine diatom *Skeletonema costatum*	66.7	148.5/ 96.25	123.3/ 79.89	415059-01, Hughes, J.sS, 1990.	Acceptable
Freshwater diatom *Navicula pelliculosa*	66.7	4.67/ 1.70	3.88/ 1.41	415059-03, Hughes, J.S., 1990.	Acceptable
Blue-green algae *Anabaena flos-aquae*	66.7	188.5/ 67.86	156.5/ 56.32	415059-02, Hughes, J.S., 1990.	Acceptable

Table F-8. Non-vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	**% ai**	**EC50 / NOAEC**		**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**		
2,4-D Isoproylamine (IPA) (PC Code: 030025)					
Green Algae *Selenastrum capricornutum*	51.3	43.4/ 13.9	34.29/ 10.98	417321-02, Hughes, J.S., 1990.	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
Green Algae *Selenastrum capricornutum*	73.8	75.7 55.4	40.88/ 29.92	417321-01, Hughes, J.S., 1990.	Acceptable
Marine diatom *Skeletonema costatum*	70.9	79.7 50.4	38.29/	434886-03, Hughes, et. al., 1994	Acceptable
Freshwater diatom *Navicula pelliculosa*	70.9	94.4 5.35	50.98/ 2.89	434886-01, Hughes, et. al., 1994.	Acceptable
Blue-green algae *Anabaena flos-aquae*	70.9	133 47.9	71.82/ 25.87	434886-04, Hughes, et. al., 1994.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Green Algae *Selenastrum capricornutum*	96	24.9/ 12.5	17.14/ 8.6	431882-01, Hughes, J.S., 1990.	Acceptable
Marine diatom *Skeletonema costatum*	96	1.48/ 0.78	1.02/ 0.538	42-684-04, Hughes,J.S., 1990.	Acceptable
Freshwater diatom *Navicula pelliculosa*	96	1.86/ 0.86	1.28/ 0.59	420684-03, Hughes, J.S., 1990	Acceptable
Blue-green algae *Anabaena flos-aquae*	96	6.37/ 3.14	4.4/ 2.2	420684-03, Hughes, J.S., 1990.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					

Table F-8. Non-vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	**% ai**	**EC50 / NOAEC**		**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**		
Green algae *Selenastrum capricornutum*	94.7 (62.8 a. eq.)	>30 / 3.75	19.8/ 2.48	417352-06, Hughes, J.S., 1990.	Acceptable
Marine diatom *Skeletonema costatum*	94.7 (62.8 a. eq.)	0.10 / 0.0938	0.066/ 0.062	417352-04, Hughes, J.S., 1990.	Acceptable
Freshwater diatom *Navicula pelliculosa*	94.7 (62.8 a. eq.)	1.9 / 1.875	1.25/ 1.24	417352-05, Hughes, J.S., 1990.	Acceptable
Blue-green algae *Anabaena flos-aquae*	94.7 (62.8 a. eq.)	>0.32 / 0.32	>0.21/ 0.21	417352-02, Hughes, J.S., 1990.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
No data					

Table F-9. Vascular aquatic plant toxicity to 2,4-D (Tier II studies)					
Species	**% ai**	**EC50 / NOAEC**		**MRID No. Author/Year**	**Study Classification**
		(mg ai/L)	**(mg ae/L)**		
2,4-D acid (PC Code: 030001)					
Duckweed ,*Lemna gibba*	96.2	0.695 / 0.0581	0.695 / 0.0581	442951-01, Hughes et al, 1997	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Duckweed ,*Lemna gibba*	73.8	0.44/ 0.07	0.2992/ 0.0476	427122-04, Thompson et. al., 1993.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Duckweed ,*Lemna gibba*	66.7	0.58/ 0.27	0.48/ 0.23	415059-04, Hughes, J.S., 1990.	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
Duckweed ,*Lemna gibba*	70.9	2.37/ 2.38	1.28/ 1.28	434886-02, Hughes, et. al., 1994.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Duckweed,*Lemna gibba*	96	0.576/ 0.204	0.3974/ 0.141	4206884-02, Hughes, J.S., 1990.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Duckweed ,*Lemna gibba*	94.7	0.50 / <0.0938	0.33/ 0.062	417352-03, Hughes, J.S., 1990.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
No data					

Table F-10. Acute bird toxicity (gavage) to 2,4-D						
Species	**% ai**	**LD50**		**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/kg-bwt)	**(mg ae/kg-bwt)**			
2,4-D acid (PC Code: 030001)						
Mallard duck *(Anas platyrhynchos)*	96.1	>5620	>5620	Practically non-toxic	415462-02, Culotta et.al., 1990	Acceptable
2,4-D Sodium Salt (PC Code: 030004)						
No data						
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)						
Northern bobwhite quail *(Colinus virginianus)*	73.1	595	404.6	Moderately toxic	419751-01, Cambell, et. al, 1991.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)						
Northern bobwhite quail *(Colinus virginianus)*	66.8	500	415	Moderately toxic	415462-01, Hoxter et. all., 1990.	Acceptable
Mallard duck *(Anas platyrhynchos)*	100	>4640	>3851.2	Practically non-toxic	233351, Fink, R., 1978	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)						
Mallard duck *(Anas platyrhynchos)*	48.7	>398	>314.4	Moderately toxic	00138871, Beavers, et. al., 1983,	Supplemental
Northern bobwhite quail (*Colinus virginianus*)	49%	377	298	Moderately toxic	442757-01 Beavers 1985	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)						
Northern bobwhite quail *(Colinus virginianus)*	70.4	>405	>218.7	Moderately toxic	416444-01, Hoxter, K.A., 1990.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)						

Table F-10. Acute bird toxicity (gavage) to 2,4-D						
Species	**% ai**	**LD50**		**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/kg-bwt)	**(mg ae/kg-bwt)**			
Northern bobwhite quail *(Colinus virginianus)*	96	>2000	>1380	Slightly toxic	414541-01, Lloyd, D., 1989.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)						
Northern bobwhite quail *(Colinus virginianus)*	96.2	633	417.78	Moderately toxic	411583-03, Beavers, J.B., 1984.	Acceptable
Mallard duck *(Anas platyrhynchos)*	92	.>3000	>1980	Slightly toxic	72472, Fink, R., 1976.	Acceptable
Mallard duck *(Anas platyrhynchos)*	92	.>4640	>3062	Practically non-toxic	226397, Fink, R., 1976.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)						
Northern bobwhite quail *(Colinus virginianus)*	98.2	1879	1578	Slightly toxic	439350-01, Palmer, et. al., 1996.	Acceptable

Table F-11. Acute bird toxicity (dietary) to 2,4-D						
Species	**% ai**	**LD50**		**Toxicity Category (based on ae)**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/kg-diet)	**(mg ae/kg-diet)**			
2,4-D acid (PC Code: 030001)						
Northern bobwhite quail *(Colinus virginianus)*	96.1	>5620	>5620	Practically nontoxic	415861-01, Culotta J., 1989.	Acceptable
Mallard duck *(Anas platyrhynchos)*	96.1	>5620	>5620	Practically non-toxic	415462-02, Culotta et.al., 1990	Acceptable
2,4-D Sodium Salt (PC Code: 030004)						
No data						
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)						
Northern bobwhite quail *(Colinus virginianus)*	73.1	>5620	>3821.6	Slightly toxic	419751-02, Hoxter, et. al., 1991.	Acceptable
Mallard duck *(Anas platyrhynchos)*	73.1	>5620	>3820.6	Slightly toxic	419751-03, Hoxter, et. al., 1991.	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)						
Northern bobwhite quail *(Colinus virginianus)*	66.8	>5620	>4665	Slightly toxic	417495-01, Long, et. al., 1990.	Acceptable
Northern bobwhite quail *(Colinus virginianus)*	100	>10,000	>8300	Practically non-toxic	233351, Fink, R., 1978.	Acceptable
Mallard duck *(Anas platyrhynchos)*	66.8	>5620	>4665	Slightly toxic	417495-02, Long, et. al., 1990.	Acceptable
2,4-D Isoproylamine (IPA) (PC Code: 030025)						
Northern bobwhite quail *(Colinus virginianus)*	48.7	>5620	>4440	Slightly toxic	00138870, Beavers, J.B., 1983.	Acceptable

Table F-11. Acute bird toxicity (dietary) to 2,4-D						
Species	% ai	LD50		Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(mg ai/kg-diet)	(mg ae/kg-diet)			
Mallard duck *(Anas platyrhynchos)*	48.7	>5620	>4440	Slightly toxic	00138872, Beavers, J.B., 1983.	Acceptable
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)						
Northern bobwhite quail *(Colinus virginianus)*	70.4	>5620	>3035	Slightly toxic	416444-02, Driscoll, et., al. 1990.	Acceptable
Mallard duck *(Anas platyrhynchos)*	70.4	>5620	>3035	Slightly toxic	416444-03, Driscoll, et., al. 1990.	Acceptable
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)						
Northern bobwhite quail *(Colinus virginianus)*	96	>5620	>3878	Slightly toxic	414484-01, Grimes, J.., 1989.	Acceptable
Mallard duck *(Anas platyrhynchos)*	96	>5620	>3866	Slightly toxic	414290-07, Grimes, J., 1989.	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)						
Northern bobwhite quail *(Colinus virginianus)*	96	>5620	>3878	Slightly toxic	414484-01, Grimes, J.., 1989.	Acceptable
Mallard duck *(Anas platyrhynchos)*	96	>5620	>3866	Slightly toxic	414290-07, Grimes, J., 1989.	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)						
Northern bobwhite quail *(Colinus virginianus)*	98.2	>5456	>4583	Slightly toxic	439349-01, Palmer, et. al., 1996.	Acceptable
Mallard duck *(Anas platyrhynchos)*	98.2	>5218	>4383	Slightly toxic	439352-01, Palmer, et. al., 1996.	Acceptable

Table F-12. Chronic bird toxicity (reproductive) to 2,4-D						
Species	**% ai**	**NOAEC / LOAEC**		**Most sensitive endpoints**	**MRID No. Author/Year**	**Study Classification**
		(mg ai/kg-diet)	**(mg ae/kg-diet)**			
2,4-D acid (PC Code: 030001) *						
Northern bobwhite quail *(Colinus virginianus)*	96.9	962/>962	962/>962	No effects	415861-01, Culotta J., 1989.	Acceptable

* No avian reproduction studies using forms of 2,4-D other than the acid were submitted to the Agency.

Table F-13. Acute mammal toxicity (gavage) to 2,4-D						
Species	**% ai**	**LD_{50} (mg ae/kg-bwt)[1]**	**Toxicity Category (based on ae)**	**MRID No.**	**Study Classification[2]**	**Comments**
2,4-D acid (PC Code: 030001)						
Laboratory rat *(Rattus norvegicus)*	NA	699	Slightly toxic	00101605	Acceptable	
2,4-D Sodium Salt (PC Code: 030004)						
No data						
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)						
Laboratory rat *(Rattus norvegicus)*	100% (assumed by study author)	619	Slightly toxic	41920901	Acceptable	Study author assumed test material was 100% DEA salt, dose listed in terms of test material administered.
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)						
Laboratory rat *(Rattus norvegicus)*	57.9% a.e.	>579	Slightly toxic	00157512	Acceptable	Chemical analysis confirmed 57.9% a.e., administered dose listed in terms of test material (an end-use product), total mortality at highest dose was 4/12 (no other mortality)
2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)						
Laboratory rat *(Rattus norvegicus)*	39.4% a.e.	747	Slightly toxic	00252291	Acceptable	Administered dose listed in terms of test material (technical), technical label indicated 39.4% a.e.
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)						

Table F-13. Acute mammal toxicity (gavage) to 2,4-D						
Species	% ai	LD_{50} (mg ae/kg-bwt)[1]	Toxicity Category (based on ae)	MRID No.	Study Classification[2]	Comments
Laboratory rat *(Rattus norvegicus)*	37.7% a.e.	441	Slightly toxic	41413501	Acceptable	Administered dose listed in terms of test material. Study author stated test material was 37.7% ae.
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)						
Laboratory rat *(Rattus norvegicus)*	NA	573	Slightly toxic	40629801	Acceptable	Administered dose listed in terms of test material, chemical analysis confirmed 66.1% ae
2,4-D 2-Ethylhexyl Ester (EHE) (PC code: 030063)						
Laboratory rat *(Rattus norvegicus)*	NA	NA	NA	41209001	Acceptable	Study conducted using end-use product EPA Reg. 34704-607. Label stated product contained 33.18% 2,4-D EHE and 32.52% 2,4-DP EHE (PCcode 31464). Because this product is a mixture, it will not be considered.
2,4-D Isopropyl Ester (IPE) (PC code: 030066)						
Laboratory rat *(Rattus norvegicus)*	37% a.e.	458	Slightly toxic	41709901	Acceptable	Administered dose listed in terms of test material, material was an end-use product, EPA Reg. 400-444. Label stated material 37% ae.

Table F-13. Acute mammal toxicity (gavage) to 2,4-D						
Species	% ai	LD_{50} (mg ae/kg-bwt)[1]	Toxicity Category (based on ae)	MRID No.	Study Classification[2]	Comments
[1] All LD_{50}s were calculated by EFED using data provided in the original study reports. Clarifications regarding the calculations are made in the "Comments" column. [2] Classifications determined by HED.						

Table F-14. Chronic mammalian toxicity (reproductive) to 2,4-D							
Species	% ai	Endpoint (mg ae/kg-bwt/day)			Affected parameters (most sensitive)	MRID No.	Study Classification
			NOAEL	LOAEL			
2,4-D acid (PC Code: 030001) *							
Laboratory rat *(Rattus norvegicus)*		Parental	Target =5 Actual (3.5-13.5)	Target =20 Actual (14-48)	Decreased female body wt gain(F1) and male renal tubule alteration (F0 and F1)	00150557; 00163996	Acceptable, determined by HED
		Reproductive	Target =20 Actual (18-35)	Target =80 Actual (69-114)	increase in gestation length		
		Offspring	Target =5 Actual (7.2-13.5)	Target =20 Actual (26-48)	decreased pup body weight; increase in pup deaths at 80 mg ae/kg-bwt/day		

* No mammalian reproduction studies using forms of 2,4-D other than the acid were submitted to the Agency.

Table F-15. Acute honey bee toxicity (contact) to 2,4-D						
Species	% ai	96-hour LD50 (95% CI)		Toxicity Category (based on ae)	MRID No. Author/Year	Study Classification
		(µg ai/bee)	(µg ae/bee)			
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019) *						
Honey bee *(Apis mellifera)*	67.3	>100	>83	Practically non-toxic	445173-04, Palmer S. et al., 1997	Acceptable
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063) *						
Honey bee *(Apis mellifera)*	96.96	>100	>66	Practically non-toxic	445173-01, Palmer S. et al., 1997	Acceptable

* No contact honey bee studies using forms of 2,4-D other than DMAS and EHE were submitted to the Agency.

Table F-16. Terrestrial plant toxicity (seedling emergence, most sensitive monocot) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Onion and sorghum	96.7	2.1	Fresh weight	424168-02, Backus, 1992	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Onion	50.2	0.38	Fresh weight	426091-01, Backus, 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Sorghum	55.5	0.026	Fresh weight	423895-01, Backus, 1992	Acceptable
2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Onion	65.6	0.36	Survival	431970-01, Narnish, 1994	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Onion	63.5	0.218	Fresh shoot weight	435269-01, Backus, 1995	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Onion	98.2	0.010	Shoot length	439821-01, Hoberg, 1996	Acceptable

Table F-17. Terrestrial plant toxicity (seedling emergence, most sensitive dicots) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Mustard	96.7	0.033	Fresh weight	424168-02, Backus, 1992	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Mustard	50.2	0.045	Fresh weight	426091-01, Backus, 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
Mustard	55.5	0.00953	Fresh weight	423895-01, Backus, 1992	Acceptable
2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Tomato	65.6	0.05	Dry weight	431970-01, Narnish, 1994	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Radish	63.5	0.037	Fresh shoot weight	424492-01, Backus, 1992	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Lettuce	98.2	0.00081	Shoot length	439821-01, Hoberg, 1996	Supplemental

Table F-18. Terrestrial plant toxicity (vegetative vigor, most sensitive monocot) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Onion	96.7	<0.0075	Fresh weight	424168-01, Backus, 1991	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Onion	50.2	0.04	Fresh weight	426091-02 Backus 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
No data					
2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Onion	65.6	0.19	Dry weight	430671-03, Narnish, 1993	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Sorghum	63.5	0.218	Fresh weight	423439-02, Backus, 1992	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Corn	82.7	0.2016	Shoot weight	437882-01, Hoberg, 1995	Acceptable

Table F-19. Terrestrial plant toxicity (vegetative vigor, most sensitive dicots) to 2,4-D - all available forms, technical only					
Species	% ai	EC25 (lbs ae/acre)	Most sensitive endpoint	MRID No. Author/Year	Study Classification
2,4-D acid (PC Code: 030001)					
Tomato	96.7	0.0075	Fresh weight	424168-01, Backus, 1991	Acceptable
2,4-D Sodium Salt (PC Code: 030004)					
No data					
2,4-D Diethanolamine (DEA) Salt (PC Code: 030016)					
Tomato	50.2	0.003	Fresh weight	426091-02 Backus, 1992	Acceptable
2,4-D Dimethylamine (DMA) Salt (PC Code: 030019)					
No data					
2,4-D Isoproylamine (IPA) Salt (PC Code: 030025)					
No data					
2,4-D Triisopropanolamine (TIPA) Salt (PC Code: 030035)					
No data					
2,4-D Butoxyethyl (BEE) Ester (PC code: 030053)					
Radish	65.6	0.02	survival	430671-03, Narnish, 1993	Supplemental
2,4-D 2-Ethylhexyl Ester (2-EHE) (PC code: 030063)					
Soybean	63.5	0.02	Fresh weight	423439-02, Backus, 1992	Acceptable
2,4-D Isopropyl Ester (IPE) (PC code: 030066)					
Radish	82.7	0.0042	Root weight	437882-01, Hoberg, 1995	Acceptable

Table F-20. Summary of seedling emergence study conducted with Gordon's Amine 4000 2,4-D Weed Killer, a TEP of 2,4-D DMAS[1]					
Species	**Most sensitive Endpoint**	**Value (lbs ae/acre)**			
		NOAEC	**EC_{05}**	**EC_{25}**	**EC_{50}**
Corn	Plant Height	4.0	2.4	>4.0	>4.0
Onion	Dry Weight	0.091	<0.0014	0.097	>0.35
Ryegrass	Plant Height	4.0	2.2	>4.0	>4.0
Wheat	Dry Weight	0.35	0.0054	0.20	>0.35
Cabbage	Dry Weight	0.020	0.010	0.043	0.12
Lettuce	Dry Weight	0.020	0.0054	0.026	0.078
Radish	Dry Weight	0.020	0.0087	0.033	0.082
Soybean	Dry Weight	0.26	<0.26	0.37	1.2
Tomato	None	0.34	N.D.	>0.34	>0.34
Turnip	Dry Weight	0.020	0.035	0.13	0.34
[1] MRID 471060-01, Porch et al. 2006, 39.21%ai, Acceptable					

Table F-21. Summary of vegetative vigor study conducted with Gordon's Amine 4000 2,4-D Weed Killer, a TEP of 2,4-D DMAS[1]					
Species	**Most sensitive Endpoint**	**Value (lbs ae/acre)**			
		NOAEC	**EC_{05}**	**EC_{25}**	**EC_{50}**
Onion	Dry Weight	0.0335	0.034	0.14	0.37
Ryegrass	Dry Weight	2.07	1.0	>2.07	>2.07
Wheat	Dry Weight	0.133	0.32	1.1	>2.03
Cabbage	Dry Weight	0.0981	0.079	0.18	0.31
Lettuce	Dry Weight	0.0017	<0.0017	0.0038	0.015
Radish	Dry Weight	0.0016	<0.0016	0.0012	>0.0266
Soybean	Dry Weight	0.0072	0.0093	0.039	>0.0998
Tomato	Dry Weight	0.0016	0.0018	0.0074	0.020
Turnip	Dry Weight	0.0015	<0.0015	0.011	0.065
[1] MRID 471060-02, Porch et al. 2006, 39.21%ai, Acceptable					

Table F-22. Summary of seedling emergence study conducted with Gordon's LV400 2,4-D Weed Killer, a TEP of 2,4-D EHE[1]					
Species	**Most sensitive Endpoint**	**Value (lbs ae/acre)**			
		NOAEC	**EC_{05}**	**EC_{25}**	**EC_{50}**
Corn	Dry Weight	1.9	1.7	3.4	>3.8
Onion	Plant height	0.019	0.047	0.17	>0.34
Ryegrass	Dry Weight	0.26	<0.26	0.27	2.8
Wheat	None	4.0	<0.26	>4.0	>4.0
Cabbage	Dry Weight	0.0015	0.0056	0.021	0.053
Lettuce	Dry Weight	0.0058	0.0061	0.018	0.039
Radish	Dry Weight	0.0058	0.0061	0.036	0.12
Soybean	Dry Weight	0.47	<0.25	0.85	2.3
Tomato	Dry Weight	0.0058	<0.0015	0.012	0.29
Turnip	Dry Weight	0.0058	0.021	0.062	0.13
[1] MRID 471060-03, Porch et al. 2006, 44.9%ai, Acceptable					

