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MEMORANDUM

SUBJECT: Refined for Turf Drinking Water Assessment Characterization for the Me Too Registration of Chlorothalonil and the Degradation Product, 4-Hydroxy-2,5,6-trichloro-1,3-dicyanobenzene (4-Hydroxy-2,5,6-trichloroisophthalonitrile; SDS-3701) in Surface Water, and Submission of DERs for Mobility of Degradation Product, 4-Hydroxy-2,5,6-trichloro-1,3-dicyanobenzene

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This memorandum transmits a refined assessment for turf uses to the amended drinking water assessment characterization of surface waters for the Me Too registration of chlorothalonil. This exercise assumes the maximum rates and agronomic practices that are the same as those listed on the ECHO 75WDG (11/26/03) label (2 applications of 11.3 lbs/acre at 14 day intervals for non-golf course, non-residential uses, and 6 applications of 11.3 lbs/acre at 14 day intervals for golf course tees, greens and fairways). Additionally, new mobility data for the degradate of concern

(one supplemental study, MRID 46786901; and one unacceptable study, MRID 46786902) which indicates greater mobility for the toxic degradate than the parent compound has been reviewed, and incorporated into the modeling in this refined assessment.

Estimated Drinking Water Concentrations (EDWCs)

This refinement consists of two distinct assessments. First, use of chlorothalonil on golf course greens, tees and fairways was estimated, adjusted using the golf course adjustment factor (GCAF), and combined. Second, a sensitivity analysis was conducted for non-golf course, non-residential turf. The only available label for turf use (ECHO 75WDG) states that application should be made by ground spraying. This assessment assumes that other labels for chlorothalonil use on turf will also specify that only ground spray applications are permitted. Even if aerial applications are permitted on labels for other turf products containing chlorothalonil, we assume that aerial application is unlikely for most, if not all, turf uses. **Table 1**, contains labeled application rates and intervals, along with the actual modeled values in this refined assessment.

Table 1. Comparison of Labeled (ECHO 75WDG) versus Modeled Application Rates and Intervals

Use Sites	Labeled Recommended Values			Actual Modeled Values		
	Application Rates *	Minimum Application Interval **	Maximum Annual Rate	Application Rates	Application Intervals ***	Number of Applications
golf course greens	4.1 to 11.3 lb. ai/acre	7 to 14 days	73 lbs.	11.3 lb. ai/acre	14 days	6
golf course tees	4.1 to 11.3 lb. ai/acre	7 to 14 days	52 lbs.	11.3 lb. ai/acre	14 days	4
golf course fairways	4.1 to 11.3 lb. ai/acre	7 to 14 days	26 lbs.	11.3 lb. ai/acre	14 days	2
sod farms	4.1 to 11.3 lb. ai/acre	7 to 14 days	26 lbs.	4.1 to 11.3 lb. ai/acre	7 to 30 days	1 to 6
other turf	4.1 to 11.3 lb. ai/acre	7 to 14 days	26 lbs.	4.1 to 11.3 lb. ai/acre	7 to 30 days	1 to 6

* label recommended application rates dependent upon specific fungal disease

** minimum labeled application interval dependent upon rate per single application

*** when multiple applications were modeled

The tables below summarized the yearly mean concentrations estimated for use on golf course greens, golf course tees, and golf course fairways, along with sod farms, and other, *non-residential* lawn turf uses. Only turf EDWCs for turf uses of chlorothalonil are presented in this part of the refined assessment. The EDWCs for crop uses appear in previous assessments. Please note that newly reviewed mobility data for the degradate of toxicological concern (appended to

this assessment) indicate that the degradate is more mobile than the parent compound. EFED currently has no approved method of calculating modeling input values for the mobility of combined toxic residues. As per general EFED policy, the most conservative value has been chosen. Additionally, the fact that, in the case of chlorothalonil, the degradate is more persistent than the parent, and that toxic residues resulting from the use of chlorothalonil are therefore expected to spend more time existing (and moving) in the open environment as the degradation product, adds further justification for choosing the average K_{oc} value for the degradate as the model mobility input value. **Table 5** presents model input parameters for chlorothalonil and the degradation product identified by HED to be of toxicological concern, 4-hydroxy-2,5,6-trichloro-1,3-dicyanobenzene. Except for the mobility value, these are the same model inputs as first outlined in the February 2, 2006 drinking water assessment.

The PRZM/EXAMS standard scenarios for turf in Pennsylvania and Florida have been used in this refined assessment. **Table 3**, below, outlines the application rates and number of annual applications for specific sections of golf courses, along with the adjusted yearly mean concentrations resulting from use on treated areas for the entire golf course. When using the golf course adjustment factor (**Table 2**) for this refined assessment, the assumption was made that roughs, which include driving ranges, were not treated with chlorothalonil, and have not been included in this assessment. This assumption was based upon the fact that the only available label for golf course use of chlorothalonil listed application rates for golf course greens, tees and fairways, and that application rates for "other turf uses" are the same application rate as for golf course fairways. Because labeled maximum application rates differ for golf course greens, tees and fairways, each was modeled separately. In order to validly combine the three model runs, the same date for the first application was used. The golf course adjustment factor was applied to each resulting EDWCs, and the values were totaled.

