Appendix 15

Ecological Risk Assessment for PCDD/F for Indaver Ringaskiddy Resource

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ECOLOGICAL RISK ASSESSMENT FOR PCDD/F FOR INDAVER RINGASKIDDY RESOURCE RECOVERY CENTRE

Technical Report Prepared For

Indaver

Technical Report Prepared By

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Our Reference

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EXECUTIVE SUMMARY

Sediment sampling was conducted at 4 locations in the Cork Harbour area in 2015 with the aim of determining background PCDD/F dioxin in muddy sediment (which are the type of sediment most likely to accumulate dioxin).

Soil samples were analysed for PCDD/F, pH and TOC (Total Organic Carbon) and the results compared with current data for Ireland and data from other countries (AWN Report RH/14/8104SR01).

Increased sediment PCDD/F concentrations due to emissions from the Ringaskiddy Resource Recovery Centre and consequent increase in PCDD/F exposure for fish eating birds and otters (based on exposure from forage fish) was modelled and found to be insignificant.

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1.0 INTRODUCTION

AWN Consulting was instructed by Indaver to undertake an ecological risk assessment study focussed on PCDD/F (dioxin and furan) in support of a proposed planning application for the Ringaskiddy Resource Recovery Centre.

2.0 ECOLOGICAL RISK ASSESSMENT BASED ON SEDIMENT PCDD/F

2.1 Ecological Risk Assessment

The risk assessment approach taken is that presented by the US EPA in the documents:

- Framework for the Application of the Toxic Equivalency Methodology, Polychlorinated Dioxins, Furans and BiPhenyls in Ecological Risk Assessment, US EPA 2003 [1]

- Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, US EPA, 1999 [2].

The approach taken was as follows:

- Model baseline impact of existing background dioxin with respect to predicted concentration in bird egg and concentration in forage fish in otter diet, bird species focused on were cormorant and common tern.

- Model worst case theoretical increase due to PCDD/F emissions from WTE plant,

- Model impact of predicted sediment concentration on selected species

2.2 Baseline Assessment

The baseline monitoring locations used were as follows (Table 2.1):

Sample ID (2015)	Sample ID (2009)	Sample Location	OSI Grid Reference* (2105)
Beach 1A	S04	Strand at Whitegate Village	583970, 564016
Beach 2A	S01	Ringaskiddy – beach adjacent to road to Haulbowline Island	579323, 564398
Beach 3A	S03	Mud Flats at Buncoille	576396, 565400
Beach 4A	S02	Mud Flats in bay to west of Hovione facility, Loughbeg	578578, 563471

Table 2.1 Baseline Monitoring Locations

The baseline was chosen to be Sample Location S04 (strand in front of Whitegate Village), due to this location having the highest organic carbon content and therefore having the greatest potential to accumulate dioxin.

The baseline calculation for both gull eggs and otters is presented in Tables 2.2 and 2.3 and follows the relevant equations from the Framework Application Document above as follows:

$$C_{(\text{fish eating bird egg})} = (Cs/Foc) \times BSAF_{(\text{egg})} \times fl_{(\text{egg})}$$

Where

$C_{(\text{fish eating bird egg})}$ is dioxin concentration (pg/g)

Cs is dioxin concentration in sediment (pg/g)

Foc is fraction of organic carbon in sediment

BSAF is the Biota-sediment accumulation factor

fl is the lipid fraction of the egg.