Table F-23. Summary of vegetative vigor study conducted with Gordon's LV400 2,4-D Weed Killer, a TEP of 2,4-D EHE[1]					
Species	**Most sensitive Endpoint**	**Value (lbs ae/acre)**			
		NOAEC	**EC_{05}**	**EC_{25}**	**EC_{50}**
Corn	Dry Weight	0.0289	<0.00803	0.17	1.6
Onion	Dry Weight	0.0254	0.025	0.088	0.21
Ryegrass	None	2.03	N.D.	>2.03	>2.03
Wheat	Dry Weight	0.0356	0.043	0.34	1.4
Cabbage	Dry Weight	0.00167	0.012	0.027	0.047
Lettuce	Dry Weight	0.00167	<0.00167	0.0021	0.0076
Radish	Survival	0.00527	0.0026	0.0068	0.013
Soybean	Dry Weight	0.0259	0.014	0.058	>0.0992
Tomato	Dry Weight	<0.00134	<0.00134	0.0044	0.016
Turnip	Dry Weight	<0.00134	<0.00134	0.0021	0.042
[1] MRID 471060-04, Porch et al. 2006, 44.9%ai, Acceptable					

Appendix A. Ecological Effects Data

Comparison of Toxicity of Organisms to different forms of Triclopyr in terms of the acid equivalent (TEA, BEE, & degradate TCP)

Taxa	Effect Type	Endpoint	Triclopyr Acid - TGAI	TEA (ae)	BEE (ae)	TCP (ae)
Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	117 mg/L	79.2 mg/L	0.47 mg/L	1.9 mg/L
Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	148 mg/L	155.4 mg/L	0.26 mg/L	16.1 mg/L
Freshwater fish Fathead Minnow (*Pimephales promelas*)	Chronic	NOEC LOEC	No Data	> 32.2 mg/L < 50.2 mg/L	No Data	No Data
Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Chronic	NOEC LOEC	No Data	No Data	0.019 mg/L 0.034 mg/L	No Data
Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	132.9 mg/L	346 mg/L	0.25 mg/L	13.4 mg/L
Freshwater invertebrate Water flea (*Daphnia magna*)	Chronic	NOEC LOEC	No Data	25 mg/L 46.2mg/L	No Data	No Data
Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	14d EC50	No Data	6.1 mg/L	0.86 mg/L	Invalid study
Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	5d EC50	29.8 mg/L	12.1 mg/L	2.5 mg/L	2.3 mg/L
Non-vascular aquatic plant Blue-green algae (*Anabeana flos-aquae*)	Acute	5d EC50	No Data	(7d EC50) 4.1 mg/L	1.42 mg/L	2.3 mg/L
Non-vascular aquatic plant Freshwater diatom (*Navicula pelliculosa*)	Acute	5d EC50	No Data	(4d EC50) 10.6 mg/L	0.07 mg/L	No Data
Avian Mallard duck (*Anas platyrhynchos*)	Acute oral	LD50	1698 mg/kg bw	(14d LC50) 1418 mg/kg bw	No Data	No Data

Taxa	Effect Type	Endpoint	Triclopyr Acid	TEA (ae)	BEE (ae)	TCP (ae)
Avian Northern bobwhite Quail (*Colinus virginianus*)	Acute oral	21d LD50	No Data	No Data	529 mg/kg bw	(8d LD50) > 2585 mg/kg bw
Avian Northern bobwhite Quail (*Colinus virginianus*)	Subacute dietary	8d LC50	2934 ppm	5,189 ppm	3385 ppm	No Data
Avian Mallard duck (*Anas platyrhynchos*)	Subacute dietary	8d LC50	No Data	> 4,464.8 ppm	> 3885	> 7265 ppm
Avian Mallard duck (*Anas platyrhynchos*)	Chronic	NOAEC LOAEC	100 ppm 200 ppm # of 14 d old survivors	No Data	No Data	No Data
Rodent Rat	Acute oral	LD50	630 (F) mg/kg	572 (M & F) mg/kg	578 (M & F) mg/kg	1026 (M) mg/kg
Rodent Rat	Chronic	NOAEL LOAEL	5 mg/kg bw 25 mg/kg bw	No Data	No Data	No Data
Honeybee (*Apis mellifera*)	Acute	Contact 48h LD50	>100 µg/bee	No Data	> 72 µg/bee	No Data
Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	14d EC25	No Data	0.005 lbs ae/A Parameter: shoot length	0.006 lbs ae/ A Parameter: shoot weight	No Data
Terrestrial monocot Onion (*Allium cepa*) (Vegetative Vigor)	Acute	14d EC25	No Data	0.114 lbs ae/A Parameter: shoot weight	0.063 lbs ae/A Parameter: shoot weight	No Data
Terrestrial dicot Alfalfa (*Medicago sativa*) (Seedling Emergence)	Acute	51d EC25	No Data	No Data	0.045 lbs ae/A parameter: emergence	No Data
Terrestrial dicot Soybean (*Glycine max*) (Seedling Emergence)	Acute	14d EC25	No Data	> 0.23 lbs ae/A Parameter: shoot length	< 8.0 lbs ae/A Parameter: emergence	No Data
Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	51d EC25	No Data	> 0.69 lbs as/A Parameter: shoot length	0.053 lbs ae/A Parameter: shoot weight	No Data

Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	14d EC25	No Data	> 0.23 lbs ae/A Parameter: shoot length	< 8.0 lbs ae/A Parameter: emergence	No Data

Triclopyr Acid (colored cells are most sensitive for triclopyr acid)

Habitat	Taxa	Effect Type	Endpoint	Value	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author))
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	117	mg/L	Practically Non-Toxic	Acceptable	00049637 Dow Chemical 1973
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	148	mg/L	Practically Non-Toxic	Acceptable	00049637 Dow Chemical 1973
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	132.9	mg/L	Practically Non-Toxic	Acceptable	40346504 McCarty 1977
Aquatic plants	Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	5d EC50	29.8	mg/L	Parameter?	Supplemental	41736303 Cowgill 1989
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Acute oral	LD50	1698	mg/kg bw	Slightly Toxic	Acceptable	40346401 Dow Chemical 1976
Terrestrial	Avian Cortunix Quail	Subacute dietary	LC50	3272	ppm	Slightly Toxic	Supplemental	00049638 Dow Chemical 1973
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Subacute dietary	LC50	2934	ppm	Slightly Toxic	Acceptable	40346403 Dow Chemical 1976
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Subacute dietary	LC50	5620	ppm	Practically Non-Toxic	Acceptable	0031249 Wildlife Int'l 1979
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Chronic	NOAEC LOAEC LOAEC	500 >500 200	ppm ppm ppm	N/A	Acceptable	00031251 Beavers 1979
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Chronic	NOAEC LOAEC	100 200	ppm	# of 14 d old survivors	Acceptable	00031250 Beavers 1979

Habitat	Taxa	Effect Type	Endpoint	Value	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial	Rodent Rat	Acute oral	LD50	729 (M) 630 (F) (F 95% CI 450-829)	mg/kg mg/kg mg/kg	Slightly Toxic	Acceptable (HED 2002)	00031940 Henck et al. 1979
Terrestrial	Rodent	Chronic	NOAEL LOAEL	25 250	mg/kg bw mg/kg bw	Reproductive/ Systemic	Acceptable (RED 1998)	43545701 Vedula et al. 1995
Terrestrial	Rodent	Chronic	NOAEL LOAEL	5 25	mg/kg bw mg/kg bw	Reproductive/ Offspring	Acceptable (HED 2002)	43545701 Vedula et al. 1995
Terrestrial	Honeybee (*Apis mellifera*)	Acute	Contact 48h LD50	>100	µg/bee	Practically Non-Toxic	Acceptable	40356602 Dingledine 1985

TCP (Degradate Toxicity Information)

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	16.1	mg/L	Slightly Toxic	Acceptable	41829003 Gorzinski et al. 1991
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	16.3	mg/L	Slightly Toxic	Acceptable	41829004 Gorzinski et al. 1991
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	1.9	mg/L	Moderately Toxic	Acceptable	44585404 Wan et al. 1987
Aquatic	Freshwater fish Coho salmon	Acute	96h LC50	2.3	mg/L	Moderately Toxic	Supplemental	44585404 Wan et al. 1987
Aquatic	Freshwater fish Chum salmon	Acute	96h LC50	2.3	mg/L	Moderately Toxic	Supplemental	44585404 Wan et al. 1987
Aquatic	Freshwater fish Sockeye salmon	Acute	96h LC50	3.2	mg/L	Moderately Toxic	Supplemental	44585404 Wan et al. 1987
Aquatic	Freshwater fish Chinook salmon	Acute	96h LC50	2.7	mg/L	Moderately Toxic	Supplemental	44585404 Wan et al. 1987
Aquatic	Freshwater fish Pink salmon	Acute	96h LC50	3.5	mg/L	Moderately Toxic	Supplemental	44585404 Wan et al. 1987
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	13.4	mg/L	Slightly Toxic	Acceptable	41829003 Gorzinski et al. 1991
Aquatic plants	Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	----	----	----	Limited critical endpoints measured	**Invalid**	45312002 Kirk et al. 2000
Aquatic plants	Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	4d EC50	2.3	mg/L	Parameter: Growth (Yield)	Supplemental	45312001 Kirk et al. 1999

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic plants	Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	4d NOAEC (as EC05)	0.84	mg/L	Parameter: Growth (Yield)	Supplemental	45312001 Kirk et al. 1999
Aquatic plants	Non-vascular aquatic plant Blue-green algae (*Anabeana flos-aquae*)	Acute	5d EC50	2.3	mg/L	Parameter: Growth and Reproduction (Yield)	Supplemental	45312003 Kirk et al. 2000
Aquatic plants	Non-vascular aquatic plant Blue-green algae (*Anabeana flos-aquae*)	Acute	5d NOAEC	0.46	mg/L	Parameter: Growth and Reproduction (Yield)	Supplemental	45312003 Kirk et al. 2000
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Acute oral	8d LD50	> 2585	mg/kg bw	Practically Non-Toxic	Acceptable	41829001 Campbell et al. 1990
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Subacute dietary	8d LC50	> 7265	ppm	Practically Non-Toxic	Supplemental	41829002 Long et al. 1990
Terrestrial	Rodent Rat	Acute oral	LD50	1026 (M) 1124 (F)	mg/kg	Slightly Toxic	Acceptable	00064938 Gerbig & Emerson 1970

Triclopyr Triethylamine (TEA) (colored cells are most sensitive for TEA)

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	273.7 (flow-through)	mg/L	Practically Non-Toxic	Acceptable	00151956 McCarty 1978
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	233.1	mg/L	Practically Non-Toxic	Acceptable	00151956 McCarty 1978
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	79.2 (flow-through)	mg/L	Practically Non-Toxic	Acceptable (for formulated product)	00049637 Dow Chemical 1973
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	398.7 (flow-through)	mg/L	Practically Non-Toxic	Acceptable	00151956 McCarty 1978
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	155.4 (flow-through)	mg/L	Practically Non-Toxic	Acceptable (for formulated product)	00049637 Dow Chemical 1973
Aquatic	Freshwater fish Fathead Minnow (*Pimephales promelas*)	Acute	96h LC50	422.8 (flow-through)	mg/L	Practically Non-Toxic	Acceptable	00151956 McCarty 1978
Aquatic	Freshwater fish Fathead Minnow (*Pimephales promelas*)	Acute	96h LC50	168.5 (static)	mg/L	Practically Non-Toxic	Acceptable	00151958 Mayes 1983
Aquatic	Freshwater fish Fathead Minnow (*Pimephales promelas*)	Acute	96h LC50	86.4 (flow-through)	mg/L	Practically Non-Toxic	Acceptable	00151958 Mayes 1983
Aquatic	Marine/Estuarine fish Inland silverside (*Menidia beryllina*)	Acute	LC50	40.1	mg/L	Practically Non-Toxic	Acceptable (for formulated product)	41633703 Ward 1989
Aquatic	Freshwater fish Fathead Minnow (*Pimephales promelas*)	Chronic	NOEC LOEC	> 32.2 < 50.2	mg/L mg/L	Parameter: Length	Acceptable	00151958 Mayes 1983
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	463.5	mg/L	Practically Non-Toxic	Acceptable	00151959 Gerisch 1982

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	346	mg/L	Practically Non-Toxic	Acceptable	00151956 McCarty 1978
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Chronic	NOEC LOEC	25 46.2	mg/L	total young and mean brood size	Acceptable	00151959 Gerisch 1982
Aquatic	Mollusca Eastern oyster (*Crassostrea virginica*) (shell deposition)	Acute	LC50/EC50	18.4	mg/L	Slightly Toxic	Acceptable (for formulated product)	42646101 Kowalski 1992
Aquatic	Mollusca Eastern oyster (*Crassostrea virginica*) (embryo larvae)	Acute	48h EC50	> 16.9 < 26.3	mg/L mg/L	Parameter: 100% abnormal development at 87 ppm	Acceptable (for formulated product)	00062623 EG & G 1975 40346606?
Aquatic	Crustacea Pink shrimp (*Penaeus duorarum*)	Acute	LC50/EC50	270.5	mg/L	Practically Non-Toxic	Supplemental	00062623 EG & G 1975 40346606?
Aquatic	Crustacea Grass Shrimp (*Palaemontes pugio*)	Acute	LC50/EC50	103.7	mg/L	Practically Non-Toxic	Acceptable (for formulated product)	42646102 Kowalski 1992
Aquatic	Crustacea Fiddler crab (*Uca pugilator*)	Acute	LC50/EC50	> 302.2	mg/L	Practically Non-Toxic	Supplemental	00062623 EG & G 1975 40346606?
Aquatic plants	Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	14d EC50	6.06	mg/L	Parameter: Growth and Reproduction	Acceptable	41633709 Cowgill 1987
Aquatic plants	Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	14d EC50	7.6	mg/L	Parameter: Growth and Reproduction	Acceptable	41736302 Cowgill 1988
Aquatic plants	Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	5d EC50	12.1	mg/L	Parameter: Growth	Acceptable	41736305 Cowgill 1987

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic plants	Non-vascular aquatic plant Blue-green algae (*Anabeana flos-aquae*)	Acute	7d EC50	4.1	mg/L	Parameter: Growth	Acceptable	41633706 Cowgill 1987
Aquatic plants	Non-vascular aquatic plant Freshwater diatom (*Navicula pelliculosa*)	Acute	4d EC50	10.6	mg/L	Parameter: Growth	Acceptable	41633708 Cowgill 1987
Aquatic plants	Non-vascular aquatic plant Marine diatom (*Skeletonema costatum*)	Acute	5d EC50	4.6	mg/L	Parameter: Growth	Acceptable	41633707 Cowgill 1987
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Acute oral	14d LD50	1418	mg/kg bw	Practically Non-Toxic	Acceptable	40346501 Fink 1978
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Acute oral	8d LD50	1417.6	mg/kg bw	Practically Non-Toxic	Acceptable	00134178
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Subacute dietary	8d LC50	5,189	ppm	Practically Non-Toxic	Acceptable	40346503 Fink 1978
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Subacute dietary	8d LC50	> 4,464.8	ppm	Practically Non-Toxic	Acceptable	40346502 Fink 1977
Terrestrial	Rodent Rat	Acute oral	LD50	572 (M & F)	mg/kg	Slightly Toxic	Acceptable	41443301 Mizell & Lomax 1988
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	14d EC25	0.0063	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	NOAEC	0.0028	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	14d EC25	0.005	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	NOAEC	0.0028	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Sugarbeet (*Beta vulgaris*) (Vegetative Vigor)	Acute	14d EC25	0.030	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Sugarbeet (*Beta vulgaris*) (Vegetative Vigor)	Acute	14d EC25	0.11	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Sugarbeet (*Beta vulgaris*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801
Terrestrial Plant	Terrestrial dicot Sugarbeet (*Beta vulgaris*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Tomato (*Lycopersicon esculentum*) (Vegetative Vigor)	Acute	14d EC25	0.0135	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Tomato (*Lycopersicon esculentum*) (Vegetative Vigor)	Acute	14d EC25	0.018	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial Plant	Terrestrial dicot Tomato (*Lycopersicon esculentum*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Tomato (*Lycopersicon esculentum*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Wheat (*Triticum aestivum*) (Vegetative Vigor)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Wheat (*Triticum aestivum*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Wheat (*Triticum aestivum*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Oilseed rape (*Brassica napus*) (Vegetative Vigor)	Acute	14d EC25	0.051	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Oilseed rape (*Brassica napus*) (Vegetative Vigor)	Acute	14d EC25	0.064	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Oilseed rape (*Brassica napus*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Oilseed rape (*Brassica napus*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Radish (*Raphanus sativus*) (Vegetative Vigor)	Acute	14d EC25	0.125	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial Plant	Terrestrial dicot Radish (*Raphanus sativus*) (Vegetative Vigor)	Acute	14d EC25	0.132	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Radish (*Raphanus sativus*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Radish (*Raphanus sativus*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Corn (*Zea mays*) (Vegetative Vigor)	Acute	14d EC25	0.121	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Corn (*Zea mays*) (Vegetative Vigor)	Acute	14d EC25	0.32	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Corn (*Zea mays*) (Seedling Emergence)	Acute	14d EC25	> 0.23	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Corn (*Zea mays*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	14d EC25	> 0.23	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	NOAEC	0.230	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Vegetative Vigor)	Acute	14d EC25	0.114	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Vegetative Vigor)	Acute	14d EC25	0.24	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	14d EC25	> 0.69	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Vegetative Vigor)	Acute	14d EC25	0.0057	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Vegetative Vigor)	Acute	NOAEC	0.0003	lbs ae/A	Parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Vegetative Vigor)	Acute	14d EC25	0.028	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Seedling Emergence)	Acute	14d EC25	> 0.23	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Seedling Emergence)	Acute	NOAEC	0.0028	lbs ae/A	Parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Seedling Emergence)	Acute	21d EC25	< 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Monocots & Dicots Veg.Crops (10 Sp.) (Vegetative Vigor)	Acute	6 wks EC25	> 9.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990

Triclopyr Butoxyethyl Ester (BEE) (colored cells are most sensitive for BEE)

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	0.47	mg/L	Highly Toxic	Acceptable	42884501 Woodburn et al. 1993
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	1.29 (Propylene glycol butyl ether)	mg/L	Moderately Toxic	Acceptable	00134181 Acc# 229783?
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	0.70	mg/L	Highly Toxic	Acceptable	43442602 Weinberg et al. 1994
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	24h LC50	0.35-1.2	mg/L	Highly to Moderately Toxic	Supplemental	41971603 Gorzinski 1991
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	1.46 (Propylene glycol butyl ether)	mg/L	Moderately Toxic	Acceptable	00134181 Acc# 229783?
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	0.25	mg/L	Highly Toxic	Acceptable	42917901 Woodburn et al. 1993
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	24h LC50	0.59	mg/L	Moderately Toxic	Supplemental	41971604 Gorzinski 1991
Aquatic	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	0.31	mg/L	Highly Toxic	Acceptable	43442601 Weinberg et al. 1994
Aquatic	Freshwater fish Coho Salmon (*Oncorhyncus kissutch*)	Acute	96h LC50	0.32-0.33 (yolk-sac fry) 1.0 (juvenile fry)	mg/L mg/L	Highly Toxic Moderately Toxic	Supplemental	41736304 Barron 1987
Aquatic	Freshwater fish Fathead Minnow (*Pimephales promelas*)	Acute	24h LC50	1.7	mg/L	Moderately Toxic	Supplemental	00151965 Batchelder 1981
Aquatic	Marine/Estuarine fish Inland silverside (*Menidia beryllina*)	Acute	96h LC50	0.32	mg/L	Highly Toxic	Acceptable	42053901 Ward 1991

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic	Marine/Estuarine fish Inland silverside (*Menidia beryllina*)	Acute	96h LC50	0.34	mg/L	Highly Toxic	Acceptable (for formulated product)	41969901 Ward 1991
Aquatic	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Chronic	NOEC LOEC	0.019 0.034	mg/L mg/L	Very Highly Toxic Parameter: growth effects	Acceptable	43230201 Weinberg et al. 1994
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	1.2	mg/L	Moderately Toxic	Supplemental	00151963 Batchelder 1980
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	8.63	mg/L	Slightly Toxic	Acceptable	00151965 47006032 Milazzo 1981
Aquatic	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	0.25	mg/L	Highly Toxic	Acceptable	43442603 Weinberg et al. 1994
Aquatic	Mollusca Eastern oyster (*Crassostrea virginica*) (shell deposition)	Acute	96h EC50	0.33 (Species)	mg/L	Highly Toxic	Acceptable	41971602 Boeri 1991
Aquatic	Mollusca Eastern oyster (*Crassostrea virginica*) (shell deposition)	Acute	96h EC50	0.23	mg/L	Highly Toxic	Acceptable (for formulated product)	41969903 Boeri 1991
Aquatic	Crustacea Grass Shrimp (*Palaemontes pugio*)	Acute	96h LC50	1.8	mg/L	Moderately Toxic	Acceptable	41971601 Boeri 1991
Aquatic	Crustacea Grass Shrimp (*Palaemontes pugio*)	Acute	96h LC50	0.77	mg/L	Highly Toxic	Acceptable (for formulated product)	41969902 Ward 1991
Aquatic plants	Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	14d EC50	0.86	mg/L	Parameter: Growth and Reproduction	Supplemental (downgraded)	42719101 Milazzo 1993