Table 2.* Recommended Golf Course Adjustment Factors (GCAFs) by Turf Type.

Treated Areas of Course (Turf Type)	GCAF
Tees and Greens (includes practice green)	$(0.024 + 0.026) = 0.05$
Fairways	0.29
Roughs (includes driving range)	0.66
Tees and Greens and Fairways	$(0.05 + 0.29) = 0.34$
Tees and Greens and Fairways and Roughs	$(0.05 + 0.29 + 0.66) = 1.0$

*from: http://www.epa.gov/oppefed1/models/water/golf_course_adjustment_factors.htm

Table 3. Tier II Estimated Drinking Water Concentrations (EDWCs) of Chlorothalonil Total Toxic Residues in Surface Water With Golf Course Adjustment Factor Applied

State/Crop Scenario Site / Application Method	Golf Course Turf Use	Application Rate*	Number of Applications	Application Interval	Yearly Mean For 100% Cropped Area	Adjusted Yearly Mean / Golf Course Adjustment Factor
FL/Turf/ground	golf course greens	11.3 lb. ai/acre	6	14 days	205 ppb	5.3 ppb / (0.026)
	golf course tees	11.3 lb. ai/acre	4	14 days	156 ppb	3.7 ppb / (0.024)
	golf course fairways	11.3 lb. ai/acre	2	14 days	71 ppb	21 ppb / (0.29)
	total golf course	11.3 lb. ai/acre	2, 4 or 6	14 days	--	30 ppb
PA/Turf/ground	golf course greens	11.3 lb. ai/acre	6	14 days	241 ppb	6.3 ppb / (0.026)
	golf course tees	11.3 lb. ai/acre	4	14 days	187 ppb	4.5 ppb / (0.024)
	golf course fairways	11.3 lb. ai/acre	2	14 days	82 ppb	24 ppb / (0.29)
	total golf course	11.3 lb. ai/acre	2, 4 or 6	14 days	--	35 ppb

*Please note a typographical error in the previous assessments had the maximum application rate listed as 12.7 lb. ai/acre instead of the 11.3 lb. ai/acre value which was actually used in the modeling. The 12.7 value was the number actually used in the modeling, which requires application rate inputs in the form of kg/ha. Also note that an application rate of 12.7 kg/ha does equal an application rate of 11.3 lb. ai/acre.

The second part of this analysis is a sensitivity analysis of non-golf course, non-residential use of chlorothalonil on turf. The Tier II, PRZM/EXAMS model was used to generate the EDWCs. The tables below outlines the results of a sensitivity analysis of the effect of application rates using maximum (11.3 lbs/acre), average (7.0 lbs/acre; BEAD 3/16/06: based on 1998, 1999, and 2001 data), and minimum (4.1 lbs/acre), suggested rates of chlorothalonil with the shortest application intervals (7 to 14 days) for ground applications. The effects of increasing the application intervals and decreasing the application rate was examined and tabulated. Additionally, this range finding exercise examined the combination of application rate and application interval necessary to achieve annual estimated drinking water concentrations (EDWCs) below the HED level of concern (LOC), 42 ppb. Finally, the percent of the watershed that would need to be in treated turf in order to reach the 42 ppb DWLOC was determined. The percentages have been captured in the far right column of **Table 4**.

Assumptions and Expectations

The range in EDWCs tabulated below provides context to the relative uncertainty in the modeled concentrations. Current policy is to assume the entire watershed (100%) is comprised of treated turf because no suitable analysis consistent with SAP recommendations has been made on a national scale to show an upper-bound percent treated area.

Golf Courses

In general, golf courses are not expected to be large enough to comprise an entire drinking water source drainage basin, although smaller watersheds may approach 100% golf course use. While the golf course adjustment factor was applied to the EDWCs for tees, greens and fairways, this adjustment factor only estimates the percent of turf type within a golf course. EFED does not currently have an approved method of assessing what percent of a watershed might exist as golf courses. Therefore, the EDWCs presented in **Table 3** are calculated using the assumption that 100% of the watershed exists as golf courses.

Sod Farms and Non-Residential Turf

The EDWCs for sod farms and other turf uses that are presented in **Table 4** were calculated using the assumption that 100% of the watershed exists as non-residential turf. These modeled EDWCs are considered conservative, and likely to exceed the actual concentration in drinking water. It is also unlikely that all lawns within any given watershed area are non-residential and that they would all be treated with chlorothalonil in the same season and at the same time.

Further Assumptions, Explanations and Results

This assessment assumes that the ECHO 75WDG label is representative of application method, highest use rates, and shortest application intervals for chlorothalonil used on turf. Additionally, it is quite possible that golf courses and residential lawns might co-exist in a watershed. There is insufficient information to assign an upper bound percent treated area for turf use other than the assumption of a 100 % treated drainage basin. In spite of these assumptions, EFED expects that less than 100 % of many watersheds will be covered by non-residential, non-golf course turf.

