Appendix G

Evaluation of Pyrethroid and Organophosphate Pesticides in Sediment for the Baseline Ecological Risk Assessment

Halaco Superfund Site, Oxnard, California

Remedial Investigation

Prepared for

U.S. Environmental Protection Agency Region 9

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G-1 Evaluation of Pyrethroid and Organophosphate Pesticides in Sediment

Acronyms and Abbreviations

µg/kg	microgram(s) per kilogram
COPEC	constituent of potential ecological concern
Halaco	Halaco Engineering Co.
LC_{50}	lethal concentration with 50 percent mortality
Site	Halaco Engineering Co. Superfund Site

APPENDIX G

Evaluation of Pyrethroid and Organophosphate Pesticides in Sediment

G.1 Objectives

A subset of the sediment bioassay samples (LGF-001, LGF-003, LGM-003, LGF-007, and DSA-001) was analyzed for 11 pyrethroid and 2 organophosphate pesticides. Although these analytes are not considered constituents of potential ecological concern (COPECs) for the Halaco Engineering Co. (Halaco) Superfund Site (Halaco Site, or Site), they are of interest. Therefore, an evaluation of potential toxicity to benthic invertebrates from exposure to these analytes was conducted.

Anderson et al. (2010) provides a compilation of available sediment effect thresholds for six of the pyrethroids and for chlorpyrifos. These values are median lethal concentrations (LC_{50}) determined from toxicity tests using the benthic invertebrate *Hyallela azteca*. These toxicity values were compared to detected and nondetected concentrations in the five samples on a point-by-point basis (Table G-1).

Concentrations of chlorpyrifos, esfenvalerate:fenvalerate, and permethrin in all five samples were below LC_{50} values (Table G-1). In contrast, concentrations of bifenthrin, cyfluthrin, cypermethrin, and lambda-cyhalothrin in the Lagoon-Main sample (LGM-003) exceeded the LC_{50} for these analytes. However, it should be noted that only the concentration for bifenthrin is a detected value. Additionally, detection limits in this sample were an order of magnitude or greater than those achieved in the other four samples (for example, the detection limit for cyfluthrin in LGM-003 was 22 micrograms per kilogram (µg/kg) compared to 1.1 µg/kg in sample LGF-003).

These results suggest that concentrations of bifenthrin in Lagoon-Main may be at levels of concern for benthic invertebrates. Detection limits for cyfluthrin, cypermethrin, and lambda-cyhalothrin in the Lagoon-Main sample are insufficient to determine risk; therefore, these are considered uncertainties.

G.2 References

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Table

TABLE G-1

Evaluation of Pyrethroid and Organophosphate Pesticides in Sediment

Baseline Ecological Risk Assessment, Halaco Site, Oxnard, California

Area	Subarea	Sample Location ID	Pesticide Type	Analyte	Result (µg/kg)	Qualifier	Sediment Threshold (µg/kg)	Endpoint	Source	HQ
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Organophosphate	Chlorpyrifos	2.2	J	399	LC50	Brown et al., 1997; Amweg and Weston, 2007	0.01
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Organophosphate	Diazinon	0.93	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Allethrin	0.52	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Bifenthrin	11.9		12.9	LC50	Amweg et al., 2005	0.92
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Cyfluthrin	1.1	U	13.7	LC50	Amweg et al., 2005	0.08
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Cypermethrin	1	U	14.87	LC50	Maund et al., 2002	0.07
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Deltamethrin:Tralomethrin	1.2	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Esfenvalerate:Fenvalerate	1.3	U	41.8	LC50	Amweg et al., 2005	0.03
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Fenpropathrin	0.73	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Lambda-Cyhalothrin	0.62	U	5.6	LC50	Amweg et al., 2005	0.11
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Permethrin	11.1		200.7	LC50	Amweg et al., 2005	0.06
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Tau-Fluvalinate	0.41	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-001-A	Pyrethroid	Tetramethrin	0.62	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Organophosphate	Chlorpyrifos	1.2	U	399	LC50	Brown et al., 1997; Amweg and Weston, 2007	0.003
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Organophosphate	Diazinon	0.93	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Allethrin	0.52	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Bifenthrin	5.5		12.9	LC50	Amweg et al., 2005	0.43
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Cyfluthrin	1.1	U	13.7	LC50	Amweg et al., 2005	0.08
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Cypermethrin	1	U	14.87	LC50	Maund et al., 2002	0.07
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Deltamethrin:Tralomethrin	1.2	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Esfenvalerate:Fenvalerate	1.3	U	41.8	LC50	Amweg et al., 2005	0.03
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Fenpropathrin	0.73	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Lambda-Cyhalothrin	0.62	U	5.6	LC50	Amweg et al., 2005	0.11
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Permethrin	7.8		200.7	LC50	Amweg et al., 2005	0.04
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Tau-Fluvalinate	0.42	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - Footbridge	SD-LGF-003-A	Pyrethroid	Tetramethrin	0.62	U	--	--	--	Uncertainty
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Organophosphate	Chlorpyrifos	52.2	J	399	LC50	Brown et al., 1997; Amweg and Weston, 2007	0.13
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Organophosphate	Diazinon	18	U	--	--	--	Uncertainty
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Allethrin	10	U	--	--	--	Uncertainty
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Bifenthrin	37.1	J	12.9	LC50	Amweg et al., 2005	**2.88**
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Cyfluthrin	22	U	13.7	LC50	Amweg et al., 2005	**1.61**
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Cypermethrin	20	U	14.87	LC50	Maund et al., 2002	**1.34**
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Deltamethrin:Tralomethrin	24	U	--	--	--	Uncertainty
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Esfenvalerate:Fenvalerate	26	U	41.8	LC50	Amweg et al., 2005	0.62
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Fenpropathrin	14	U	--	--	--	Uncertainty
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Lambda-Cyhalothrin	12	U	5.6	LC50	Amweg et al., 2005	**2.14**
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Permethrin	22	U	200.7	LC50	Amweg et al., 2005	0.11
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Tau-Fluvalinate	8	U	--	--	--	Uncertainty
OID Lagoon	Lagoon - Main	SD-LGM-003-A	Pyrethroid	Tetramethrin	12	U	--	--	--	Uncertainty