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic plants	Vascular aquatic plant Duckweed (*Lemna gibba*)	Chronic	14d NOAEC	< 0.111	mg/L	Parameter: Growth and Reproduction	Supplemental	42719101 Milazzo 1993
Aquatic plants	Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	5d EC50	2.5	mg/L	Parameter: Growth	Acceptable	41633704, 42090422 Cowgill & Millazzo 1989
Aquatic plants	Non-vascular aquatic plant Blue-green algae (*Anabeana flos-aquae*)	Acute	5d EC50	1.42	mg/L	Parameter: Growth	Acceptable	42721101 Hughes 1993
Aquatic plants	Non-vascular aquatic plant Freshwater diatom (*Navicula pelliculosa*)	Acute	5d EC50	0.073	mg/L	Parameter: Growth	Acceptable	42721102 Hughes 1993
Aquatic plants (BEE)	Non-vascular aquatic plant Freshwater diatom (*Navicula pelliculosa*)	Chronic	5d NOAEC	0.0014	mg/L	Parameter: Growth	Acceptable	42721102 Hughes 1993
Aquatic plants	Non-vascular aquatic plant Marine diatom (*Skeletonema costatum*)	Acute	5d EC50	0.84	mg/L	Parameter: Growth	Acceptable	42721103 Hughes 1993
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Acute oral	21d LD50	529	mg/kg bw	Practically Non-Toxic	Acceptable	41902002 Campbell & Lynn 1991
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Acute oral	14d LD50	611	mg/kg bw	Practically Non-Toxic	Acceptable	41902003 Campbell & Lynn 1991
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Subacute dietary	8d LC50	6038	ppm	Slightly Toxic	Acceptable	00134180 Wildlife Int'l 1978
Terrestrial	Avian Northern bobwhite Quail (*Colinus virginianus*)	Subacute dietary	8d LC50	3885	ppm	Slightly Toxic	Acceptable	41905501 Lynn et al. 1991
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Subacute dietary	8d LC50	> 6689	ppm	Practically Non-Toxic	Acceptable	00134179 Wildlife Int'l 1977

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial	Avian Mallard duck (*Anas platyrhynchos*)	Subacute dietary	8d LC50	> 3885	ppm	Practically Non-Toxic	Acceptable	41905501 Lynn et al. 1992
Terrestrial	Rodent Rat	Acute oral	LD50	578 (M & F)	mg/kg	Slightly Toxic	Acceptable	40557004 Wall et al. 1987
Terrestrial	Honeybee (*Apis mellifera*)	Acute	Contact 48h LD50	> 72	µg/bee	Practically Non-Toxic	Acceptable	41219109 Dingledine 1985
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	51d EC25	0.006	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995
Terrestrial Plant	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	NOAEC	0.028	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995
Terrestrial Plant	Terrestrial dicot Tomato (*Lycopersicon esculentum*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Radish (*Raphanus sativus*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	51d EC25	0.053	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995

Habitat	Taxa	Effect Type	Endpoint	Value (expressed as the acid equivalent)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial Plant (BEE)	Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	NOAEC	0.0021	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Vegetative Vigor)	Acute	51d EC25	0.063	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Vegetative Vigor)	Acute	NOAEC	< 0.063	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995
Terrestrial Plant	Terrestrial dicot Sugarbeet (*Beta vulgaris*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Corn (*Zea mays*) (Seedling Emergence)	Acute	21d EC25	> 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial monocot Wheat (*Triticum aestivum*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Oilseed rape (*Brassica napus*) (Seedling Emergence)	Acute	21d EC25	< 8.0	lbs ae/A	Parameter: emergence	Acceptable	41734301 Weseloh & Stockdale 1990
Terrestrial Plant	Terrestrial dicot Alfalfa (*Medicago sativa*) (Seedling Emergence)	Acute	51d EC25	0.045	lbs/A	parameter: emergence	Acceptable	43650001 Schwab 1995
Terrestrial Plant (BEE)	Terrestrial dicot Alfalfa (*Medicago sativa*) (Seedling Emergence)	Acute	NOAEC	0.0026	lbs/A	parameter: emergence	Acceptable	43650001 Schwab 1995

Triclopyr Butoxyethyl Ester (BEE)/Picloram ethyl ester Mixture

Habitat	Taxa	Effect Type	Endpoint	Value (% ai)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic plants	Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	14d EC50 NOEC	6.6 (9.2; 99.8) 1.03 (1.43; 15.9) (TBEE = 9.2% ai)	mg/L mg/L	Parameter: Growth (plants)	Acceptable	43230310 Milazzo 1994
Aquatic plants	Non-vascular aquatic plant Blue-green algae (*Anabeana flos-aquae*)	Acute	5d EC50	0.20 (0.276; 3.0) (TBEE = 9.2% ai)	mg/L	Parameter: Growth	Invalid	43230307 Boeri et al. 1994
Aquatic plants	Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	5d EC50 NOEC	0.32 (0.441; 4.9) 0.211 (0.294; 3.2) (TBEE = 9.2% ai)	mg/L mg/L	Parameter: Growth	Supplemental	42645901 Hughes et al. 1993
Aquatic plants	Non-vascular aquatic plant Marine diatom (*Skeletonema costatum*)	Acute	5d EC50	0.12 (0.166; 1.8) (TBEE = 9.2% ai)	mg/L	Parameter: Growth	Invalid	43230304 Boeri et al. 1994
Aquatic plants	Non-vascular aquatic plant Freshwater diatom (*Navicula pelliculosa*)	Acute	5d EC50	0.36 (0.50; 5.4) (TBEE = 9.2% ai)	mg/L	Parameter: Growth	Invalid	43230301 Boeri et al. 1994
Terrestrial	Honeybee (*Apis mellifera*)	Acute	Contact 44h LD50	> 1.62 (> 2.25; > 25) (TBEE = 9.2% ai)	µg/bee	Practically Non-Toxic	Acceptable	42625901 Hoxter et al.1992
Terrestrial Plant	Terrestrial dicot Radish (*Raphanus sativus*) (Vegetative Vigor)	Acute	21 d EC25 NOEL	0.008 (0.035) 0.0035 (0.015) (TBEE = 23.5% ai)	lbs ae/A lbs ae/A	Parameter: height	Supplemental	41296501 Weseloh and Stockdale 1989
Terrestrial Plant	Terrestrial dicot Soybean (*Glycine max*) (Vegetative Vigor)	Acute	55 d EC25 NOEL	0.00005 (0.00021) 0.000026 (0.00011) (TBEE = 23.5% ai)	lbs ae/A lbs ae/A	Parameter: height	Supplemental	41296501 Weseloh and Stockdale 1989

Habitat	Taxa	Effect Type	Endpoint	Value (% ai)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial Plant	Terrestrial monocot Wheat (*Triticum aestivum*) (Vegetative Vigor)	Acute	42 d EC25 NOEL	0.05 (0.21) 0.0146 (0.062) (TBEE = 23.5% ai)	lbs ae/A lbs ae/A	Parameter: height	Supplemental	41296501 Weseloh and Stockdale 1989
Terrestrial Plant	Terrestrial dicot Drybean (*Phaseolus vulgaris*) (Seedling Emergence)	Acute	14 d EC25 NOEL	0.0000009 (0.000004) < 0.000007 (< 0.00003) (TBEE = 23.5% ai)	lbs ae/A lbs ae/A	Parameter: emergence	Supplemental	41296501 Weseloh and Stockdale 1989
Terrestrial Plant	Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	14 d EC25 NOEL	0.008 (0.035) 0.004 (0.0156) (TBEE = 23.5% ai)	lbs ae/A lbs ae/A	Parameter: emergence	Supplemental	41296501 Weseloh and Stockdale 1989
Terrestrial Plant	Terrestrial monocot Wheat (*Triticum aestivum*) (Seedling Emergence)	Acute	21d EC25 NOEL	0.006 (0.025) 0.02 (0.08) (TBEE = 23.5% ai)	lbs ae/A lbs ae/A	Parameter: emergence	Supplemental	41296501 Weseloh and Stockdale 1989
Terrestrial Plant	Terrestrial Lima bean (*Phaseolus lunatus*) (Seedling Emergence)	Acute	21d EC25 NOEL	0.00003 (0.00004; 0.00042) (TBEE = 9.2% ai)	lbs ae/A lbs ae/A	Parameter: shoot height	Supplemental	43276601 Schwab 1994
Terrestrial Plant	Terrestrial monocot Barley (*Hordeum vulgare*) (Seedling Emergence)	Acute	21d EC25 NOEL	0.57 (0.791; 8.6) (TBEE = 9.2% ai))	lbs ae/A lbs ae/A	Parameter: shoot weight	Supplemental	43276601 Schwab 1994

Combined –Most sensitive when converted to acid equivalent (Acid, TEA or BEE)

Habitat	Taxa	Effect Type	Endpoint	Form Tested	Value (acid equivalent)	Value (Original Value)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic (BEE)	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	F (Garlon 4) 62.9% ai TBEE	0.32	0.44	mg/L	Highly Toxic	Acceptable	43442601 Weinberg et al. 1994
Aquatic (BEE)	Freshwater fish Bluegill sunfish (*Lepomis macrochirus*)	Acute	96h LC50	TGAI 96.98% ai TBEE	0.26	0.36	mg/L	Highly Toxic	Acceptable	42917901 Woodburn et al. 1993
Aquatic (BEE)	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	F (Garlon 4) 62.9% ai TBEE	0.70	0.98	mg/L	Highly Toxic	Acceptable	43442602 Weinberg et al. 1994
Aquatic (BEE)	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Acute	96h LC50	TGAI 96.98% ai TBEE	0.47	0.65	mg/L	Highly Toxic	Acceptable	42884501 Woodburn et al. 1993
Aquatic (BEE)	Freshwater fish Rainbow Trout (*Oncorhynchus mykiss*)	Chronic	NOEC LOEC	TGAI 96.98% ai TBEE	0.019 0.034	0.0263 0.048	mg/L	Very Highly Toxic Parameter: growth effects	Acceptable	43230201 Weinberg et al. 1994
Aquatic (TEA)	Freshwater fish Fathead Minnow (*Pimephales promelas*)	Chronic	NOEC LOEC	F 44.9% ai TEA	> 32.2 <50.2	>46.7 (>104) <72.7 (<162)	mg/L	Parameter: Length	Acceptable	00151958 Mayes 1983
Aquatic (BEE)	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	F (Garlon 4) 62.2% ai TBEE	0.25	0.35	mg/L	Highly Toxic	Acceptable	43442603 Weinberg et al. 1994
Aquatic (BEE)	Freshwater invertebrate Water flea (*Daphnia magna*)	Acute	48h EC50	TGAI 96.4% ai TBEE	1.2	1.7 (nominal)	mg/L	Moderately Toxic	Supplemental	00151963 Batchelder 1980
Aquatic (TEA)	Freshwater invertebrate Water flea (*Daphnia magna*)	Chronic	NOEC LOEC	F 44.9% ai TEA	25 46.2	36.2 (80.7) 66.9 (149.0)	mg/L	total young and mean brood size	Acceptable	00151959, 42090411, 92189013 Gerisch 1982
Aquatic plants (BEE)	Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	14d EC50	TGAI 96.98% ai TBEE	0.86	1.2	mg/L	Parameter: Growth and Reproduction	Supplemental	42719101 Milazzo et al. 1993

Habitat	Taxa	Effect Type	Endpoint	Form Tested	Value (acid equivalent)	Value (Original Value)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Aquatic plants (BEE)	Duckweed (*Lemna gibba*)	Chronic	14d NOAEC	TGAI 96.98% ai TBEE	< 0.111	< 0.155	mg/L	Parameter: Growth and Reproduction	Supplemental	42719101 Milazzo et al. 1993
Aquatic plants (TEA)	Vascular aquatic plant Duckweed (*Lemna gibba*)	Acute	14d EC50	F 44.9% ai TEA	6.1	8.8 (19.5)	mg/L	Parameter: Growth and Reproduction	Acceptable	41633709 Cowgill 1987
Aquatic plants (BEE)	Non-vascular aquatic plant Freshwater diatom (*Navicula pelliculosa*)	Acute	5d EC50	TGAI 96.98% ai TBEE	0.073	0.102	mg/L	Parameter: Growth	Acceptable	42721102 Hughes 1993
Aquatic plants (BEE)	Non-vascular aquatic plant Freshwater diatom (*Navicula pelliculosa*)	Chronic	5d NOAEC	TGAI 96.98% ai TBEE	0.0014	0.002	mg/L	Parameter: Growth	Acceptable	42721102 Hughes 1993
Aquatic plants (TEA)	Non-vascular aquatic plant Blue-green algae (*Anabeana flos-aquae*)	Acute	7d EC50	F 45% ai TEA	4.1	5.9	mg/L	Parameter: Growth	Acceptable	41633706 Hughes 1987
Aquatic plants (BEE)	Non-vascular aquatic plant Green algae (*Kirchneria subcapitata*) (Formerly *Selenastrum capricortum*)	Acute	5d EC50	F 61.3% ai TBEE	2.5	3.4 (5.6)	mg/L	Parameter: Growth	Acceptable	41633704, 42090422 Cowgill & Millazzo 1989
Terrestrial (BEE)	Avian Northern bobwhite Quail (*Colinus virginianus*)	Acute oral	21d LD50	TGAI 96.1% ai TBEE	529	735	mg/kg bw	Practically Non-Toxic	Acceptable	41902002 Campbell & Lynn 1991
Terrestrial (BEE)	Avian Northern bobwhite Quail (*Colinus virginianus*)	Acute oral	14d LD50	F (Garlon 4) 62.9% ai TBEE	611	849 (1350)	mg/kg bw	Practically Non-Toxic	Acceptable	41902003 Campbell & Lynn 1991
Terrestrial (Acid)	Avian Northern bobwhite Quail (*Colinus virginianus*)	Subacute dietary	LC50	TGAI Acid	2934	2934	ppm	Slightly Toxic	Acceptable	40346403 Dow Chemical 1976
Terrestrial (BEE)	Avian Northern bobwhite Quail (*Colinus virginianus*)	Subacute dietary	8d LC50	TGAI 96.1% ai TBEE	3885	5401	ppm	Slightly Toxic	Supplemental	41905501 Lynn et al. 1991
Terrestrial (BEE)	Avian Mallard duck (*Anas platyrhynchos*)	Subacute dietary	8d LC50	TGAI 96.1% ai TBEE	> 3,885	> 5,401	ppm	Practically Non-Toxic	Acceptable	41905502 Lynn et al. 1992

Habitat	Taxa	Effect Type	Endpoint	Form Tested	Value (acid equivalent)	Value (Original Value)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial (Acid)	Avian Mallard duck (*Anas platyrhynchos*)	Chronic	NOAEC LOAEC	TGAI 98.9% ai Acid	100 200	100 200	ppm	# of 14 d old survivors	Acceptable	00031250 Beavers & Fink 1980
Terrestrial (Acid)	Avian Northern bobwhite Quail (*Colinus virginianus*)	Chronic	NOAEC LOAEC LOAEC	TGAI 98.9% ai Acid	500 >500 200	500 >500 200	ppm ppm ppm	No sign. reproductive impairment	Acceptable	00031251 Beavers & Fink 1979
Terrestrial (Acid)	Rodent Rat	Acute oral	LD50	TGAI Acid	729 (M) 630 (F)	729 (M) 630 (F)	mg/kg	Slightly Toxic	Acceptable	00031940 Henck et al. 1979
Terrestrial (TBEE)	Rodent Rat	Acute oral	LD50	TGAI 96% ai TBEE	578 (M &F)	803 (M & F)	mg/kg	Slightly Toxic	Acceptable	40557004 Wall et al. 1987
Terrestrial (TEA)	Rodent Rat	Acute oral	LD50	TGAI 44.9 % ai TEA	572 (M &F)	1847 (M & F)	mg/kg	Slightly Toxic	Acceptable	41443301 Mizell & Lomax 1988
Terrestrial (Acid)	Rodent	Chronic	NOAEL LOAEL	TGAI 99.4% ai Acid	25 250	25 250	mg/kg bw mg/kg bw	Reproductive/ Systemic	Acceptable (RED 1998)	43545701 Vedula et al 1995
Terrestrial (Acid)	Rodent	Chronic	NOAEL LOAEL	TGAI 99.4% ai Acid	5 25	5 25	mg/kg bw mg/kg bw	Reproductive/ Offspring	Acceptable (HED 2002)	43545701 Vedula et al 1995
Terrestrial (Acid)	Honeybee (*Apis mellifera*)	Acute	Contact 48h LD50	TGAI 99.2% ai Acid	>100	>100	µg/bee	Practically Non-Toxic	Acceptable	40356602 Dingledine 1985
Terrestrial (BEE)	Honeybee (*Apis mellifera*)	Acute	Contact 48h LD50	TGAI 97.7% ai TBEE	> 72	> 100	µg/bee	Practically Non-Toxic	Acceptable	41219109 Dingledine 1985
Terrestrial Plant (TEA)	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	14d EC25	F 46.2% ai TEA	0.005	0.0076	lbs/A	parameter: shoot length	Acceptable	43129801 Schwab 1993
Terrestrial Plant (BEE)	Terrestrial dicot Sunflower (*Helianthus annus*) (Vegetative Vigor)	Acute	51d EC25	F (Garlon 4) 62.2% ai TBEE	0.006	0.0089	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995

Habitat	Taxa	Effect Type	Endpoint	Form Tested	Value (acid equivalent)	Value (Original Value)	Unit	Toxicity category	Study Classification	Source (MRID or Acc#, author)
Terrestrial Plant (BEE)	Terrestrial monocot Onion (*Allium cepa*) (Vegetative Vigor)	Acute	51d EC25	F (Garlon 4) 62.2% ai TBEE	0.063	0.0888	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995
Terrestrial Plant (TEA)	Terrestrial monocot Onion (*Allium cepa*) (Vegetative Vigor)	Acute	14d EC25	F 46.2% ai TEA	0.114	0.166	lbs/A	parameter: shoot weight	Acceptable	43129801 Schwab 1993
Terrestrial Plant (BEE)	Terrestrial dicot Alfalfa (*Medicago sativa*) (Seedling Emergence)	Acute	51d EC25	F (Garlon 4) 62.2% ai TBEE	0.045	0.0622	lbs/A	parameter: emergence	Acceptable	43650001 Schwab 1995
Terrestrial Plant (BEE)	Terrestrial monocot Onion (*Allium cepa*) (Seedling Emergence)	Acute	51d EC25	F (Garlon 4) 62.2% ai TBEE	0.053	0.0732	lbs/A	parameter: shoot weight	Acceptable	43650001 Schwab 1995

Appendix L Ecological Effects Data

Aquatic Animals

Coho salmon (Oncorhynchus kisutch), Static, LC50, / Diuron, 95% ai	96 hr LC50 < 2.4 ppm ai (slope = N.R.)	40098001, 1986 /Supplemental
Cutthroat trout (Oncorhynchus clarki), Static, LC50, / Diuron, 95% ai	96 hr LC50 1.4 ppm ai (slope = N.R.)	40094602, 1980 /Core
Cutthroat trout (Oncorhynchus clarki), Static, LC50, / Diuron, 95% ai	96 hr LC50 0.71 ppm ai (slope = N.R.)	40098001, 1986 /Supplemental
Fathead minnow (Pimephales promelas), Static, LC50, / Diuron, 98.6% ai	96 hr LC50 14.2 ppm ai (slope = N.R.)	00141636, 1975 /Supplemental
Fathead minnow (Pimephales promelas), Static, LOEC, / Diuron, 98.6% ai	60day LOEC 61.8 ppb ai (slope = N.R.)	00141636, 1975 /Core

Lake trout (Salvelinus namaycush), Static, LC50, / Diuron, 95% ai	96 hr LC50 2.7 ppm ai (slope = N.R.)	40094602, 1980 /Core
Lake trout (Salvelinus namaycush), Static, LC50, / Diuron, 95% ai	96 hr LC50 1.2 ppm ai (slope = N.R.)	40098001, 1986 /Supplemental
Rainbow trout (Oncorhynchus mykiss), Static, LC50, / Diuron, 80% ai	96 hr LC50 19.6 ppm ai (slope = N.R.)	42046002, 1991 /Core
Rainbow trout (Oncorhynchus mykiss), Static, LC50, / Diuron, 28% ai	96 hr LC50 23.8 ppm ai (slope = N.R.)	TN 0897, 1975 /Core
Rainbow trout (Oncorhynchus mykiss), Static, LC50, / Diuron, 80WP% ai	96 hr LC50 16 ppm ai (slope = N.R.)	40094602, 1980 /Supplemental