		Cs	Foc	Cs/Foc	BSAF	Fl	Cs (egg)	C
								TEF (bird)
Congener	Avian TEF	pg/g			pg/g			pg/g egg
2,3,7,8 TCDD	1	0.053	0.01	5.3	1.2188	0.08	0.516771	0.516771
1,2,3,7,8 PeCDD	1	0.11	0.01	11	1.0313	0.08	0.907544	0.907544
1,2,3,4,7,8 HxCDD	0.05	0.17	0.01	17	0.0368	0.08	0.050048	0.002502
1,2,3,7,8,9 HxCDD	0.1	0.25	0.01	25	0.0102	0.08	0.0204	0.00204
1,2,3,6,7,8 HxCDD	0.01	0.36	0.01	36	0.2321	0.08	0.668448	0.006684
1,2,3,4,6,7,8 HpCDD	0.001	4.4	0.01	440	0.0016	0.08	0.05632	5.63E-05
OCDD	0.0001	35	0.01	3500	0.0018	0.08	0.504	5.04E-05
			0.01					
2,3,4,7,8 PeCDF	1	0.25	0.01	25	0.3068	0.08	0.6136	0.6136
1,2,3,4,7,8 HxCDF	0.1	0.32	0.01	32	0.1081	0.08	0.276736	0.027674
1,2,3,7,8,9 HxCDF	0.1	0.19	0.01	19	0.0174	0.08	0.026448	0.002645
2,3,4,6,7,8 HxCDF	0.1	0.3	0.01	30	0.12	0.08	0.288	0.0288
1,2,3,7,8 PeCDF	0.1	0.24	0.01	24	0.0221	0.08	0.042432	0.004243
2,3,7,8 TCDF	1	0.49	0.01	49	0.025	0.08	0.098	0.098
1,2,3,4,6,7,8 HpCDF	0.01	2.1	0.01	210	0.0001	0.08	0.00168	1.68E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.44	0.01	44	0.0027	0.08	0.009504	9.5E-05
1,2,3,6,7,8 HxCDF	0.1	0.21	0.01	21	0.0893	0.08	0.150024	0.015002
OCDF	0.0001	2.1	0.01	210	0.0002	0.08	0.00336	3.36E-07
Sum								2.23

Table 2.2 Baseline Dioxin Concentration in Egg of Fish Eating Bird

For comparison, Ecological Risk Assessment for Dioxins in Australia, Technical Report No.11, Australian Department of Environment and Heritage, 2004, notes that the NOAEL (No Observable Adverse Effects Level) geometric mean for herring and black eyed gull eggs is 50,000 pg/g.

		Cs	Foc	Cs/Foc	BSAF	Fl	Cs (FISH)	C
	TEF	S4						TEF
Congener		pg/g			pg/g			pg/g fish
2,3,7,8 TCDD	1	0.053	0.01	5.3	0.133	0.0311	0.021922	0.021922
1,2,3,7,8 PeCDD	1	0.11	0.01	11	0.18	0.0311	0.061578	0.061578
1,2,3,4,7,8 HxCDD	0.1	0.17	0.01	17	0.03	0.0311	0.015861	0.001586
1,2,3,7,8,9 HxCDD	0.1	0.25	0.01	25	0.02	0.0311	0.01555	0.001555
1,2,3,6,7,8 HxCDD	0.1	0.36	0.01	36	0.02	0.0311	0.022392	0.002239
1,2,3,4,6,7,8 HpCDD	0.01	4.4	0.01	440	0.008	0.0311	0.109472	0.001095
OCDD	0.0001	35	0.01	3500	0.0005	0.0311	0.054425	5.44E-06
2,3,4,7,8 PeCDF	0.5	0.25	0.01	25	0.33	0.0311	0.256575	0.128288
1,2,3,4,7,8 HxCDF	0.1	0.32	0.01	32	0.01	0.0311	0.009952	0.000995
1,2,3,7,8,9 HxCDF	0.1	0.19	0.01	19	0.04	0.0311	0.023636	0.002364
2,3,4,6,7,8 HxCDF	0.1	0.3	0.01	30	0.05	0.0311	0.04665	0.004665
1,2,3,7,8 PeCDF	0.1	0.24	0.01	24	0.01	0.0311	0.007464	0.000746
2,3,7,8 TCDF	0.1	0.49	0.01	49	0.12	0.0311	0.182868	0.018287
1,2,3,4,6,7,8 HpCDF	0.01	2.1	0.01	210	0.001	0.0311	0.006531	6.53E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.44	0.01	44	0.03	0.0311	0.041052	0.000411
1,2,3,6,7,8 HxCDF	0.1	0.21	0.01	21	0.01	0.0311	0.006531	0.000653
OCDF	0.0001	2.1	0.01	210	0.001	0.0311	0.006531	6.53E-07
Sum								0.25

Table 2.3 Baseline Concentration in Forage Fish

No direct measurement of the impact of forage fish intake is available, so the relative change will be assessed.

2.3 Predicted Increase

The increase in dioxin concentration in sediment resulting from airborne dioxin deposition was estimated using a very conservative approach, which was to assume the maximum dioxin deposition rate from the proposed facility fell within the SAC.