TABLE G-1

Evaluation of Pyrethroid and Organophosphate Pesticides in Sediment

Baseline Ecological Risk Assessment, Halaco Site, Oxnard, California

Area	Subarea	Sample Location ID	Pesticide Type	Analyte	Result (µg/kg)	Qualifier	Sediment Threshold (µg/kg)	Endpoint	Source	HQ
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Organophosphate	Chlorpyrifos	0.16	J	399	LC50	Brown et al., 1997; Amweg and Weston, 2007	0.0004
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Organophosphate	Diazinon	0.09	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Allethrin	0.05	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Bifenthrin	0.2	J	12.9	LC50	Amweg et al., 2005	0.02
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Cyfluthrin	0.11	U	13.7	LC50	Amweg et al., 2005	0.01
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Cypermethrin	0.1	U	14.87	LC50	Maund et al., 2002	0.01
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Deltamethrin:Tralomethrin	0.12	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Esfenvalerate:Fenvalerate	0.13	U	41.8	LC50	Amweg et al., 2005	0.003
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Fenpropathrin	0.07	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Lambda-Cyhalothrin	0.06	U	5.6	LC50	Amweg et al., 2005	0.01
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Permethrin	0.12	J	200.7	LC50	Amweg et al., 2005	0.001
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Tau-Fluvalinate	0.04	U	--	--	--	Uncertainty
OID Lagoon	Lagoon Finger - West	SD-LGF-007-A	Pyrethroid	Tetramethrin	0.06	U	--	--	--	Uncertainty
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Organophosphate	Chlorpyrifos	1.3	U	399	LC50	Brown et al., 1997; Amweg and Weston, 2007	0.003
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Organophosphate	Diazinon	0.95	U	--	--	--	Uncertainty
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Allethrin	0.53	U	--	--	--	Uncertainty
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Bifenthrin	4.8	J	12.9	LC50	Amweg et al., 2005	0.37
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Cyfluthrin	1.2	U	13.7	LC50	Amweg et al., 2005	0.09
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Cypermethrin	1.1	U	14.87	LC50	Maund et al., 2002	0.07
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Deltamethrin:Tralomethrin	1.3	U	--	--	--	Uncertainty
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Esfenvalerate:Fenvalerate	1.4	U	41.8	LC50	Amweg et al., 2005	0.03
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Fenpropathrin	0.74	U	--	--	--	Uncertainty
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Lambda-Cyhalothrin	0.64	U	5.6	LC50	Amweg et al., 2005	0.11
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Permethrin	11.3	J	200.7	LC50	Amweg et al., 2005	0.06
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Tau-Fluvalinate	0.42	U	--	--	--	Uncertainty
Wetlands Beach	WMU Ditch	SD-DSA-001-A	Pyrethroid	Tetramethrin	0.64	U	--	--	--	Uncertainty

Notes:

µg/kg = microgram(s) per kilogram

HQ = hazard quotient

J = estimated value

LC50 = lethal concentration with 50 percent mortality (median lethal concentration)

U = nondetected

Uncertainty = toxicity data are lacking; therefore, risks associated with this analyte are uncertain

OID = Oxnard Industrial Drain

WMU = waste management unit

Shading and bold indicates exceedance of the LC50.