Rainbow trout (Oncorhynchus mykiss), Static, LC50, / Diuron, 95% ai	96 hr LC50 1.95 ppm ai (slope = N.R.)	TN 1020, 1976 /Core
Sheepshead minnow (Cyprinodon variegatus), Static, LC50, / Diuron, 99% ai	96 hr LC50 6.7 ppm ai (slope = N.R.)	41418803, 1986 /Core
Sheepshead minnow (Cyprinodon variegatus), Flow-through, LOEC, / Diuron, 96.8% ai	38 D LOEC < 0.44 ppm ai (slope = N.A.)	42312901, 1992 /Supplemental
Striped mullet (Mugil cephalus), Static, LC50, / Diuron, 95% ai	48 hr LC50 6.3 ppm ai (slope = N.R.)	40228401, 1986 /Supplemental
Brown shrimp (Penaeus aztecus), Flow-through, LC50, / Diuron, 95% ai	48 hr LC50 > 1.0 ppm ai (slope = N.A.)	40228401, 1986 /Supplemental

Mysid (Americamysis bahia), Static, LC50, / Diuron, 99% ai	96 hr LC50 1.1 ppm ai (slope = 12.35)	41418801, 1987 /Supplemental
Mysid (Americamysis bahia), Static, LOEC, / Diuron, 96.8% ai	28 D LOEC 0.56 ppm ai (slope = N.R.)	42500601, 1992 /Core
Scud (Gammarus fasciatus), Static, LC50, / Diuron, 95% ai	96 hr LC50 0.16 ppm ai (slope = N.R.)	40094602, 1980 /Core
Water flea (Simocephalus sp.), Static, EC50, / Diuron, 95% ai	48 hr EC50 2.0 ppm ai (slope = N.R.)	40094602, 1980 /Core
Water flea (Daphnia magna), Static, EC50, / Diuron, 80% ai	48 hr EC50 8.4 ppm ai (slope = 9.10)	42046003, 1991 /Core
Water flea (Daphnia pulex), Static, EC50, / Diuron, 95% ai	48 hr EC50 1.4 ppm ai (slope = N.R.)	40094602, 1980 /Core

Water flea (Daphnia magna), Static, LOEC, / Diuron, 98.2% ai	28 D LOEC 0.2 ppm ai (slope = N.R.)	TN 2418, 1979 /Supplemental
Stonefly (Pteronarcys sp.), Static, LC50, / Diuron, 95% ai	96 hr LC50 1.2 ppm ai (slope = N.R.)	40094602, 1980 /Core
Eastern oyster (Crassostrea virginica), Flow-through, EC50, / Diuron, 96.8% ai	96 hr EC50 4.8 ppm ai (slope = 4.49)	42217201, 1991 /Core
Eastern oyster (Crassostrea virginica), Flow-through, EC50, / Diuron, 95% ai	96 hr EC50 1.8 ppm ai (slope = N.R.)	40228401, 1986 /Core

Terrestrial Animals

Bobwhite quail (Colinus virginianus), O, LD50, / Diuron, 92.8% ai	21 D LD50 940 mg/kg ai (slope = 4.01)	50150170, 1985 /Core

Bobwhite quail (Colinus virginianus), Dietary, LC50, / Diuron, >95% ai	8 D LC50 1730 ppm ai (slope = 7.22)	00022923, 1975 /Core
Japanese quail (Coturnix japonica), Dietary, LC50, / Diuron, >95% ai	8 D LC50 > 5000 ppm ai (slope = N.R.)	00022923, 1975 /Supplemental
Mallard duck (Anas platyrhynchos), Oral, LD50, / Diuron, 95% ai	14 D LD50 > 2000 mg/kg ai (slope = N.R.)	00160000, 1970 /Core
Mallard duck (Anas platyrhynchos), Dietary, LC50, / Diuron, >95% ai	8 D LC50 > 5000 ppm ai (slope = N.R.)	00022923, 1975 /Core
Ring-necked pheasant (Phasianus colchicus), Dietary, LC50, / Diuron, >95% ai	8 D LC50 > 5000 ppm ai (slope = N.R.)	00022923, 1975 /Core

Honey bee (Apis mellifera), Contact, LD50, / Diuron, Tech% ai	48 hr LD50 > 145.03 ug/Bee ai (slope = N.R.)	36935, 1975 /Core

Plants

Algae (Nitzschia closterium), Static, EC50, / Diuron, 95% ai	72 hr EC50 50 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Algae (Amphora exigua), Static, EC50, / Diuron, 95% ai	72 hr EC50 31 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Algae (Stauroneis amphoroides), Static, EC50, / Diuron, 95% ai	72 hr EC50 31 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Algae (Achnanthes brevipes), Static, EC50, / Diuron, 95% ai	72 hr EC50 24 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Algae (Cyclotella nana), Static, EC50, / Diuron, 95% ai	72 hr EC50 39 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Algae (Isochrysis galbana), Static, EC50, / Diuron, 95% ai	240hr EC50 10 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Algae (Monochrysis lutheri), Static, EC50, / Diuron, 95% ai	72 hr EC50 18 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Algae (Porphyridium cruentum), Static, EC50, / Diuron, 95% ai	72 hr EC50 24 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Diatom (Thalassiosira fluviatilus), Static, EC50, / Diuron, 95% ai	72 hr EC50 95 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental

Green algae (Selenastrum capricornutum), Static, EC50, / Diuron, 96.8% ai	96 hr EC50 2.4 ppb ai (slope = 2.96)	42218401, 1991 /Core
Green algae (Chlorella sp.), Static, EC50, / Diuron, 95% ai	72 hr EC50 19 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Green algae (Chlorococcum sp.), Static, EC50, / Diuron, 95% ai	72 hr EC50 10 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Green algae (Chlamydomonas sp.), Static, EC50, / Diuron, 95% ai	72 hr EC50 37 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Green algae (Dunaliella tertiolecta), Static, EC50, / Diuron, 95% ai	240hr EC50 20 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Green algae (Platymonas sp.), Static, EC50, / Diuron, 95% ai	72 hr EC50 17 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Green algae (Neochloris sp.), Static, EC50, / Diuron, 95% ai	72 hr EC50 28 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Marine diatom (Phaeodactylum tricornutum), Static, EC50, / Diuron, 95% ai	240hr EC50 10 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Marine diatom (Navicula incerta), Static, EC50, / Diuron, 95% ai	72 hr EC50 93 ppb ai (slope = N.R.)	40228401, 1986 /Supplemental
Rape (Brassica sp.), Veg. Vigor sw, EC25, / Diuron, 97.3% ai	21 D EC25 0.0331 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Sorghum (Sorghum halepense), Seed Emerg. sh, EC25, / Diuron, 96.8% ai	14 D EC25 < 12 lb/A ai (slope = NA)	42398501, 1992 /Core
Sorghum (Sorghum bicolor), Veg. Vigor sw, EC25, / Diuron, 97.3% ai	21 D EC25 0.0753 lb/A ai (slope = N.R.)	44113401, 1996 /Core

Sorghum (Sorghum bicolor), Seed Emerg. sh, EC25, / Diuron, 97.3% ai	14 D EC25 0.81 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Soybean (Glycine max), Seed Emerg. , EC25, / Diuron, 96.8% ai	14 D EC25 > 12 lb/A ai (slope = NA)	42398501, 1992 /Core
Soybean (Glycine max), Veg. Vigor sw, EC25, / Diuron, 97.3% ai	21 D EC25 0.012 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Soybean (Glycine max), Seed Emerg. sh, EC25, / Diuron, 97.3% ai	14 D EC25 > 12 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Sugarbeet (Beta vulgaris), Seed Emerg. sh, EC25, / Diuron, 96.8% ai	14 D EC25 < 12 lb/A ai (slope = NA)	42398501, 1992 /Core
Sugarbeet (Beta vulgaris), Veg. Vigor sw, EC25, / Diuron, 97.3% ai	21 D EC25 0.0087 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Sugarbeet (Beta vulgaris), Seed Emerg. sw, EC25, / Diuron, 97.3% ai	14 D EC25 0.092 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Tomato (Lycopersicon esculentum), Seed Emerg. , EC25, / Diuron, 96.8% ai	14 D EC25 > 0.038 lb/A ai (slope = NA)	42398501, 1992 /Core
Tomato (Lycopersicon esculentum), Seed Emerg. sw, EC25, / Diuron, 97.3% ai	14 D EC25 0.075 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Tomato (Lycopersicon esculentum), Veg. Vigor sw, EC25, / Diuron, 97.3% ai	21 D EC25 0.0017 lb/A ai (slope = N.R.)	44113401, 1996 /Core
Wheat (Triticum aestivum), Seed Emerg. sh, EC25, / Diuron, 96.8% ai	14 D EC25 < 12 lb/A ai (slope = NA)	42398501, 1992 /Supplemental
Wheat (Triticum aestivum), Veg. Vigor sw, EC25, / Diuron, 97.3% ai	21 D EC25 0.0208 lb/A ai (slope = 0.90)	44113401, 1996 /Core

Wheat (Triticum aestivum), Seed Emerg. sw, EC25, / Diuron, 97.3% ai	14 D EC25 1.05 lb/A ai (slope = N.R.)	44113401, 1996 /Core

APPENDIX A

Ecological Effects

a. Ecological Effects Data

(1) Terrestrial Animal Data

Avian Acute Toxicity

Avian Acute Oral Toxicity Findings			
Species	**% Test Material (TGAI)**	**LD_{50}**	**Conclusion**
Bobwhite Quail	92.8	940 mg/kg	slightly toxic

These results show that linuron is slightly toxic to birds on an acute basis. The guideline requirement for the avian acute oral LD_{50} study is fulfilled. (MRID 00150170)

Avian Subacute Dietary Toxicity

No acceptable avian dietary toxicity studies on technical linuron have been submitted for review. However, the following data from the USFWS (United States Fish and Wildlife Service) using a 50% formulation were considered. Some toxicity in formulation testing may be due to ingredients other than the active ingredient. Other formulations may be more or less toxic, depending on their ingredients. Technical testing allows prediction of the toxicity due to the active ingredient across all formulations. Therefore, tests with the technical material are still required.

Avian Subacute Dietary Toxicity Findings			
Species	**% Test Material**	**LC_{50}**	**Conclusions**
Mallard Duck	50	1700ppm a.i.	slightly toxic
Japanese Quail	50	>5,000 ppm	practically nontoxic
Ring-necked Pheasant	50	3438 ppm	slightly toxic

The USFWS extrapolation suggests that 100 precent active ingredient material would be considered "slightly toxic" to the mallard and ring-necked pheasant and "practically nontoxic" to the Japanese quail. (MRID 00034769).

Avian Reproductive Toxicity

Avian reproduction studies are required when birds may be exposed repeatedly or continuously through persistence, bioaccumulation, or multiple applications, or if mammalian reproduction tests indicate reproductive hazard. Because linuron is persistent and can be applied more than one time during a season these studies were required.

Avian Reproductive Toxicity		
Species	**% Test Material**	**Results**
Mallard Duck	98.4	NOEL = 100 ppm LOEL = 300ppm(1)
Bobwhite Quail	98.4	NOEL = 100 ppm LOEL = 300 ppm(2)

(1) Treatment-related effects in adult body weight, feed consumption, egg production, and eggshell thickness.
(2) Treatment-related effects in egg production, hatchability, and offspring survival.

There are sufficient data to characterize the effects of linuron on avian reproduction. The No Observable Effects Level for the mallard duck is 100 ppm and the Lowest Observable Effects Level is 300 ppm. (MRID 42541802)

The No Observable Effects Level for the bobwhite quail is 100 ppm and the Lowest Observable Effects Level is 300 ppm. (MRID 42541801)

Toxicity to Mammals

Mammalian Acute Oral Toxicity Findings		
Species	LD_{50}(mg/kg)	Conclusion
Rat	2600	practically nontoxic

The available data indicate that at a lowest acute oral LD50 of 2600 mg/kg, linuron is practically nontoxic to the rat.

Toxicity to Insects

The minimum data required to establish the acute toxicity to honey bees is an acute contact LD_{50} study with the technical material.

Acute Toxicity to Insects			
Species	% Test Material	LD_{50}	Conclusion
Apis mellifera	not reported	>120.86 ug/bee	practically nontoxic

There is sufficient information to characterize linuron as practically non-toxic to bees. (MRID 00018842).

(2) Aquatic Animal Data

Freshwater Fish Toxicity

Acute testing with the TGAI

In order to establish the toxicity of a pesticide to freshwater fish, the minimum data required on the technical grade of the active ingredient are two freshwater fish toxicity studies. One study should use a coldwater species (preferably the rainbow trout), and the other should use a warmwater species (preferably the bluegill sunfish).

Freshwater Fish Acute Oral Toxicity			
Species	**% Test Material (TGAI)**	**LC_{50}**	**Conclusions**
Rainbow trout	96.2	3 ppm	moderately toxic
Bluegill sunfish	96.2	9.6 ppm	moderately toxic

The results of the 96-hour acute toxicity studies indicate that linuron can be characterized as being moderately toxic to both cold and warm water fish. (MRIDs 40445501 and 40354201).

Acute testing with the formulated product

Formulated product testing is specified if there is direct application to an aquatic environment or if EECs are greater than or equal to the LC50. Linuron is registered for use on rights-of-way (ROWs) which can result in a direct application to aquatic environments.

Freshwater Fish Acute Testing with the Formulated Product			
Species	**% A.I.**	**Result LC50**	**Conclusions**
Rainbow trout	Lorox 50 (WP)	16.4 ppm	slightly toxic
Bluegill sunfish	Lorox 50 (WP)	16.2 ppm	slightly toxic
Bluegill sunfish	Lorox 50 (DF)	9.2 ppm	moderately toxic

The results of the 96-hour EC50 studies indicate that Lorox 50 WP (wettable powder) is slightly toxic to rainbow trout and bluegill sunfish. Lorox 50 DF (dry flowable) is considered moderately toxic to bluegill sunfish. (MRIDs 00018165, 00018165, and 00018198).

Chronic Test-Early Life Stage

The fish early life stage is required to support reregistration of a chemical if exposure is expected to be continuous, recurrent or persistent, and multiple applications of the chemical may occur. The minimum data required to establish chronic toxicity of linuron to fish is the early life stage toxicity test based on survival of fish embryos and post-hatch larvae. There are no data available.

Freshwater Invertebrate Toxicity

Acute testing with the TGAI

The minimum testing required to assess the hazard of a pesticide is a freshwater aquatic invertebrate toxicity test, preferably using first instar *Daphnia magna* or early instar amphipods, stoneflies, mayflies, or midges.

Freshwater Invertebrate Toxicity Findings			
Species	**% Test Material (TGAI)**	**EC_{50}**	**Conclusion**
Daphnia magna	94.4	0.12 ppm	highly toxic

There is sufficient information to characterize linuron as highly toxic to aquatic invertebrates. (MRID 00142932).

Chronic Test-life cycle

The *Daphnia* Life Cycle is required to support reregistration if the chemical's presence in water is likely to be continuous, recurrent or persistent, and multiple applications of the chemical may occur. The minimum data required to establish chronic toxicity of linuron to invertebrates is the Daphnia life cycle test based on reproduction, growth and survival.

Chronic Test-Life Cycle		
Species	**% A.I.**	**Results**
Daphnia magna	98.4	MATC > 0.13 < 0.24 ppm

Based on the data submitted, the MATC is greater than 0.13 and less than 0.24 ppm. The Agency has chronic invertebrate data that appear inconsistent with acute data: chronic effects were not seen until levels higher than those causing acute effects. Also, invertebrates were more sensitive than fish in acute tests, but appear considerably less sensitive in the chronic test. Therefore, additional testing is required based on inconsistent results with the acute toxicity data. (MRID 42153401)

Estuarine/Marine Toxicity

Acute testing with the TGAI

Acute toxicity testing with estuarine and marine organisms is required when an end-use product is intended for direct application to the marine/estuarine environment or is expected to reach this environment in significant concentrations.

The requirements under this category include a 96-hour LC_{50} for an estuarine fish, a 96-hour LC_{50} for shrimp, and either a 48-hour embryo-larvae study or a 96-hour shell deposition study with oysters.

Estuarine/Marine Acute Toxicity Findings			
Species	**% Test Material (TGAI)**	**LC_{50}**	**Conclusions**
Sheepshead minnow	98.4	0.89 ppm	highly toxic
Eastern oyster	98.4	5.4 ppm	moderately toxic
Mysid shrimp	98.4	3.3 ppm	moderately toxic

There is sufficient information to characterize the TGAI of linuron as highly toxic to the sheepshead minnow and moderately toxic to the eastern oyster and mysid shrimp. (MRIDs 42061801, 42061802, and 42061803).

Acute testing with the formulated product

Marine and estuarine testing using the formulated products is required due to the ROW (Rights-of-way) use. ROWs could cross virtually any habitat, including marine aquatic habitat such as salt marshes. Data are not currently available. Testing is required with at least the most sensitive species in acute testing (sheepshead minnow) using the DF (dry flowable) formulation. A DF formulation was found to be more toxic than expected based on active ingredient testing. Because of the ROW (right-of-way) use, there could be direct exposure to the aquatic environment by the formulated product. TEP testing will enable the Agency to assess the risk of specific formulation(s) actually used on ROWs. Additional species and/or formulations may also be required.

Chronic effects

Chronic marine and estuarine testing are indicated based on the same criteria as freshwater species. In the case of linuron, these indications include (1) LC50 value less than 1 mg/l, (2) EEC 0.01 LC50 and (3) aquatic half-life of less than 4 days. Sheepshead minnow and mysid shrimp should be tested.

(3) Non-Target Plants Data

Toxicity to Terrestrial Plants

Data requirements for determining toxicity to terrestrial plants (Tier 2) remain outstanding. These data are required for linuron because it is an herbicide registered for use on terrestrial food and nonfood sites and the vapor pressure is $\geq$ 1.0 X 10^{-5}. Labeling indicate that aerial application can be used for soybeans, as well as ground boom spray for other crops. However, a plant risk assessment for linuron cannot be performed without the phytotoxicity data.

Toxicity to Aquatic Plants

Only one of the five required species for testing for toxicity to aquatic plants has been submitted. Testing for *Lemna gibba*, *Skeletonema costatum*, *Anabaena flos-aquae*, and a freshwater diatom remain outstanding. These data are required for linuron as it is an herbicide registered for use on terrestrial food/nonfood sites, has a vapor pressure $ 1.0 X 10^{-5} mm Hg, and a water solubility greater than 10 ppm. These data are required to conduct the plant risk assessment for linuron.

Aquatic Plant Toxicity		
Species	**% A.I.**	**EC_{50}**
Selenastrum capricornutum	**100**	**5-day = 0.067 mg ai/l**

With a 5-day exposure of 0.067 mg active ingredient per liter of linuron, *S. capricornutum* can be expected to sustain a 50% reduction in density or number of cells. (MRID 42086801).

Appendix A. Ecological Effects Data for Captan

Table A.1. Freshwater Fish Data - Captan Parent						
Species	**% A.I.**	**LC50, µg/L (confidence interval)**	**Measured/ Nominal Flow-through /static**	**Toxicity Classification**	**MRID (study year)**	**Class-ification**
Brook Trout	88.4	34 (22 - 52)	Measured, Flow-through 8-day test	Very Highly toxic	00057846 (Hermanutz, 1973)	Supplemental
Fathead Minnow	88.4	65 (59 – 72)	Measured, Flow-through 6-day test	Very Highly toxic	00057846 (Hermanutz, 1973)	Supplemental
Bluegill sunfish	88.4	72 (47 – 111)	Measured, Flow-through 5-day	Very Highly toxic	00057846 (Hermanutz, 1973)	Supplemental
Coho Salmon	90	137 (117-160)	Static	Highly Toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Coho Salmon	90	56.5 (52.3-61)	Flow-through	Very Highly toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Chinook Salmon	90	120 (103-140)	Static	Highly Toxic	40098001	Supplemental
Cutthroat trout	90	56.4 (42.2-75.4)	Static	Very Highly toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Rainbow Trout	90	73.2 (66.6-80.4)	Static	Very Highly toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Brown Trout	90	80 (63.8– 100)	Static	Very Highly toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Brown Trout	90	26.2 (21.9-31.3)	Flow-through	Very Highly toxic	40098001	Supplemental
Lake Trout	90	49 (40.1-59.9)	Static	Very Highly toxic	(Johnson & Finley, 1980)* 40098001	Supplemental

Lake Trout	90	63.2 (49.6-80.5)	Static	Very Highly toxic	40098001	Supplemental
Lake Trout	90	51 (39.2-66.2)	Flow-through	Very Highly toxic	40098001	Supplemental
Fathead Minnow	90	200 (168-238)	Static	Highly Toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Fathead Minnow	90	134 (100-178)	Flow-through	Highly Toxic	40098001	Supplemental
Channel catfish		77.5 (70.5-85.2)	Static	Very Highly toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Bluegill sunfish	90	141 (119 – 167)	Static	Highly Toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Yellow Perch	90	120 (97.3-147)	Flow-through	Highly Toxic	(Johnson & Finley, 1980)* 40098001	Supplemental
Bluegill sunfish	90	310 (280 – 340) Slope = 1.17	Static	Highly Toxic	GS0120-042 (1979)	Supplemental
Harlequin Fish (Rasbora heteromorpha)	89	300	Static	Highly Toxic	00034713 Tooby et al. 1975	Supplemental (26 hr test, daily change of test water, no mortality data, test species)

* In Mayer and Ellersieck (MRID 40098001)
* Original source: Johnson, W. W., and M. T. Finley. 1980. Handbook of acute toxicity of chemicals to fish and aquatic invertebates. U.S.F.W.S., Resource. Pub. 137.98 pp.