The sensitivity analysis results tabulated below reveal that at the average and the lowest recommended use rates, and with longer application intervals, the 42 ppb LOC would be exceeded if 100 % of the watershed was treated. However, under all of the application rates and reapplication intervals presented in **Table 5**, at least 40 % of the watershed could be treated before

the LOC is reached. When chlorothalonil is used at typical use rates, 60 %, or more, of the watershed could be safely treated. While we do not have data to quantify the amount of a watershed that may be covered with treated turf, *it is not unreasonable to expect that, nationwide, many, but not all, watersheds would be covered by less than 40 % to 60 % non-residential, non-golf course turf.*

Table 4. Sensitivity Analysis of the Effect of Application Rate, Application Interval and Number of Applications For Ground Applications, on Tier II EDWCs of Chlorothalonil Total Toxic Residues in Surface Water – Sod Farms and Other Non-Residential Turf Uses – 100% Cropped Area

Agronomic Practice	Application Rate	Number of Application	Application Interval	State/Crop Scenario Site	Yearly Mean	Percent Cropped Area Needed to Reach 42 ppb
<i>application at highest allowed single application rate and shortest allowed application interval</i>						
maximum rate / shortest interval	11.3 lb. ai/acre	2	14 days	FL/Turf	71 ppb	59 %
				PA/Turf	82 ppb	51 %
<i>application at highest allowed single application rate and longer application interval</i>						
maximum rate / longer interval	11.3 lb. ai/acre	2	30 days	FL/Turf	69 ppb	61 %
				PA/Turf	96 ppb	44 %
<i>application at lowest suggested single application rate, maximum applications, shortest allowed application interval</i>						
minimum suggested rate / shortest interval	4.1 lb. ai/acre	6	7 days	FL/Turf	84 ppb	50 %
				PA/Turf	105 ppb	40 %
<i>application at lowest suggested single application rate, maximum applications, longer application interval</i>						
minimum suggested rate / longer interval	4.1 lb. ai/acre	6	14 days	FL/Turf	76 ppb	55 %
				PA/Turf	87 ppb	48 %

Table 4. Sensitivity Analysis of the Effect of Application Rate, Application Interval and Number of Applications For Ground Applications, on Tier II EDWCs of Chlorothalonil Total Toxic Residues in Surface Water – Sod Farms and Other Non-Residential Turf Uses – 100% Cropped Area

Agronomic Practice	Application Rate	Number of Application	Application Interval	State/Crop Scenario Site	Yearly Mean	Percent Cropped Area Needed to Reach 42 ppb
<i>sensitivity analysis to discover number of applications and application rate needed not to exceed DWLOC</i>						
average use rate / shortest interval	7.0 lb. ai/acre	3	14 days	FL/Turf	70 ppb	60 %
				PA/Turf	86 ppb	49 %
average use rate / longer interval	7.0 lb. ai/acre	3	30 days	FL/Turf	57 ppb	74 %
				PA/Turf	84 ppb	50 %
fewer applications, average use rate / longer interval	7.0 lb. ai/acre	2	14 days	FL/Turf	51 ppb	82 %
				PA/Turf	44 ppb	95 %
fewer applications, decreased rate / shortest interval	6.5 lb. ai/acre	2	14 days	FL/Turf	41 ppb	100 %
fewer applications / decreased rate / shortest interval	5.5 lb. ai/acre	2	14 days	PA/Turf	40 ppb	100 %
fewer applications / maximum rate	11.3 lb. ai/acre	1	none	FL/Turf	37 ppb	100 %
				PA/Turf	47 ppb	89 %

Table 5. Summary of Environmental Fate Data for Total Toxic Residues Used in Drinking Water Assessment for Chlorothalonil.		
Fate Property	Value	MRID (or source)
Molecular Weight	265.9	Chlorothalonil RED, EPA 738-R-99004, April, 1999
Henry's constant	2.6×10^{-7} atm - m ³ /mole	Chlorothalonil RED, EPA 738-R-99004, April, 1999
Vapor Pressure	5.72×10^{-7} torr	00153732
Solubility in Water	0.8 mg/L at 25 °C	Chlorothalonil RED, EPA 738-R-99004, April, 1999
Photolysis in Water	0.4 days (11 hours)	45710223 (40183418)
Aerobic Soil Metabolism Half-life	78 days (90% upper bound on mean of 89, 51, 44, and 31 days; $48 + ((2.4 \times 24.8) / \text{sqrt } 4)$)	00087351
Hydrolysis	stable @ pH =5 and 7	0040539
Aerobic Aquatic Metabolism	133 days (90% upper bound on mean of 35.5, 106, 12.8 days; $51 + ((2.9 \times 49) / \text{sqrt } 3)$)	(42226101) 45908001
Anaerobic Aquatic Metabolism	296 days (90% upper bound on mean of 123 and 58 days; $91 + ((6.3 \times 46) / \text{sqrt } 2)$)	00147975
Koc	543 (average of 718, 351, 559)	46786901 (degradate)
Application Efficiency	99 percent	EFED Guidance
Spray Drift	6.4 percent	EFED Guidance