Table A.2 Freshwater Fish Data - Captan Degradates						
Species	**% A.I.**	**96-hr LC_{50}, µg/L (confidence interval)**	**Measured/ nominal Flow-through /static**	**Toxicity Classification**	**MRID (study year)**	**Satisfies Guideline/ Comments**
Rainbow Trout	96% THPI	> 120,000	Measured, Static Renewal	Practically non-toxic	43869806	Acceptable
Rainbow Trout	96% THPAm	> 126,000	Measured, Static	Practically non-toxic	44738801	Supplemental (used 10 fish, but 30 are required for limit test

A.3. Chronic Toxicity to Freshwater Fish			
Species	**Toxicity**	**Source**	**Effects**
Fathead minnow	NOAEC = 16.5 µg/L LOAEC = 39.5 µg/L	MRID 00057846	Acceptable Reductions in adult and larval survival, growth and overall larval-juvenile development, survival of the juvenile species, a reduction in eggs laid, and an inability for juveniles to reproduce

Table A.4. Aquatic Invertebrate Captan Data						
Species	**% A.I.**	**Toxicity**	**Measured/ nominal Flow-through /static**	**Toxicity Classification**	**MRID (study year)**	**Classification**
Daphnia magna	90	48-hr LC_{50} = 8400 (7060-9960) µg/L Slope= 1.187	Static	Moderately Toxic	GS0120041	Acceptable
Daphnia magna	96% THPI	48-hr LC_{50} >113,000 µg/L	Static	Practically non-toxic	438698-08	Acceptable
Daphnia magna	technical	NOAEC = 560 µg/L LOAEC = 1000 µg/L	Static	--	441488-01	Supplemental (based on nominal concentrations)

Table A.5. Aquatic Plant Captan Data					
Species	**% A.I.**	**EC_{50}, µg/L (confidence interval)**	**Toxicity Classification**	**MRID (study year)**	**Classification**
Scenedesmus subspicatus Green algae (96-hr)	92.7	320	Highly toxic	00137688	Supplemental (based on nominal concentrations)
Selenastrum capricornutum Green Algae (96 hr)	90	1770 (1550-2030)	Moderately Toxic	438698-09	Acceptable
Anabaena flos-aquae Freshwater Algae (96 hours)	99.8	1200 (830-1600)	Moderately Toxic	448065-01	Acceptable
Lemna gibba Duckweed (7 days)	99.8	> 12,700	Slightly Toxic	448065-03	Acceptable
Selenastrum capricornutum Green Algae (72 hours)	96% THPI	> 180,000	Practically non-toxic	438698-10	Supplemental (short test duration)

Note: *Skeletonema costatum* (marine diatom), *Isochrysis galbana, Pavlova gyrans, Pavlova lutheria,* and *Dunaliella tertiolecta* (marine algae) are marine species and not applicable to RLF assessment (MRID 40228401).

U.S. EPA. 1986. Acute Toxicity Handbook of Chemicals to Estuarine Organisms., *U.S.EPA, Gulf Breeze,FL* (US EPA MRID 40228401).

Table A. 6. Captan Bird Data						
Species	**LD_{50} mg/kg bw**	**Acute Oral Toxicity (MRID)**	**LC_{50} (mg/kg diet)**	**Subacute Dietary Toxicity (MRID)**	**NOAEC mg/kg diet MRID**	**Affected Endpoints**
Northern bobwhite Quail *Colinus virginianus*	> 2150	00151236 Beavers, 1978	> 2400	GS0120 Fiche/Master ID 00022923 Hill, 1975	1000 (00098295 Fink, 1980)	No affected endpoints
Mallard Duck *Anas platyrhynchos*	> 2000	GS999-001 Hudson, 1984	>5000	GS0120 Fiche/Master ID 00022923 Hill, 1975	1000 (00098296 Fink, 1980)	No affected endpoints

Table A.7. Mammalian Captan Data					
Species	Test Type	LC_{50} (mg/kg diet)	NOAEL/ LOAEL (mg/kg diet)	Citation (MRID)	Comments
Rat	Acute Oral	> 5000	--	00265785 (1984)	Two males died. One death occurred on day 1 and one on day 12. One female died on day 4. The deaths were treatment related according to necropsy.
Rat	Acute Oral	Male: 5400 (4290-6800) Female: 5500 (4370-6930)	--	ACC# 241805	--
Rat	Acute Oral	9000	--	00054789 (1949)	--
Rat	One generation	--	> 500/ >500	00120315	
Rat	Three Generation	--	250 / 500	00125293 246101 241001	decreases in the mean litter weights of pups and severe sexual organ atrophy in adults and pups, signs of severe changes in liver weights in the adult males as well as abdominal and intestinal atrophy. In females, there were signs of stomach atrophy and esophageal atrophy

Table A. 8. Terrestrial Invertebrate Data				
Species	**Test Type**	**LD_{50} (µg/kg bee)**	**Citation (MRID)**	**Comments**
Apis mellifera Honeybee	Acute Contact	> 10	Fiche/Master ID 05001991 Stevenson, 1978	
Apis mellifera Honeybee	Acute Contact	> 215	Fiche/Master ID 00080871 Atkins, 1972	
Osmia lignaria Bee	72-hr Acute Oral	46.26 (32.75 – 77.44)	Ecotox # 87252 Ladurner et al, 2005	Captan 50WP 48.9% a.i.
	72-hr Acute Contact	269.68 (151.32 – 2841.84)		

Summary of Amphibian Larvae Study

Chemical Name: Captan
PC Code: 081301

ECOTOX Record Number and Citation: 90515. Mouchet, F., Gauthier, L., Mailhes, C., Ferrier, V, and Devaux, A. 2006. Comparative evaluation of genotoxicity of captan in amphibian larvae (*Xenopus laevis* and *Pleurodeles waltl*) using the comet assay and the micronucleus test. Environmental Toxicology 21(3): 264-277.

Purpose of Review: Litigation (California Red-Legged Frog)

Date of Review: October 2007

Brief Summary of Study Findings:
The toxic and genotoxic potentials of captan were evaluated with the micronucleus test (MNT) and the comet assay (CA).

Adult pairs of *Xenopus* and *Pleurodeles* were mated. Viable eggs were maintained until they reached a development stage appropriate for testing (3 weeks for *Xenopus* and 6 weeks for *Pleurodeles*). Experimental conditions generally followed the French Standard AFNOR (French National Organization for Quality Regulation) NF T90-325. Amphibians were exposed to either reconstituted water (RW) to which nutritive salts were added or mineral water (MW). Nominal captan concentrations were: 2000, 1000, 500, 250, 125, 65.5, 31.25, and 15.60 µg/L. Actual concentrations in water were not measured. Negative controls were either RW or MW. Positive controls were benzo[a]pyrene (B[a]P, [50-32-8], purity: 96.0%, Sigma France) at 0.125 mg/L for MNT and methyl methanesulfonate (MMs, [66-27-3], purity: 99%, Sigma France) at 1.56 mg/L for CA. Captan was dissolved in DMSO at a final concentration of 0.05% before addition to water. Media in all flasks was renewed daily.

Acute toxicity was examined for 12 days by visual inspection (death, abnormal behavior, reduced size, diminished food intake. No signs of toxicity or mortality were observed in any of the negative controls (personal communication with F. Mouchet, October 2007).

Captan flasks containing RW became turbid between 12-24 hours after renewal. The study author hypothesized that this turbidity was probably caused by amphibian residues/excretion or by the suspended captan or the degradation products that may interact with mineral ions, which make up a larger proportion of RW than MW.

Results of acute toxicity to *Xenopus* and *Pleurodeles* larvae exposed to captan (µg/L) in mineral water (MW) and reconstituted water (RW) for 12 days

Conc(µg/L)		2000	1000	500	250	125	62.5	31.25	15.60
Xenopus	MW	++(100%)	++(100%)	++(100%)	++(100%)	++(55%)	-	-	-
	RW	++(100%)	++(100%)	++(100%)	+	-	-	-	-
Pleurodeles	MW	++(100%)	++(100%)	++(75%)	++(45%)	-	-	-	-
	RW	++(100%)	++(100%)	++(50%)	+	-	-	-	-

%: percent dead (of 20 larvae); - No toxicity of larvae; + weak toxicity; ++ severe toxicity.

Genotoxicity was only assayed in MW at those concentrations where there was no acute toxicity. At 12 days for MNT and 1, 2, 4, 8, or 12 days for CA a blood sample was taken. Genotoxicity was assessed to the highest concentration that did not lead to signs of acute toxicity of the exposed larvae.

The results of the *Xenopus* MNT showed that a captan concentration of 62.50 µg/L induced a significant genotoxic response. The lowest concentrations (15.60 and 31.25 µg/L) were not genotoxic to *Xenopus* larvae. The results of the *Pleurodeles* MNT showed no genotoxicity regardless of the concentration of captan tested: 125, 62.50, 31.25, or 15.60 µg/L.

Results of the *Xenopus* CA showed that captan had genotoxic effects at all concentrations tested (15.60 µg/L after 8 and 12 days; 31.25 and 62.5 µg/L after 1, 2, 4, and 8 days; and 125 µg/L after 1, 2, and 4 days). The results of the Pleurodeles CA showed genotoxic effects at captan concentrations of 62.5 and 125 µg/L after 1 and 2 days of exposure, whatever the parameter, except with tail DNA after 2 days of exposure to 62.5 µg/L.

LC_{50} and slope (when possible) was estimated by the reviewer using TOXANAL software.

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RESULTS CALCULATED USING THE PROBIT METHOD
ITERATIONS    G               H            GOODNESS OF FIT PROBABILITY
 16            .1202498      1              .8025137
SLOPE    =     4.58749
95 PERCENT CONFIDENCE LIMITS  = 2.996684     AND    6.178296
LC50 =         311.0651
95 PERCENT CONFIDENCE LIMITS = 253.3895 AND  381.8606
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		LD50, (µg/L) (confid int)	**Method**
Xenopus	MW	119.4 (62.5, 250)	Binomial
	RW	353.6 (250, 500)	Binomial
Pleurodeles	MW	311.1 (253.4, 381.9)	Probit
	RW	500 (250, 1000)	binomial

Description of Use in Document: Qualitative
Rationale for Use: This is the only known study evaluating the toxicity of captan to amphibians.

Limitations of Study:
1. Detailed raw data not available.
2. LC_{50} and slope (using probit model) not estimable for 3 survival curves as there was only one concentration with partial mortality.
3. Captan concentrations not measured.
4. Turbidity in RW flasks containing captan not definitively explained.

Reviewers: Christine Hartless, Wildlife Biologist (ERB1)

Summary of Wheat Study

Chemical Name: Captan
PC Code: 081301

ECOTOX Record Number and Citation: 91168. Mantecon, J. D. (1989). Persistence of Systemic and Non-Systemic Fungicides in the Control of Seedling Blight of Wheat (Fusarium graminearum). *Tests Agrochem.Cultiv*. 10: 76-77.

Purpose of Review: Litigation (California Red-Legged Frog)

Date of Review: September 2007

Brief Summary of Study Findings:
This study was conducted in a greenhouse at the Experiment Station INTA Balcarce, Buenos Aires Province, Argentina. Highly infected seeds of a durum wheat (Triticum durum Desf.) cv. Buck Patacon were sown in an artificially infested soil. The treatments were arranged in a randomized complete block design with three replications of 100 seeds each. Greenhouse temperatures averaged 20 ± 5 C. Fungicides were applied one day before sowing the seed. Four fungicides (including captan) were evaluated. Captan was applied at a rate of 120 g ai/kg-seed (0.26 lbs ai/cwt) using a wettable powder product from Stauffer Chemicals that was 83% ai.

The measured response variable was number of seedlings present after 7, 14, 21, and 28 days. Data were analyzed for each day by ANOVA and Tukey's test. Only the results from captan and the control are included in the table below.

	Time (days) after sowing			
	7	**14**	**21**	**28**
Captan	67	89	79	69
Control	39	43	28	26

At each time point, there was a statistically significant difference between the mean number of seedlings in the captan and the control groups.

Description of Use in Document: Qualitative

Rationale for Use: One of several seed treatment studies used in lieu of seedling emergence studies.

Limitations of Study:
1. Detailed raw data not available.
2. Only one treatment level evaluated (EC_{25} cannot be determined).
3. Exposure is by seed treatment, rather than by spray on top of soil surface.
4. Watering regime not available.

Reviewers: Christine Hartless, Wildlife Biologist (ERB1)

Summary of Sorghum Study # 91004

Chemical Name: Captan
PC Code: 081301

ECOTOX Record Number and Citation: 91004. Mc Laren, N. W. and Rijkenberg, F. H. J. (1989). Efficacy of Fungicide Seed Dressings in the Control of Pre- and Post-Emergence Damping-Off and Seedling Blight of Sorghum. *S.Afr.J.Plant Soil* 6 : 167-170.

Purpose of Review : Litigation (California Red-Legged Frog)

Date of Review: September 2007

Brief Summary of Study Findings:

This field study was conducted in Potchefstroom, Republic of South Africa in a field in which seedling diseases had been previously recorded. The seed cultivars DC34, DC99, NK283, and PNR8311 were used. A randomized split plot design with five replications was used. Cultivar was the whole plot factor and seed treatment was the sub-plot factor. Captan was applied as a seed dressing at a rate of 135 mg ai/kg-seed (0.30 lbs ai/cwt). Each subplot consisted of three rows, 11 m in length, spaced 1 m apart. After application of 2:3:2 fertilizer (300 kg/ha) seeds were planted to a depth of ± 5 cm and spaced 15 cm apart. A total of 17 fungicide treatments was used, only captan and control results are reported here.

To facilitate recovery of seed from the soil for determination of germination and pre-emergence damping-off, samples of 20 seeds were planted in cocoons, 30 cm in length, folded from single ply cheesecloth. Two cocoons with the relevant seed treatment and cultivar were randomly placed in each subplot row. Cocoons were recovered after 7 days and the percentage germination and per-emergence damping-off were assessed. Pre-emergence damping-off was measured as the percentage germinated seeds in which rotting was so severe that growth had ceased prior to emergence of seedlings from soil.

Twenty-one days after planting the percentage post-emergence damping-off (as a percentage of emerged seedlings) was determined in each sub-plot. Thereafter, 25 seedlings were removed from each sub-plot row and washed to remover adhering soil particles. Visual assessments of the percentage mesocotyl and primary root discoloration were made. Seedlings were also dried and weighed.

For each of the measured parameters, there were no statistically significant differences between the captan and the control group.

	Pre-emergence damping off (%)	Mesocotyl discoloration (%)	Root discoloration (%)	Post-emergence damping off (%)	Seedling mass (g)
Captan	19.4	58.2	19.8	10.5	3.8
Control	18.0	64.9	21.4	11.3	3.5
Least Significant Difference LSD (0.05)	8.2	16.4	7.5	2.3	0.5

Description of Use in Document: Qualitative

Rationale for Use: One of several seed treatment studies used in lieu of seedling emergence studies.

Limitations of Study:
1. Detailed raw data not available.
2. Only one treatment level evaluated (EC_{25} cannot be determined).
3. Exposure is by seed treatment, rather than by spray on top of soil surface.
4. Watering regime not available.

Reviewers: Christine Hartless, Wildlife Biologist (ERB1)

Summary of Sorghum Study # 90836

Chemical Name: Captan
PC Code: 081301

ECOTOX Record Number and Citation: 90836. Davis, M. A. and Bockus, W. W. (2001). Evidence for a *Pythium* sp. as a Chronic Yield Reducer in a Continuous Grain Sorghum Field. *Plant Dis.* 85: 780-784.

Purpose of Review (DP Barcode or Litigation): Litigation (California Red-Legged Frog)

Date of Review: September 2007

Brief Summary of Study Findings:

Field experiments
Two field experiments were conducted (planting dates of 11 May 1995 and 7 June 1995) in which there were three treatment groups (control, captan, and metalaxyl). A high vigor commercial hybrid seed (germination rate > 90%, Cargill 618Y) was planted. Prior to planting, seed was treated. A glass canning jar (1 liter) was "seasoned" by adding 2.5 ml water, the correct amount of chemical, and 100 g of seed. Jar was shaken until all liquid was absorbed by seed. This seed was discarded; procedure was repeated to produce treated seed for experiments. Treated seed was placed in paper bags to dry before sowing. Captan 400D at 3.0 fl oz/cwt (73g ai/kg-seed or 0.16 lbs ai/cwt) was used. Stand counts (plants/m^2) were taken on 12 and 23 June, vigor ratings (scale of 1 to 5) were taken on 3 July (boot and growing point differentiation growth stages), and grain yields (kg/acre) were measured on 17 and 20 October. There was a statistically significant increase or no difference in the captan treated seed responses relative to the control seeds in all measured parameters for both experiments.

		11 May 1995	7 June 1995
Stand			
	Control	3.8 c	6.0 b
	captan	7.3 a	7.9 a
	Metalaxyl	6.3 b	7.7 a
Vigor			
	Control	2.3 b	4.2 a
	captan	2.9 a	4.0 a
	Metalaxyl	3.1 a	3.6 a
Grain yield			
	Control	2592 b	5651 b
	captan	2754 b	6302 ab
	Metalaxyl	3947 a	6742 a

Values within a column and parameter followed by a common letter are not significantly different according to analysis of variance followed by least significant difference (*P* = 0.05).

Greenhouse experiment

Seed (Cargill 618Y) was treated or not treated with captan or metalaxyl at 0.16 lbs ai/cwt using the same method as described above. The experiment was arranged in a randomized complete block design using 10 plastic tubes 2.5 cm in diameter by 15 cm long. Each treatment had four replications. Soil was collected from the field experiment site above and left nontreatd or autoclaved at 121C for 2 hrs and placed I the tubes. One seed was sown per tube and plants were maintained in a greenhouse at 15-27 C Plant counts (out of 10 seeds planted) and shoot fresh weight per plant were recorded after 28 days. . There was a statistically significant increase or no difference in the captan treated seed responses relative to the control seeds in all measured parameters for either naturally infested soil or autoclaved soil.

		Experiment 1		**Experiment 2**	
Seed trt	**Soil trt**	**Stand**	**Fresh shoot wt**	**Stand**	**Fresh shoot wt**
Nontreated	Autoclaved	5.8 a	0.83 a	7.8 a	1.03 a
Captan	Autoclaved	7.5 a	0.85 a	8.0 a	1.18 a
Metalaxyl	Autoclaved	7.0 a	0.87 a	8.0 a	1.15 a
Nontreated	Nonautoclaved	3.0 b	0.57 b	5.5 b	0.52 b
Captan	Nonautoclaved	7.0 a	0.60 b	7.8 a	0.69 b
Metalaxyl	Nonautoclaved	7.8 a	0.90 a	8.0 a	1.07 a

Values within a column followed by a common letter are not significantly different according to analysis of variance followed by least significant difference (*P* = 0.05).

Description of Use in Document: Qualitative

Rationale for Use: One of several seed treatment studies used in lieu of seedling emergence studies.

Limitations of Study:
1. Detailed raw data not available.
2. Only one treatment level evaluated (EC_{25} cannot be determined).
3. Exposure is by seed treatment, rather than by spray on top of soil surface.

Reviewers: Christine Hartless, Wildlife Biologist (ERB1)

Summary of Lupine Study

Chemical Name: Captan
PC Code: 081301

ECOTOX Record Number and Citation: 91007. Fahim, M. M., Osman, A. R., Sahab, A. F., and El-Kader, M. M. A. (1983). Agricultural Practices and Fungicide Treatments for the Control of Fusarium Wilt of Lupine. *Egypt.J.Phytopathol.* 15: 35-46.

Purpose of Review (DP Barcode or Litigation): Litigation (California Red-Legged Frog)

Date of Review: September 2007

Brief Summary of Study Findings:

In vivo experiments were carried out in unsterilized 25-cm diameter clay pots containing clay sand mixture (1:1, w/w), referred to as loamy soil. The seeds were treated with the tested fungicides by shaking them in polyethylene bags until an even dressing was observed. Captan was applied at 0.50 lbs ai/cwt as the enduse product Orthocide (75% captan, recommended rate of 3 g Orthocide/kg-seed). Each treatment had five replicates. A total of eight fungicides and the control were evaluated in the experiment; only the captan results are summarized below.

Soil infestation was conducted by mixing cultures of *Fusarium oxysporum* with the soil at a rate of 5%, w/w. The inoculum was a 2-week-old growth of a virulent isolate, obtained from Alquam, Giza Governorate, on barley/sand (3:1, w/w) medium at 30 C. visual observations were made during the growth season. Macroscopic checks were also carried out at maturity. Seeds were air-dried for several days.

At the end of growing season, average weight of 100 seeds in the treated group was the same or greater than in the control. Percent occurrence of diseased plants was less in treated group than in control group.

		Diseased plants, %			**Avg wt of 100 seeds, g.**
		Pre-emergence	**Post-emergence**	**total**	
Captan	Infested	0	10	10	19.0
	Uninfested	0	7.5	8	20.2
Control	Infested	12.5	68.9	73	14.7
	Uninfested	7.5	19.1	25	16.7
Least Significant Difference (LSD) at P=0.05					
Main effect of fungicide		3.5	6.2	-	3.3
Main effect of infestation		1.6	2.9	-	1.5
Interaction (fungicide x infestation)		4.9	8.6	-	4.7

Description of Use in Document: Qualitative

Rationale for Use: One of several seed treatment studies used in lieu of seedling emergence studies.

Limitations of Study:
1. Detailed raw data not available.
2. Only one treatment level evaluated (EC_{25} cannot be determined).
3. Exposure is by seed treatment, rather than by spray on top of soil surface.
4. Rainfall/watering regime not available.

Reviewers: Christine Hartless, Wildlife Biologist (ERB1)

Summary of Blueberry Study

Chemical Name: Captan
PC Code: 081301

ECOTOX Record Number and Citation: 63909. Polavarapu, S. (2000). Evaluation of Phytotoxicity of Diazinon and Captan Formulations on Highbush Blueberries. *Horttechnology* 10: 308-314.

Purpose of Review (DP Barcode or Litigation): Litigation (California Red-Legged Frog)

Date of Review: September 2007

Brief Summary of Study Findings:

Experiments were conducted during the 1997 and 1998 growing seasons at Rutgers University Blueberry and Cranberry Research and Extension Center, Chatsworth, NJ, on highbush blueberries planted in 1994. Bushes were 4-5 yrs old, approx 5 ft tall, and spaced 9 x 4 ft apart on light sandy organic matter soil wth pH of 4.5. Two formulations of diazinon (Diazinon AG600 and Diazanon 50W) and of captan (Captec 4L and Captan 80WP) as well as an adjuvant, LI-700 were evaluated. Results pertaining to the adjuvant will not be reported here. All experiments described below had a negative control group. Application rates (author stated maximum labeled rates were used) are below:

formulation	Rate/acre	lbs ai/acre
Diazinon AG600	22.5 fl oz	NA
Diazanon 50W	2 lb	NA
Captec 4L	3.12 lb	2.43 lbs ai/acre
Captan 80WP	2.5 qt	2.5 lbs ai/acre

NA – not applicable, reviewer did not calculate as only captan is under review in this summary.

Treatments were arranged in a randomized complete block design. Treatments within a block were separated by at least 4 bushes and blocks were arranged 50-133 ft apart.

Pesticides were applied with a CO_2 pressurized backpack sprayer equipped with a hollowcone nozzle calibrated to deliver 30 gal/acre. At each evaluation, samples of foliage and fruit were collected in polyethylene bags and transported to lab for phytotoxicity evaluations. A fruit or foliage cluster was determined to have phytotoxicity even if only one fruit or leaf was injured.

Phytotoxicity injury occurred within 24 to 36 hrs after application of pesticides. Phytotoxicity on berries ranged from deep purple blotches to circular depressions, especially where residues accumulated. In the most severe cases, fruit had 2 to 3 mm diameter circular depressions filled with apparent pesticide residue. Phytotoxicity on leaves was typically brownish purple spots on the underside of the leaf surface. The degree of phytotoxicity severity caused by the mixtures of captan and diazinon was much greater than the phytotoxicity when captan or diazinon was applied alone.

Data were analyzed using ANOVA and Duncan's multiple range test (P=0.05). Data were transformed before analysis using square root (number of clusters with phytotoxicity, number of berries, and berry weight) or arcsin (percent phytotoxicity) transformations.

Experiment 1

- Conducted in 1997, treated on 11 June 1997
- 5 single bush reps per treatment, variety Ellicot
- single treatment was Diazinon AG600 and Captec 4L
- 5 fruit and 5 foliage clusters collected from each side of each bush - 10 days after treatment
- the combined treatment had a significantly greater proportion of berries exhibiting phytotoxicity and lighter weight berries; although, the number of berries per 10 clusters was not different than the control.

	Berries with phytotoxicity (%)		Number of berries/10 clusters	Wt of 100 berries (g)
treatment	green	Blue		
Diazinon AG600 + Captec 4L	99.6±0.4 a	97.7±1.7 a	103±6.6 a	108.4±7.2 a
Untreated	0.0±0 b	1.5±1.0 b	99.2±5 a	145.5±11.2 b

For each response variable, treatment means followed by different letters are significantly different at P=0.05.
Listed response is mean ± standard error

Experiment 2

- Conducted in 1997, treated on 12 June 1997
- Three replications, each consisting of 6 bushes in a row, variety Bluecrop
- Treatments were combinations of the 4 listed pesticides.
- First evaluation 7 days after trt, 10 clusters from 3 randomly selected bushes within each replication
- Second evaluation 13 July with 25 fruit clusters per rep (during harvest)
- For all responses, the single pesticide applications were not significantly different from the control. Responses with no significant differences (means not listed in summary, are available in paper) were number of berries per 30 clusters 7 days after treatment, blue berries with phytotoxicity/25 clusters (%) at harvest, all berries with phytotoxicity/25 clusters (%) at harvest, and number of berries/25 clusters at harvest.

	Clusters with phytotoxicity (no/30 clusters) 7 d after treatment		Green berries with phytotoxicity/25 clusters (%) at harvest
	fruit	leaf	
Diazinon AG600	0.0±0 c	0.0±0 d	0.7±0.7 b
Captec 4L	0.0±0 c	0.3±0.3 d	1.9±0.5 ab
Diazinon AG600 + Captec 4L	9.3±1.9 a	22.7±1.2 a	5.2±1.4 a
Diazinon AG600 + Captan 80WP	7.7±1.3 a	16.0±2.0 b	1.1±0.5 b
Diazinon 50W + Captec 4L	3.0±0 b	3.0±1.0 c	0.4±0.4 b
control	0.0 ±0 c	0.0±0 d	0.6±0.6 b

For each response variable, treatment means followed by different letters are significantly different at P=0.05, Duncan's multiple range test.
Listed response is mean ± standard error

Experiment 3

- Conducted in 1997, treatment applied on 25 June 1997
- Three replications, each consisting of three bushes, variety Ellicott
- Treatments were combinations of the 4 listed pesticides.
- 20 fruit and leaf clusters per rep (10 each from two randomly selected bushes) sampled 8 d after treatment.
- In addition to responses reported below, percent phytoxicity/20 clusters was also analyzed, results were similar to the number of clusters (reported below). There were no significant differences in the number of berries per 20 clusters among treatments.
- Relative to control, captan alone or with diazinon resulted in no significant change or an increase in the observed phytotoxicity in fruit and leaves.

	Clusters with phytotoxicity (no/20 clusters) 8 d after treatment	
	fruit	leaf
Diazinon AG600	0.0±0 c	4.0±1.5 c
Diazinon 50W	0.0±0 c	0.3±0.3 d
Captec 4L	0.3±0.3 bc	14.0±1.5 b
Captan 80WP	0.7±0.3 bc	0.3±0.3 d
Diazinon AG600 + Captec 4L	4.0±2.5 a	20.0±0 a
Diazinon AG600 + Captan 80WP	1.0±1.0 bc	15.3±0.9 b
Diazinon 50W + Captec 4L	1.0±0.6 bc	4.7±1.7 c
control	0.0±0 c	0.0±0 e

For each response variable, treatment means followed by different letters are significantly different at P=0.05, Duncan's multiple range test.
Listed response is mean ± standard error

Experiment 4

- Conducted in 1998, treatments applied on 18 May. For some trts, diazinon applied first, followed by captan 8 hrs later.
- 4 reps, each consisted of 6 bushes in a single row, variety Weymouth

- 30 fruit and leaf clusters sampled from each rep 9 days after trt.
- In addition to responses reported below, percent phytoxicity/30 clusters was also analyzed, results were similar to the number of clusters (reported below).
- Relative to control, captan alone or with diazinon resulted in no significant change or an increase in the observed phytotoxicity in fruit and leaves. Applying captan 8 hrs after diazinon did demonstrate a significant reduction in phytotoxicity relative to applying both simultaneously.

	Clusters with phytotoxicity (no/30 clusters) 9 d after treatment	
	fruit	**leaf**
Diazinon AG600	0.0±0 e	0.0±0 c
Diazinon 50W	0.3±0.3 de	0.3±0.3 c
Captec 4L	1.8±0.5 c	8.0±1.5 b
Diazinon AG600 + Captec 4L	25.8±2.5 a	14.5±2.0 a
Diazinon 50W + Captec 4L	13.5±0.6 b	7.2±0.9 b
Diazinon AG600 first + Captec 4L 8 hrs later	2.8±1.1 c	7.0±1.1 b
Diazinon 50W first + Captec 4L 8 hrs later	1.5±0.6 cd	5.0±1.5 b
control	0.0±0 e	0.0±0.0 c

For each response variable, treatment means followed by different letters are significantly different at P=0.05, Duncan's multiple range test.
Listed response is mean ± standard error

Experiment 5

- Conducted in 1998, treatments applied on 26 May. For some trts, chemicals were applied with an 8 h interval between them.
- 4 reps, each consisted of 6 bushes in a single row, variety Bluecrop
- 30 fruit and leaf clusters sampled from each rep 8 days after trt.
- Relative to control, captan alone resulted in no significant change or an increase in the observed phytotoxicity in fruit and leaves. Using an 8 hr interval between pesticide applications (with either captan or diazinon first) resulted in a significant reduction in phytotoxicity relative to applying both simultaneously.

	Phytotoxicity /30 clusters (%) 8 d after treatment	
	fruit	**Leaf**
Captan 80WP	0.2±0.2 b	1.4±0.5 b
Diazinon AG600 + Captan 80WP	18.1±3.1 a	9.0±1.3 a
Captec 4L first + Diazinon AG600 8 hrs later	2.2±1.8 b	3.5±1.1 b
Captan 80WP first + Diazinon AG600 8 hrs later	1.5±1.0 b	1.8±0.8 b
Captan 80WP first + Diazinon 50W 8 hrs later	0.1±0.1 b	2.3±1.3 b
control	0.0±1 b	0.0±0 c

For each response variable, treatment means followed by different letters are significantly different at P=0.05, Duncan's multiple range test.
Listed response is mean ± standard error

Experiment 6

- Evaluated effect of repeated applications of captan and diazinon applied together
- Conducted in 1998, treatments applied on 22 May, 26 June, 29 July.
- Variety Ellicott was used

- Samples collected 5 to 8 days after treatment.
- Only one treatment (Diazinon AG600 + Captec 4L, applied at same time) that caused most severe phytotoxicity plus control were used.
- Statistical analysis indicated a time*treatment interaction – a greater percentage of fruit and leaves showed phytotoxicity after 22 May application (immediately following petal fall) than after the other two application dates.

Description of Use in Document: Qualitative

Rationale for Use: Foliar spray study used in lieu of vegetative vigor studies.

Limitations of Study:
1. Detailed raw data not available.
2. Only one treatment level evaluated (EC_{25} cannot be determined).
4. Watering regime not available.
5. Impact on growth of plants not measured.
6. Plants were established, not young seedlings.

Reviewers: Christine Hartless, Wildlife Biologist (ERB1)

Summary of Bee Study

Chemical Name: Captan
PC Code: 081301

ECOTOX Record Number and Citation: 87252. Ladurner, E., Bosch, J., Kemp, W. P., and Maini, S. (2005). Assessing Delayed and Acute Toxicity of Five Formulated Fungicides to *Osmia lignaria* Say and *Apis mellifera*. *Apidologie* 36: 449-460.

Purpose of Review (DP Barcode or Litigation): Litigation (California Red-Legged Frog)

Date of Review: October 2007

Brief Summary of Study Findings:

Contact and oral toxicity of five formulated pesticides were evaluated in this study. Only the results for captan (Captan 50WP, 49% ai) will be reported here.

In May 2002, wintering *O. lignaria* females, reared at the Bee Biology and Systematics Laboratory, Logan, Utah, were incubated at 25 C until emergence from cocoons. Unfed females were transferred to a screened flight cage to all them to deposit meconium. Females were then starved overnight and exposed to a specific fungicide treatment the next morning, approximately 24 h after emergence. In June 2002, *A. mellifera* foragers of different ages from a healthy, queen-right colony were captured in a clear plastic jar as they left the hive in the morning. All bees were chilled for a maximum of 30 minutes at 4 C prior to treatment.

In the contact toxicity tests, 1 µL of test solution was applied to the dorsal surface of the thorax with a 50 µL-micro syringe. Test solution was prepared by dissolving fungicide in acetone and purified distilled water (50% v/v) to obtain desired concentrations; fresh test solution was used for all tests.

In the oral toxicity tests known amounts of the fungicide were dissolved in a feeding solution (25% v/v sucrose in purified distilled water) to obtain desired concentrations. *O. lignaria* and *A. mellifera* were fed 10 µL of the test solution using the flower method devised by Ladurner et al (2003). The test solution was pipetted into a plastic ampoule and inserted into the calyx of a flower (cherry for *O. lignaria* and morning glory for *A. mellifera*). Flowers and bees were individually housed in holding cages (waxed cardboard cups, 8 cm diameter x 5 cm height) with a wire mesh screen lid. Flowers and bees in holding cages were kept in an incubator (22 C for *O. lignaria* and 25 C for *A. mellifera*) under artificial light (two 15W Cool White fluorescent tubes 15cm above holding cages) for one hour.

For the contact test, control bees were dosed with the mixture of acetone and purified distilled water (50% v/v). For the oral test, control bees were fed the feeding solution (25% v/v sucrose in purified distilled water).

TEST 1

Three sets of ten bees each were evaluated for delayed toxicity in the form of a single dose (122.5 µg ai/bee) for both oral and contact tests. After exposure, each set of 10 bees was transferred to a holding cage (same as described for oral test) with an artificial feeder. The feeder was a 5 mL-LDPE sample vial containing a sucrose solution (25% v/v sucrose in water) with a soaked cigarette filter inserted through the end of the vial. Fresh solution was provided every 24 hrs. Holding cages for *A. mellifera* were also provided with a piece of wax foundation comb. Holding cages were kept in an incubator (*O. lignaria* – temperature=22 C, relative humidity=60-80%, L:D=12:12hr; *A. mellifera* – temperature=25 C, relative humidity=60-80%, L:D-0:24 hr). Survival was recorded every 24 hrs for 7 days.

In oral exposure trials, 97.7% of *A. mellifera* and 88.2% of *A. mellifera* consumed all the test solution in one hour. Control survival was 100% in the *O. lignaria* studies and was 75-80% in the *A. mellifera* studies. Captan resulted minimal mortality for *A. mellifera* and higher mortalty rates for *O. lignaria.*

For *A. mellifera*, survival was not significantly reduced relative to control at the end of 7 days (Wilcoxon test) in either the oral or contact tests. For *O. lignaria*, survival was significantly reduced relative to control at the end of 7 days: in the contact test, survival was approximately 50%; and in the oral test, survival was approximately 35% on day 1 and approximately 0% by day 3.

TEST 2 – Methods of administration and bee maintenance were the same as described above. Only *O. lignaria* bees were used for captan, as there was minimal mortality for *A. mellifera* in the first test.

This test was designed to provide an estimate of an LD50. Five doses were administered; however, the test concentrations were not provided. Probit analysis was used for LD50 estimation.

	24 hr	48 hr	72 hr	7 days
Contact	NA	NA	269.68 (151.32, 2841.84)	95.26 (79.83, 134.59)
oral	NA	100.45 (63.75, 245.23)	46.26 (32.75, 77.44)	10.87 (5.40, 19.28)

Units are in µg ai/bee
NA – not available (LD50 was > than highest dose)
95% confidence interval in parentheses

Reference:
Ladurner, E., Bosch, J., Maini, S., Kemp, W.P. 2003. A method to feed individual bees (Hymenoptera: Apiformes) known amounts of pesticides. Apidologie 34: 597-602.

Description of Use in Document: Quantitative

Rationale for Use: This study provides a definitive toxicity endpoint for bees.

Limitations of Study:
1. Detailed raw data not available.
2. Dose concentrations not provided for second test.

Reviewers: Christine Hartless, Wildlife Biologist (ERB1)

Appendix B. Chlorothalonil Ecological Effects Characterization

This appendix presents additional details on available registrant-submitted and open literature studies available on chlorothalonil and its major degradate of toxicological concern, SDS-3701. Studies submitted to the Agency in support of pesticide registration or re-registration are categorized as either; acceptable, supplemental, or invalid. Acceptable means that all essential information was reported, the data are scientifically valid, and the study was performed according to recommended protocols. Studies in the "acceptable" category fulfill the corresponding data requirement in 40 CFR Part 158 and are appropriate for use in risk assessment. Supplemental studies are also scientifically valid; however, they were either performed under conditions that deviate from recommended guideline protocols or certain data necessary for complete verification are missing. Supplemental studies may be used quantitatively in the risk assessment and can, at the Agency's discretion, fulfill the corresponding data requirement in 40 CFR Part 158. Invalid studies are not scientifically valid, or deviate substantially from recommended protocols such that they are not useful for risk assessment. Invalid studies do not fulfill the corresponding data requirement in 40 CFR Part 158.

With respect to the open literature, studies may be classified as either; qualitative, quantitative, or invalid. The degree to which open literature data are quantitatively or qualitatively characterized is dependent on whether the information is directly correlated with the assessment endpoints (i.e., maintenance of the survival, reproduction, and growth of the California red-legged frog and PCEs of their designated critical habitat identified in the problem formulation). Open literature studies classified as qualitative are not appropriate for quantitative use but are of good quality, address issues of concern to the risk assessment, and, when appropriate, are discussed qualitatively in the risk characterization discussion. Those open literature studies that are classified as quantitative are appropriate for quantitative use in the risk assessment including calculation of RQs. This appendix includes registrant-submitted studies in addition to studies identified in the open literature. In general, effects data in the open literature that are more conservative than the registrant-submitted data or that add to the weight of evidence on the toxicity to under-represented species or taxa are considered for quantitative use. Open literature studies that were either rejected by ECOTOX or that were not considered in this assessment are in Appendix H. Those appendices also include rationale for rejection of studies that did not pass the ECOTOX screen and those that were not evaluated as part of this endangered species assessment. Further detail on the ECOTOX exclusion categories is provided in the Agency's *Guidance of the*

Evaluation Criteria for Ecological Toxicity Data in the Open Literature (U.S. EPA, 2004).

B.1 Toxicity to Birds, Reptiles, and Terrestrial Phase Amphibians

No studies in reptiles or terrestrial phase amphibians have been submitted to the Agency or were located in the open literature. Therefore, birds were used as surrogates for terrestrial phase amphibians. Acute oral, subacute dietary, and chronic reproduction toxicity studies for birds are discussed in Sections B.1.1 through B.1.3. All avian studies described below are registrant-submitted studies. No additional information on the acute, subacute, and/or chronic toxicity of chlorothalonil or SDS-3701 to birds was located in the open literature that suggests greater sensitivity than the registrant submitted data. In addition, no relevant information on the toxicity of chlorothalonil and/or SDS-3701 to reptiles and/or terrestrial-phase amphibians was located in the open literature.

B.1.1 Birds: Acute and Subacute Studies

Chlorothalonil

An acute oral toxicity study using the technical grade of the active ingredient (TGAI) is required to establish the toxicity of chlorothalonil to birds. The preferred test species is either mallard duck (*Anas platyrhynchos*; a waterfowl) or bobwhite quail (*Colinus virginianus*; an upland gamebird). Results of these studies are summarized below in Table B.1-1 and B.1-2. These studies suggest that chlorothalonil is practically non-toxic to birds on an acute basis.

Table B.1-1. Avian Acute Oral Toxicity Findings for Chlorothalonil

Test Species	% a.i.	LD_{50} mg/kg	Citation (MRID)	Toxicity Category	Fulfills Guideline?
Mallard	96%	> 4640	00068753	Practically non-toxic	Yes
Japanese quail	Tech.	> approx. 2000	40964105	Practically non-toxic	Supplemental

Table B.1-2. Avian Subacute Dietary Toxicity Findings for Chlorothalonil					
Test Species	**% a.i.**	**LC_{50} ppm**	**Citation (MRID)**	**Toxicity Category**	**Fulfills Guideline?**
Northern Bobwhite	96%	> 10,000	00030388	Practically non-toxic	Yes
Mallard	93.6%	> 21,500	00039146	Practically non-toxic	Yes
Mallard	96%	> 10,000	00030389	Practically non-toxic	Yes

SDS-3701

Acute avian LD_{50} data for the chlorothalonil degradate, SDS-3701, are summarized in Table B.1-3. These studies show that SDS-3701 is "moderately toxic" on an acute oral basis and "slightly toxic" on a dietary basis to the test birds on an acute basis. Sublethal effects were seen in some birds at the lowest test level with the mallard, including lethargy, depression, lost reaction to stimuli, lost coordination, and wing droop.

In an acute oral study (MRID 00030395), fourteen-day old mallard ducks were dosed with 46, 100, 215, 464, and 1000 mg/kg of technical SDS-3701. No deaths occurred in the control pens. The acute oral LD50 for SDS-3701 was 158 mg/kg, with 95% confidence limits of 125 to 201 mg/kg. The highest dose at which no deaths occurred was 46 mg/kg. All the birds died in the two highest dosing groups.

Table B.1-3. Avian Acute Oral and Subacute Dietary Toxicity Findings for SDS-3701					
Test Species	**% a.i.**	**Results**	**Citation (MRID #)**	**Toxicity Category**	**Fulfills Guideline?**
Mallard	SDS-3701 (87%)	LD_{50} = 158 mg/kg	00030395	Moderately toxic	Yes
Northern Bobwhite	SDS-3701 (87%)	LC_{50} = 1746mg/kg NOEL = 562 mg/kg	00115109	Slightly toxic	Yes
Mallard	SDS-3701 (87%)	LC_{50} = 2000 mg/kg	00115108	Slightly toxic	Yes

B.1.3 Birds: Reproduction Studies

Chlorothalonil

Avian reproduction studies using the TGAI are required because chlorothalonil is persistent (i.e., half-life exceeds 4 days in aerobic soils) and has multiple applications per growing season. The preferred test species are mallard duck and bobwhite quail. Results of these tests are summarized in Table B.1-4.

Table B.1-4. Avian Reproduction Findings of Chlorothalonil Exposure

Test Species	% a.i.	NOEL PPM	LOEL PPM	Endpoints affected	Citation (MRID #)	Fulfills Guideline ?
Bobwhite	Tech.	1000 (reprod.)	5000 (reprod.)	"Overt signs of toxicity and reduced reproduction" cited at 5000 ppm; "overt signs of toxicity, mortalities, and profound effects upon several reproductive parameters related to egg production, hatching success, and survival of hatchlings" cited at 10,000 ppm.	40964104	Yes
Bobwhite	Tech.	153	624	18% reduction in no. of eggs laid per hen.	45710218	Yes
Bobwhite	99.6	50 ppm	Not established. Highest level of 50 ppm did not cause impairment.	None	00041440	Suppleme ntal
Mallard	Tech.	>10,000 (reprod.)	>10,000 (reprod.)	No reproductive effects cited at any test level (1000, 5000, 10,000 ppm)	40964102	Yes
Mallard	99.6	50 ppm	Not established. Highest	None	00041441	Suppleme

Table B.1-4. Avian Reproduction Findings of Chlorothalonil Exposure						
Test Species	**% a.i.**	**NOEL PPM**	**LOEL PPM**	**Endpoints affected**	**Citation (MRID #)**	**Fulfills Guideline ?**
			level of 50 ppm did not cause impairment.			ntal

In the most sensitive avian reproduction study (MRID 45710218) chlorothalonil was administered to bobwhite quail in the diet at nominal concentrations of 0 (negative control), 40, 160, or 640 ppm. Mean-measured concentrations were <1.5 (<LOD, control), 41, 153, and 624 ppm a.i., respectively. A treatment-related reduction in the number of eggs laid/hen and thus in the number of 14-day old survivors/hen were observed at the 624 ppm a.i. level. The number of eggs laid/hen was 62.0 for the control group, and 62.4, 68.9, and 51.0 for the 41, 153, and 624 ppm a.i. test groups, respectively. The number of 14-day old survivors/hen was 37.2 for the control group, and 42.8, 42.2, and 30.4 for the 41, 153, and 624 ppm a.i. test groups, respectively. Although not statistically significant, these findings were considered to be biological significance by the study authors and the study reviewers.

SDS-3701

Avian reproduction studies have also been required for SDS-3701. These studies are summarized in the following table. The most sensitive NOAEC was 50 ppm based on reduction in eggshell thickness. However, the relevance of this endpoint to terrestrial amphibians is questionable. Therefore, the NOAEC of 100 ppm was chosen for use in risk assessment.

Table B.1-5. Avian Reproduction Findings (SDS-3701)

Test Species	% SDS-3701	NOEL PPM	LOEL PPM	Endpoints affected	Citation (MRID)	Fulfills Guideline?
Mallard	99.6	50	100	Reduction in eggshell thickness seen at 100 ppm; at 250 ppm adult body weight, food consumption, and gonad development affected, as well as effects on numbers of eggs laid, embryonic development, eggshell thickness, hatchability, and hatching survival.	40729402	Yes
Bobwhite	99.6	100	250	Reduction in numbers of eggs laid	40729404	Yes

B.2 Toxicity to Mammals

Wild mammal testing is required on a case-by-case basis, depending on the results of lower tier laboratory mammalian studies, intended use patterns, and pertinent environmental fate characterisitics. For this assessment, registrant-submitted reproduction toxicity data obtained from the Agency's Health Effects Division (HED) was used. Acute and chronic toxicity data for mammals is presented in Sections B.2.1 and B.2.2, respectively.

B.2.1 Mammals, Acute

Chlorothalonil

Acute mammalian toxicity studies for chlorothalonil are summarized in Table B.2-2. The available mammalian data indicate that chlorothalonil is "practically non-toxic" to small mammals on an acute oral basis, based on the rat oral LD_{50}.

Table B.2-1 Mammalian Acute Toxicity Findings--Chlorothalonil					
Test Species	**% a.i.**	**LD50**	**Citation (MRID #)**	**Toxicity Category**	**Fulfills guidelines?**
Rat (small mammal surrogate)	96%	Oral >10,000	MRID 00094941	practically non-toxic	Yes

SDS-3701

Data on the toxicity of SDS-3701 to mammals are tabulated below. These data indicate that the degradate SDS-3701 is more toxic to mammals than the parent chlorothalonil, and is moderately toxic on an acute oral basis.

Table B.2-2 Mammalian Acute Toxicity Findings--SDS-3701				
Test Species	**LD_{50} mg/kg**	**Comments**	**Citation (MRID #)**	**Toxicity Category**
Rat (small mammal surrogate)	242 (females)	The LD50 for males was 422 mg/kg-bw and was 332 for the combined sexes	MRIDs MRID 00047938, 00047939, and 00095783	moderately toxic

B.2.2 Mammals, Reproduction Studies

Chlorothalonil

When available, 2-generation reproduction toxicity studies are used to estimate chronic risk to mammals. In a two-generation study, Sprague Dawley rats were administered chlorothalonil (98%) in the diet at levels of 0, 500, 1500 or 3000 ppm (0, 38, 115 and 234 mg/kg/day). For parental/systemic toxicity, the NOAEL was less than 500 ppm (<38 mg/kg/day). The LOEL was 500 ppm (38 mg/kg/day) based on hyperplasia of renal and forestomach tissues. For offspring toxicity, the NOEL was 1500 ppm (115 mg/kg/day) and the LOEL was 3000 ppm (234 mg/kg/day) based on lower neonatal body weights by day 21 (MRID 41706201).

Test Species	Offspring NOAEL	Offspring LOAEL	Citation (MRID)	Fulfills Guidelines?
Rat (2 generation reproduction)	1500 ppm	3000 ppm decrease in pup weight	41706201C	Yes

SDS-3701

Data on the toxicity of the SDS-3701 degradate to mammalian reproduction are tabulated below. In a 1-generation reproduction study in Sprague-Dawley rats, SDS-3701 was administered at 0, 10, 20, 30, 60, or 120 ppm (approximately 0, 0.5, 1.0, 1.5, 3.0 or 6.0 mg/kg/day). For parental systemic toxicity, the NOEL was 1.5 mg/kg/day and the LOEL was 3.0 mg/kg/day. No ecologically relevant reproductive or offspring toxicity occurred at up to the highest level tested (MRID 00127845).

In a 3-generation reproduction study in Sprague-Dawley rats, SDS-3701 was administered at 0, 10, 60 or 125 ppm (approximately 0, 0.5, 3.0 or 6.25 mg/kg/day). No ecologically relevant reproductive or offspring toxicity occurred at up to the highest level tested, 6.25 mg/kg/day (MRID 00127844).

Test Species	Reproduction NOAEL	Reproduction LOAEL	Citation (MRID #)
Rat (3-generation reproduction)	120 ppm	None	00127844
Rat (1-generation reproduction)	125 ppm	None	00127845

B.2.3 Mammals: Open Literature

Based on a review of the open literature, no additional information on the acute or chronic toxicity of chlorothalonil or SDS-3701 to mammals was located that produced more sensitive endpoints relevant to ecological risk assessment.

B.3 Toxicity to Non-Target Terrestrial Invertebrates

B.3.1 Honey Bee Acute Contact Study

Hhoney bee acute contact LD_{50} study is required if the proposed use will likely result in exposure to honey bees. The available acute contact toxicity findings for chlorothalonil are summarized in Table B.3-1. The available data suggests that chlorothalonil is practically non-toxic to honey bees.

Table B.3-1: Non-target Insect Acute Contact Toxicity Findings

Test Species	% a.i.	Results	Citation (MRID)	Toxicity Category	Fulfills Guideline?
Honey bee	Tech.	at 181 ug/bee, 14.28% mortality	00036935	Practically non-toxic	Yes
Honey bee	Tech.	non-toxic at 181 ug/bee	00077759	Practically non-toxic	Yes

In addition, a number of studies were located in the open literature that evaluated the toxicity of chlorothalonil to terrestrial invertebrates (Table B.3-2). The available data suggest that sensitive terrestrial invertebrates exist, but many of the species tested were not sensitive to chlorothalonil at the levels tested, which typically approximated maximum labeled application rates.

Table B.3-2: Nontarget Invertebrate Acute Contact Toxicity Findings from the Open Literature

Test Species	Material Tested	Results Summary	Citation ECOTOX#	Comment
Aphid endoparasitoid wasp *(Aphidius rhopalosiphi*)	Daconil 500 Flowable (50% a.i.)	NOEL =1250 g a.i./ hectare (1.1 lbs a.i./Acre;	64665 (Jansen, 1999)	Chlorothalonil was considered "slightly harmful" to *A. rhopalosiphi.* Endpoints evaluated included mortality and reproduction
Earthworms and arthropods	Daconil 2787	NOAEL = 12.6 kg (AI)/ha (11.25 lbs a.i./acre)	71484 (Potter et. al. 1990)	Endpoint studied was abundance and biomass
Carabidae	Daconil (54% a.i.)	NOAEL = 8.2 kg a.i./ha (7.3 lbs a.i./Acre)	89639 (Smitley and Rothwell, 2003)	Transient reduction in abundance occurred after the first week of treatment.
		No reduction in		--

Test Species	Material Tested	Results Summary	Citation ECOTOX#	Comment
Onion Thrips *Thrips tobaci*	Bravo 500	abundance occurred at an application rate of 4.5 pints/acre (approx. 2.3 lbs a.i./Acre).	90255 (Al-Dosari et.al 1996)	
Corn earworm; fall armyworm	Bravo 720	Dietary exposure to the fall armyworm and corn earworm at 800 ppm and higher resulted in high mortality rates.	90193 (Lynch, 1996)	--
Mustard beetle (*Phaedon cochleariae*)	Jupital	No significant effects on survival.	90531 (Cherry et. al. 1992)	--
Rove Beetle (*Aleochara bilineata*)	Daconil 500 (50%)	No effects occurred at levels reportedly equivalent to maximum application rate.	63488 (Samsoe-Petersen, 1995)	Effects evaluated included reproduction, egg production and viability.
Predatory mite (*Amblyseius victoriensis*)	Bravo	<10% mortality at up to 10-times the reported maximum field rate	67984 (James et.al. 1995)	--
Aphid Predatory Midge (*Aphidoletes aphidimyza*)	Repulse	Mortality was approximately 10% in larvae after 72 hours at 1100 mg a.i./L.	89884 (Helyer, 1991)	Test level was reportedly equivalent to the maximum labeled application rate.
Aphareta pallipes E. muscae Delia antique D. platura *Coenosio tigrina*	Bravo 6 F	LC50 = 7.83% 100% mortality at 0.0054% No effects to these species were observed at any test level	71029 (Carruthers et. al. 1985)	Cups sprayed with various concentrations of chlorothalonil from 0.0054% to 10.8%.

B.4 Toxicity to Freshwater Animals

B.4.1 Freshwater Fish, Acute Submitted Data

In order to establish the toxicity of a pesticide to freshwater fish, the minimum data required on the technical grade of the active ingredient are two (one cold water and one warm water) freshwater fish toxicity studies. The freshwater fish acute toxicity findings for the technical grade of the active ingredient are summarized in the Table B.4-1. The registrant submitted studies are consistent with each other and indicate that chlorothalonil is very highly toxic to freshwater fish.

Table B.4-1: Freshwater Fish Acute Toxicity Findings					
Test Species	**% a.i.**	**LC_{50} ppb a.i.**	**Citation (MRID #)**	**Toxicity Category**	**Fulfills Guideline?**
Rainbow trout	96	42.3	00056486	very highly toxic	Supplemental
Rainbow Trout	96	18	45710219	very highly toxic	Yes
Bluegill	96	60	00041439	very highly toxic	Yes
Bluegill	99	84	00029410	very highly toxic	Yes
Bluegill	98	51	RIOCHL01 Pitcher (1976)	very highly toxic	Yes
Channel catfish	96	48	00030390	very highly toxic	Yes
Fathead minnow	96	23	00030391	very highly toxic	Yes

The most sensitive LC50 value for registrant-submitted freshwater fish studies was from MRID 45710219. In this study Rainbow Trout (*Oncorhynchus mykiss*) were exposed under flow-through conditions to chlorothalonil at nominal concentrations of 0 (negative and solvent controls), 0.010, 0.018, 0.032, 0.056, and 0.10 ppm. Mean-measured concentrations were ≤0.0004 (≤LOD, solvent control), 0.0085, 0.0177, 0.0357, 0.0491, and 0.0739 ppm a.i., respectively. Following 96 hours of exposure, cumulative mortality was 0% in control groups and 0, 60, 90, 100, and 100% in the 0.0085, 0.0177, 0.0357, 0.0491, and 0.0739 ppm a.i. treatment groups, respectively. The 96-hour LC_{50} (with 95% C.I.) was 0.018 (0.013-0.023) ppm a.i., which classifies chlorothalonil as very highly toxic to Rainbow Trout (*Oncorhynchus mykiss*) on an acute toxicity basis. Swimming and/or hanging at the surface, lethargy, loss of equilibrium, and/or moribundity were observed in surviving fish from the ≥0.0177 ppm a.i. groups; effects were first observed within 6 hours of exposure and continued through 96 hours in groups with surviving fish. The NOEC (for mortality and sub-lethal effects) was 0.0085 ppm a.i.

B.4.2 Freshwater Fish, Open Literature Data

Acute LC50s reported in the open literature are summarized in Table B.4-2. One study (Davies and White, 1985) located in the open literature reported an LC50 that was more sensitive than the most sensitive registrant submitted studies. Davies and White (1985) reported an LC50 of 10.5 ppb in rainbow trout. The most sensitive rainbow trout LC50 from registrant submitted studies was 18 ppb (MRID 45710219), which is similar to the LC50 reported by Davies and White (1985) of 10.5 ppb. Although the LC50 of 10.5 ppb was from a study that used low oxygen levels, the oxygen levels utilized did not affect controls and were not outside values commonly found in the environment. Therefore, an LC50 of 10.5 ppb was chosen for use in risk estimation.

Table B.4-2: Freshwater Fish Lethal Effect Studies from the Open Literature

Test Species	LC_{50} ppb a.i.	Citation (MRID or Ecotox No.)	Toxicity Category	Comment
Jollytail	16	Ecotox No. 87454	very highly toxic	--
Spotted mountain galaxias	19 – 29	Ecotox No. 87454	very highly toxic	Tested species has not been evaluated in registrant submitted studies.
Threespine stickleback	69	Ecotox No. 7055	very highly toxic	Tested species has not been evaluated in registrant submitted studies.
Rainbow trout	10.5 - 76	Ecotox No. 87454; 7055	very highly toxic	The 10.5 ug/L value is the most sensitive acute LC50 available and is consistent with the range of LC50s in rainbow trout. 10.5 ug/L was chosen for use in risk quotient calculations. Study used an oxygen level of 50%; however, controls were not affected by the low DO, and the oxygen levels are not outside of the range expected to occur in the environment.
Tilapia	100 - 120	Ecotox No. 229772	highly toxic	--

A number of studies were also located in the open literature that evaluated sublethal endpoints such as biochemical endpoints. These studies did not report more sensitive toxicity values on endpoints that are correlated with assessment endpoints (survival and reproduction).

B.4.3. Toxicity of Formulated Products:

Formulated product testing is specified for products with direct application to aquatic habitats and for typical end-use products where the EEC for the active ingredient is $\geq$ LC_{50}. The previous Phase IV Review (1/12/93) specified further testing of a 54% ai flowable concentrate due to a cranberry use. The freshwater fish acute toxicity findings for the 54%, 75%, and Bravo W-75 formulations are summarized in Table B.4-3. The data suggest that studies using chlorothalonil products were of similar toxicity than studies using technical grade chlorothalonil.

Table B.4-3: Freshwater Fish Acute Toxicity Findings—Formulated Products				
Test Species	**% a.i.**	**LC_{50} ppb formulation**	**Citation (MRID #)**	**Toxicity Category (FP)**
Rainbow trout	54 (Bravo 720)	61 (33.2 ppb ai)	43302101	very highly toxic
Bluegill	54 (Bravo 720)	49 (26.3 ppb ai)	42433804	very highly toxic
Rainbow trout	75	152 (114 ppb ai; 48-hr study)	00087304	highly toxic
Rainbow trout	75	103 (77.2 ppb ai)	00087303	highly toxic
Bluegill	Bravo W-75	167 (125 ppb ai)	00087258	highly toxic

B.4.4. Toxicity of SDS-3701

Testing using the degradate SDS-3701 has been previously specified due to its persistence in water. Freshwater fish acute toxicity findings for the degradate SDS-3701 are summarized in Table B.4-3. These studies show that SDS-3701 is "slightly toxic" to the bluegill and therefore is significantly less toxic than parent chlorothalonil.

Table B.4-4: Freshwater Fish Acute Toxicity Findings—SDS-3701

Test Species	% SDS-3701	LC_{50} (ppb)	Citation (MRID #)	Toxicity Category
Bluegill	not avail.	45,000	00029415	slightly toxic
Bluegill	99	15,000	00030393	slightly toxic

B.4.5. Freshwater Fish, Chronic Submitted Data

Data from fish early life-stage testing is required for chlorothalonil since it can be expected to be transported to water from the intended use site, acute LC_{50} values are less than 1 mg/L, and aquatic EECs are $\geq$ 0.01 of LC_{50}s. The fish early life stage data are summarized in Table B.4-5.

In an early life-stage study in fathead minnows (MRID 00030391), fish were exposed to chlorothalonil at 0, 0.6, 1.4, 3.0, 6.5, and 16 ppb under flow-through conditions. Exposure at 16 and 6.5 ppb chlorothalonil produced adverse effects on egg production and on the survival. Specifically, the hatching success in the control groups averaged between 90% and 92.5% compared with 79.5% at 6.5 ppb and 46.5% at 16 ppb. The percent survival of the Fo generation in the control groups averaged 94% compared with 9% at 16 ppb. The results indicate that fathead minnow hatching success and survival were affected between 3 and 6.5 ppb.

Table B.4-5. Chronic Fish Toxicity Findings

Test Species	% a.i.	NOAEL (ppb)	LOAEL (ppb)	Citation (MRID #)	Endpoints Affected
Fathead minnow	96	3	6.5	00030391	Hatching success and survivability

B.4.7. Effects to Amphibians

No relevant data on terrestrial or aquatic phase amphibians were located in the open literature or were submitted by chlorothalonil registrants.

B.4.8. Freshwater Invertebrates, Acute Submitted Data

Registrant submitted freshwater invertebrate toxicity studies for technical grade chlorothalonil are summarized in Table B.4-6. Two studies in daphnids were submitted that reported consistent results. The lowest EC50 was 54 ppb (MRID 45710221).

Table B.4-6: Freshwater Invertebrate Toxicity Findings

Test Species	% a.i.	LC_{50} (ppb)	Citation (MRID #)	Toxicity Category	Fulfills Guideline?
Daphnia magna	Tech.	68	00068754	very highly toxic	Yes
Daphnia magna	Tech.	54	45710221	very highly toxic	Supplemental

B.4.9. Freshwater Invertebrates, Open Literature Data

Table B.4-7 summarizes the information available from the open literature. The data found in the open literature are not inconsistent with the registrant submitted studies; however, the only species tested in registrant submitted studies was the daphnid. Acute studies in several additional species were located in the open literature, which are summarized in Table B.4-7.

Table B.4-7: Freshwater Invertebrate Acute Effect Studies from the Open Literature

Study type / Test material	Test Organism (Common and Scientific Name) and Age and/or Size	Test Design	Endpoint Concentration in ppb	Citation (ECOTOX #)	Rationale for Use in Risk Assessment[1]
Acute (48 hr) Bravo 500 (40% a.i.)	Water flea (Daphnia magna) adult egg-bearing	Static Renewal; 4 treatment levels; 2 replicates, one fed and one not fed; algal food source	LC50 = 129 (95% CI 84-174) EC50 = 97 (95% CI 81-113)	Ernst et. al. 1991 (7055)	Qualitative. EC50 is not more sensitive than the lowest registrant-submitted study. Results based on nominal chlorothalonil levels.
Acute: Lethal and Sublethal 4 and 7 day values reported ≥ 98% a.i.	Giant Tasmanian Freshwater Crayfish (*Astacopsis gouldi*)	Flow through; 4 and 7 day values reported; 5 treatment levels	LC50 = 12.0 (7.9-18.1) 4 Day LC50 = 3.6 (2.1-6.0) 7-Day value	Davies et. al 1994 (64835)	Quantitative (acute lethal studies only)
Acute: Lethal and Sublethal 4 and 7 day values reported ≥ 98% a.i.	Amphipod (*Neoniphargus sp. A*)	Flow through; 4 and 7 day values reported; 5 treatment levels	LC50 = >40 (4 and 7 Day)	Davies et. al 1994 (64835)	QUAL The LC50 value was above the highest test concentration.
Acute: Lethal and Sublethal 4 and 7 day values reported ≥ 98% a.i.	Isopod (*Colubotelson chiltoni minor*)	Flow through; 4 and 7 day values reported; 5 treatment levels	LC50 = >40 (4 and 7 Day)	Davies et. al 1994 (64835)	QUAL The LC50 value was above the highest test concentration.
Acute: Lethal and Sublethal 4 and 7 day values reported ≥ 98% a.i.	Freshwater aytid shrimp Parataya australiensis	Flow through; 4 and 7 day values reported; 5 treatment levels	LC50 = 16 (14.4-17.9) 4-Day LC50 = 10.9 (9.1-13.1) 7-Day	Davies et. al 1994 (64835)	Quantitative (acute lethal data). The LC50 value is definitive and bounded by a 95% confidence interval. Study design appears adequate.

Toxicity of Formulated Product: The freshwater invertebrate toxicity findings for formulated product testing are summarized in the following table.

Table B.4-8: Freshwater Invertebrate Toxicity Findings—Formulated Product

Test Species	% a.i.	LC_{50} (ppb) formulation	Citation (MRID #)	Toxicity Category (FP)	Fulfills Guideline? (for FP tested)
Daphnia magna	54 (Bravo 720)	180 (97; ai) Probit slope = 7.9	42433806	highly toxic	Yes

Toxicity of SDS-3701: The freshwater invertebrate toxicity findings for the degradate, SDS-3701, are summarized in the following table. The data indicate that SDS-3701 is slightly toxic to aquatic invertebrates.

Table B.4-8: Freshwater Invertebrate Toxicity Findings—SDS-3701

Test Species	% SDS-3701	EC_{50} (ppb)	Citation (MRID #)	Toxicity Category	Fulfills Guideline?
Daphnia magna	99	26,000 Probit slope = 5.75	00030394	slightly toxic	Yes (for SDS-3701)

In MRID 00030394, the acute toxicity of SDS-3701 was evaluated in daphnids. Procedures used in this acute toxicity test were based on EPA protocols specified in "Methods for Acute Toxicity Tests with Fish, MAcroinvertebrates, and amphibians (U.S.EPA, 1975). Acetone was used as asolvent and in a solvent control. Nominal concentrations were 10, 15. 22. 32,46, 68 and 100 mg/L (ppm) and were tested in triplicate. The 48-hour EC50 for Daphnids exposed to SDS-3701 was calculated to be 26 ppm with 95% confidence limits of 21 to 31 ppm. The lowest concentration at which 100% mortality occurred was 68 ppm, while highest concentration in which there were no deaths was 10 ppm.

B.4.6 Freshwater Invertebrate, Chronic Submitted Data

The aquatic invertebrate life-cycle toxicity findings are summarized in the following table.

Table B.4-9: Aquatic Invertebrate Life-Cycle Toxicity Findings

Test Species	NOEL (ppb)	LOEL (ppb)	Citation (MRID #)	Endpoints Affected	Fulfills Guideline?
Daphnia magna	39	79	00115107	survival, cumulative numbers of offspring/ female	Yes
	0.6	1.8	45710222	Survival	

In the most sensitive chronic study in aquatic invertebrates (MRID 45710222), the 21-day-chronic toxicity of chlorothalonil to *Daphnia magna* was studied under static renewal conditions. Nominal concentrations were 0 (negative and solvent controls), 0.0010, 0.0032, 0.010, 0.032, and 0.10 ppm. Mean-measured concentrations were <0.0001 (<LOD, solvent control), 0.00060, 0.0018, 0.0058, 0.019, and 0.075 ppm a.i., respectively. However, chlorothalonil was unstable under the static renewal conditions employed in this test, declining to less than the level of detection to 62% of nominal concentrations in expired test media. Because chlorothalonil concentrations declined to < the level of detection at the lower concentrations, there is considerable uncertainty in the chlorothalonil levels associated with toxic effects in this study.

After 21 days of exposure, cumulative adult mortality/immobility was 7% for both control groups, and 5, 25, 40, 55, and 60% in the 0.00060, 0.0018, 0.0058, 0.019, and 0.075 ppm a.i. treatment groups, respectively. There was a significant inhibitory effect on reproduction (number of live young/adult) at the 0.075 ppm a.i. test level. The total number of live young produced per adult was at least 40 for the control through 0.019 ppm a.i. test groups, and was 31 for the 0.075 ppm a.i. group. No dead young were observed during the study in any test group, and the number of unhatched eggs per adult was <1 for all control and test groups. Terminal growth measurements were not performed. The NOAEC for survival was 0.6 ug/L (0.0006 mg/L).

B.5 Toxicity to Non-target Terrestrial Plants

B.5.1 Non-Target Terrestrial Plants: Submitted Data

The required tier 1 plant toxicity data are summarized in Table B.5-1.

Table B.5-1: Nontarget Terrestrial Plant Toxicity Findings

Study	% a.i.	Results (lb ai/A)	Citation (MRID #)	Fulfills Guideline?
Seed germination/seedling emergence--Tier 1 (122-1A); 10 species	97.9	NOEL ≥ 16	42433808	Yes
Vegetative vigor--Tier 1 (122-1B); 10 species	97.9	NOEL ≥ 16	42433809	Yes

B.5.2 Non-Target Terrestrial Plants: Open Literature Data

Based on a review of the open literature, no additional information was located that indicates greater non-target terrestrial plant sensitivity to chlorothalonil than the submitted data. Studies located in the open literature were predominantly efficacy studies (i.e., studies that evaluated effects of chlorothalonil on fungal diseases) or were studies that did not elicit adverse effects to plants.

B.5.3 Aquatic Plants: Registrant Submitted Data

Available aquatic plant toxicity data summarized in Table B.5-2. The most sensitive aquatic plant species from registrant studies was the diatom with an EC50 of 14 ppb.

Table B.5-2: Nontarget Aquatic Plant Toxicity Findings

Test Species	% a.i.	Results (ppb)	Citation (MRID #)	Meets Guideline Requirements
Freshwater Vascular Plant Duckweed (*Lemna gibba*)	TGAI	Number of fronds EC50 = 730 ppb (670-800ppb Probit slope = 8.08 Biomass (dry weight) EC50 = 630 ppb (550-730ppb) Probit Slope = 5.3 NOEC 290ppb	44908102	The only DER available is a contractor version. The contractor classifies this study as core.
Freshwater non-vascular plant. *Selenastrum capricornutum*	97.9	EC_{50} = 190 NOEC = 50 LOEC = 100 Slope = 4.027 95% CI 1.34-6.71	42432801	Yes

Test Species	% a.i.	Results (ppb)	Citation (MRID #)	Meets Guideline Requirements
Freshwater non-vascular plant. (Diatom) *Navicula pelliculosa*	TGAI	EC50 = 14 ppb (12-17 ppb) Probit slope = 4.49 NOEC = 3.9 ppb	44908105	The only DER available is a contractor version. The contractor classifies this study as core.

B.5.3 Aquatic Plants: Open Literature Data

Aquatic plant studies located in the open literature are summarized in Table B.5-3. The most sensitive aquatic plant study was from Mezcua et al. (2002), which reported a 72-hour EC50 of 6.8 ppb in *Selenastrum capricorotum*. This study reportedly followed OECD 201.

Table B.5-3: Aquatic Plant Toxicity Tests (Laboratory)

Study type/ Test material	Test Organism (Common and Scientific Name)	Test Design	Endpoint Concentration / Results	Citation (ECOTOX)	Study Classification[(1)]
30% SC	Green Algae *Scenedesmus obliqnus*	Laboratory bioassay	EC50 = 100 ppb	65723 (Ma et. al., 2001)	QUAL
30% SC	Green Algae *Chlorella pyrenoidosa*	Laboratory bioassay	EC50 = 8069 ppb		QUAL
Tech.	Green Algae *Selenastrum capricorotum*	Laboratory bioassay using Toxkit Algaltoxkit™ (Creasel Belgium) a growth inhibition assay – study reportedly followed OECD 201.	72-hr EC50 = 6.8 ppb. The EC50 @ 30 h = 42,400ppb	80747 (Fernandez-Alba et. al., 2002) 80359 (Mezcua et. al. 2002)	QUAN.

[(1)] QUAL = The paper is not appropriate for quantitative use but is of good quality, addresses issues of concern to the risk assessment and is used in the risk characterization discussion.

B.6 References

ECOTOX or MRID **Citation**

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CHEMICAL	2,4-D	2,4-D	2,4-D	2,4-D	2,4-D	2,4-D
PERCENT	100	100	100	100	100	100
DESCRIP	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
SPECIES	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT
SIZE						
WEIGHT	0.5	0.8	0.5	0.4	0.6	0.8
STRAIN						
DIET						
TEMP	10	10	10	15	5	10
PH	7.4	7.4	8.5	7.4	7.4	6.5
HARDNESS	300	160	44	44	44	44
TYPE	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC
TEST_UNT	LC	LC	LC	LC	LC	LC
TOX_UNT	MG	MG	MG	MG	MG	MG
LC50_24H	32	41	40	41.5	41.5	43.5
FROM_24H	23.7	32.4	30.7	33.1	32.8	35
TO_24H	43.3	51.9	52.1	52	52.5	54.1
LC50_48H						
FROM_48H						
TO_48H						
LC50_96H	24.5	37	40	41.5	41.5	43.5
FROM_96H	18.4	27.9	30.2	33.1	32.8	35
TO_96H	32.6	49	52.1	42	52.5	54.1

2,4-D	2,4-D	2,4-D	2,4-D	2,4-D	2,4-D	2,4-D
100	100	100	100	100	100	100
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	LAKE TROUT
0.5	0.4	0.6	0.5	0.8	0.8	0.3
10	10	10	10	10	10	10
7.4	7.4	6.5	7.5	7.5	8.5	7.4
44	44	44	44	44	44	44
STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC	LC	LC
MG	MG	MG	MG	MG	MG	MG
49	64	67	130	169	185	44.5
40.4	57.3	57.5	100	146	165	35.3
59.4	71.5	78	170	195	207	56.1
44	64	67	130	169	172	44.5
35.7	57.3	57.5	100	146	148	35.3
54.2	71.5	78	170	195	199	56.1

2,4-D	2,4-D	2,4-D	2,4-D	2,4-D	2,4-D	2,4-D
100	100	100	100	100	98	98
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
LAKE TROUT	LAKE TROUT	LAKE TROUT	LAKE TROUT	LAKE TROUT	RAINBOW TROUT	BLUEGILL
0.7	0.7	0.7	0.9	0.7	0.3	0.5
10	15	5	10	10	12	22
6.5	7.4	7.4	7.5	8.5	7.3	7.3
44	44	44	44	44	40	40
STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC	LC	LC
MG	MG	MG	MG	MG	MG	MG
63	64	65.7	105	127.5		
59.3	47.8	47.2	95.6	110		
67	85.7	91.4	115	149		
62	64	65.7	105	120	110	180
54	47.8	47.2	95.6	103	77	
71.2	85.7	91.4	115	140	157	

2,4-D
98
TECHNICAL MATERIAL
FATHEAD MINNOW
0.9
22
7.3
40
STATIC
LC
MG
133
103
171

CHEMICAL		TRICLOPYR		TRICLOPYR
PERCENT		43		43
DESCRIP		LIQUID		LIQUID
SPECIES		BLUEGILL		RAINBOW TROUT
SIZE				
WEIGHT		0.8		0.9
STRAIN				
DIET				
TEMP		22		12
PH		7.4		7.4
HARDNESS		44		44
TYPE		STATIC		STATIC
TEST_UNT		LC		LC
TOX_UNT		MG		MG
LC50_24H		>100.		>100.
FROM_24H				
TO_24H				
LC50_48H				
FROM_48H				
TO_48H				
LC50_96H		>100.		>100.
FROM_96H				
TO_96H				

CHEMICAL	DIURON	DIURON	DIURON	DIURON
PERCENT	95	95	95	95
DESCRIP	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
SPECIES	ASELLUS BREVICAUDUS	BLUEGILL	BLUEGILL	BLUEGILL
SIZE	MATURE			
WEIGHT		0.8	1.1	0.8
STRAIN				
DIET				
TEMP	15	13	12	7
PH	7.1	7.1	8	7.1
HARDNESS	44	44	300	44
TYPE	STATIC	STATIC	STATIC	STATIC
TEST_UNT	LC	LC	LC	LC
TOX_UNT	MG	MG	MG	MG
LC50_24H	>10.	27	>30.0	29.8
FROM_24H		24.8		27.3
TO_24H		29.4		32.5
LC50_48H				
FROM_48H				
TO_48H				
LC50_96H	15.5	9.5	8	9.3
FROM_96H	7.2	8.5	5.8	8.1
TO_96H	33.4	10.6	11.7	10.7

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
BLUEGILL	BLUEGILL	BLUEGILL	BLUEGILL	BLUEGILL
0.8	0.8	0.8	1.1	1.1
18	24	29	12	12
7.1	7.1	7.1	6.5	8
44	44	44	44	44
STATIC	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
16.7	8.4	3.6	>30.0	>30.0
14.9	7.7	3		
18.7	9.3	4.2		
8.2	6.4	2.8	8.6	10
7.4	5.9	2.3	7.1	8.5
9.1	7	3.3	10.4	11.8

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
BLUEGILL	BLUEGILL	BLUEGILL	BLUEGILL	COHO SALMON
1.1	1.1	1.1	0.9	1.4
12	12	12	12	13
8.5	9.5	8	7.5	7.1
44	44	170	44	44
STATIC	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
>30.0	38.8	>30.0	35	11
	33.2		28.6	
	45.4		42.8	
10.4	7	8.3	10.4	<2.4
7.3	5.4	7	7.6	
14.9	9	9.8	14.2	

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT
0.7	0.7	1	0.8	0.9
10	10	10	10	10
7	7.7	6.5	7.7	7.5
44	165	44	295	44
21 DAY DEGRA	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
>30.0	>5.0	>4.5	>5.0	4.2
				3.1
				5.7
12.8	1.9	2.1	1.9	1.4
9	1.5	1.7	1.5	1
18	2.5	2.6	2.5	1.9

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT
1	0.6	0.8	0.4	0.3
10	10	15	5	10
8.5	7.8	7.2	7.4	7.2
44	44	44	44	44
STATIC	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
>4.5	>4.0	2.8	>4.0	3.4
		1.9		2.9
		4.2		3.8
2.2	1.7	0.71	1.4	1.4
1.8	1.4	0.53	1.1	1.1
2.7	2.1	0.96	1.7	1.9

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT	CUTTHROAT TROUT
0.7	0.7	0.7	0.7	3.1
10	10	10	10	10
7	7	7	7	7.4
44	44	44	44	162
28 DAY DEGRA	14 DAY DEGRA	7 DAY DEGRA	0 DAY DEGRA	FLOW THROUGH
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
30	>20.0	>10.0	>5.0	>4.0
12.3	13.8	11.5	1.5	1.9
9.5	6.3	6.3	1.1	1.6
15.8	29.9	20.9	2	2.1

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
DAPHNIA PULEX	GAMMARUS FASCIATUS	LAKE TROUT	LAKE TROUT	LAKE TROUT
1ST INSTAR	MATURE			SWIMUP FRY
		1	0.9	
15	21	10	10	10
7.1	7.1	6.5	8	7
44	44	44	175	44
STATIC	STATIC	STATIC	STATIC	STATIC
EC	LC	LC	LC	LC
MG	MG	MG	MG	MG
	0.7	>4.5	3.5	4.2
	0.59		2.8	3.3
	0.83		4.4	5.3
1.4				
1				
1.9				
	0.16	2.5	2.1	1.1
	0.13	1.9	1.5	1
	0.19	3.1	3	1.3

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
LAKE TROUT	LAKE TROUT	LAKE TROUT	LAKE TROUT	LAKE TROUT
5.1	0.3	1.5	1.5	0.4
10	10	10	10	5
7.4	7	7	7	7.5
162	44	44	44	44
FLOW THROUGH	STATIC	21 DAY DEGRA	14 DAY DEGRA	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
	3.5	>20.0	17.5	5.3
	2.2		10.8	4
	5.5		28.5	7
1.8	1.8	11.5	3.6	2.2
1.6	1.5	7.9	2.5	1.7
2.1	2	16.8	5	2.7

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
LAKE TROUT	LAKE TROUT	LAKE TROUT	LAKE TROUT	LAKE TROUT
1.2	1.1	1	1	0.4
10	10	10	10	15
8	8	8.5	7.5	7.5
295	44	44	44	44
STATIC	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
>3.0	3.3	4.2	>4.0	2.9
	2	2.8		2.2
	5.3	6.2		3.9
2.6	2.2	2.6	2.4	1.2
2	1.6	1.9	1.9	0.9
3.4	2.9	3.1	2.9	1.5

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
LAKE TROUT	LAKE TROUT	PTERONARCYS CALIFORNICA	RAINBOW TROUT	RAINBOW TROUT
		2ND YEAR CLASS		
1.5	1.5		1.5	0.8
10	10	15	12	13
7	7	7.1	7.5	7.1
44	44	44	44	44
STATIC	7 DAY DEGRA	STATIC	21 DAY DEGRA	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
>3.5	>5.0	3.6		9
		2.8		7.6
		4.7		11
2.7	3.2	1.2	7.4	4.9
2.4	2.2	0.9	6.2	4.1
3	4.6	1.7	8.7	5.9

DIURON	DIURON	DIURON	DIURON	DIURON
80	95	95	95	95
WETTABLE POWDER	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
RAINBOW TROUT	RAINBOW TROUT	RAINBOW TROUT	RAINBOW TROUT	RAINBOW TROUT
1.2	1.2	1.2	1.2	1.2
13	2	7	13	18
7.1	7.1	7.1	7.1	7.1
44	44	44	44	44
STATIC	STATIC	STATIC	STATIC	STATIC
LC	LC	LC	LC	LC
MG	MG	MG	MG	MG
71	11.5	15.5	12.5	8.4
61.1	10.5	14.1	11.5	7.9
82.5	12.7	17.1	13.6	9.1
16	7.7	7.2	6.2	5.3
11.3	6.8	6.5	5.8	5.1
22.7	8.9	7.9	6.6	5.7

DIURON	DIURON	DIURON	DIURON	DIURON
95	95	95	95	95
TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL	TECHNICAL MATERIAL
RAINBOW TROUT	RAINBOW TROUT	RAINBOW TROUT	RAINBOW TROUT	SIMOCEPHALUS SERRULATUS
				1ST INSTAR
1.5	1.5	1.5	1.5	
12	12	12	12	15
7.5	7.5	7.5	7.5	7.1
44	44	44	44	44
0 DAY DEGRA	14 DAY DEGRA	28 DAY DEGRA	7 DAY DEGRA	STATIC
LC	LC	LC	LC	EC
MG	MG	MG	MG	MG
				2
				1.4
				2.8
3.5	13.4	9.4	4.2	
2.7	10.7	8.3	3.1	
4.4	16.7	10.7	5.6	

CHEMICAL	LINURON	LINURON	LINURON	LINURON	LINURON	LINURON
PERCENT	50	95	50	95	50	95
DESCRIP	WETTABLE POWDER	TECHNICAL MATERIAL	WETTABLE POWDER	TECHNICAL MATERIAL	WETTABLE POWDER	TECHNICAL MATERIAL
SPECIES	CHANNEL CATFISH	CHANNEL CATFISH	CHIRONOMUS PLUMOSUS	CHIRONOMUS PLUMOSUS	DAPHNIA MAGNA	DAPHNIA MAGNA
SIZE			3RD INSTAR	3RD INSTAR	1ST INSTAR	1ST INSTAR
WEIGHT	0.6	0.4				
STRAIN						
DIET						
TEMP	22	22	22	22	17	17
PH	7	7.4	7	7	7	7
HARDNESS	40	40	43	43	43	43
TYPE	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC
TEST_UNT	LC	LC	EC	EC	EC	EC
TOX_UNT	MG	MG	MG	MG	MG	MG
LC50_24H	3.2					
FROM_24H	2.3					
TO_24H	4.4					
LC50_48H			4.3	2.9	0.21	0.27
FROM_48H			3.4	1.9	0.16	0.22
TO_48H			5.4	4.2	0.28	0.33
LC50_96H	1.8	2.9				
FROM_96H	1.2	2				
TO_96H	2.6	4.2				