It was also assumed that the sediment in question was permanently exposed to the atmosphere, whereas in reality the sediments will be covered by the tide for much of the day.

The modelled increase was determined using deposition data modelled by AWN and the MARI model for soil dioxin.

Using this conservative approach, the predicted increase in dioxin values over the lifetime of the facility are shown in Tables 2.4 and 2.5.

		Cs	Foc	Cs/Foc	BSAF	FI	Cs (egg)	C
								TEF (bird)
Congener	Bird TEF	pg/g			pg/g			pg/g egg
2,3,7,8 TCDD	1	0.0530	0.01	5.300282	1.2188	0.08	0.516799	0.516799
1,2,3,7,8 PeCDD	1	0.1146	0.01	11.45769	1.0313	0.08	0.945305	0.945305
1,2,3,4,7,8 HxCDD	0.05	0.1792	0.01	17.91587	0.0368	0.08	0.052744	0.002637
1,2,3,7,8,9 HxCDD	0.1	0.2682	0.01	26.81988	0.0102	0.08	0.021885	0.002189
1,2,3,6,7,8 HxCDD	0.01	0.3698	0.01	36.97569	0.2321	0.08	0.686565	0.006866
1,2,3,4,6,7,8 HpCDD	0.001	4.5010	0.01	450.0958	0.0016	0.08	0.057612	5.76E-05
OCDD	0.0001	35.172	0.01	3517.227	0.0018	0.08	0.506481	5.06E-05
2,3,4,7,8 PeCDF	1	0.2649	0.01	26.48911	0.3068	0.08	0.650149	0.650149
1,2,3,4,7,8 HxCDF	0.1	0.3729	0.01	37.28941	0.1081	0.08	0.322479	0.032248
1,2,3,7,8,9 HxCDF	0.1	0.2150	0.01	21.50024	0.0174	0.08	0.029928	0.002993
2,3,4,6,7,8 HpCDF	0.1	0.3406	0.01	34.0623	0.12	0.08	0.326998	0.0327
1,2,3,7,8 PeCDF	0.1	0.2463	0.01	24.63014	0.0221	0.08	0.043546	0.004355
2,3,7,8 TCDF	1	0.4916	0.01	49.15541	0.025	0.08	0.098311	0.098311
1,2,3,4,6,7,8 HpCDF	0.01	2.2377	0.01	223.7724	0.0001	0.08	0.00179	1.79E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.4558	0.01	45.58382	0.0027	0.08	0.009846	9.85E-05
1,2,3,6,7,8 HxCDF	0.1	0.2361	0.01	23.60847	0.0893	0.08	0.168659	0.016866
OCDF	0.0001	2.2041	0.01	220.4148	0.0002	0.08	0.003527	3.53E-07
Sum								2.31

Table 2.4 Predicted Increase in Dioxin Concentration in Egg of Fish Eating Bird

		Cs	Foc	Cs/Foc	BSAF	FI	Cs (FISH)	C
	TEF							TEF
Congener		pg/g			pg/g			pg/g fish
2,3,7,8 TCDD	1	0.0530	0.01	5.300282	0.133	0.0311	0.021924	0.021924
1,2,3,7,8 PeCDD	1	0.1146	0.01	11.45769	0.18	0.0311	0.06414	0.06414
1,2,3,4,7,8 HxCDD	0.1	0.1792	0.01	17.91587	0.03	0.0311	0.016716	0.001672
1,2,3,7,8,9 HxCDD	0.1	0.2682	0.01	26.81988	0.02	0.0311	0.016682	0.001668
1,2,3,6,7,8 HxCDD	0.1	0.3698	0.01	36.97569	0.02	0.0311	0.022999	0.0023
1,2,3,4,6,7,8 HpCDD	0.01	4.5010	0.01	450.0958	0.008	0.0311	0.111984	0.00112
OCDD	0.0001	35.1723	0.01	3517.227	0.0005	0.0311	0.054693	5.47E-06
2,3,4,7,8 PeCDF	0.5	0.2649	0.01	26.48911	0.33	0.0311	0.271858	0.135929
1,2,3,4,7,8 HxCDF	0.1	0.3729	0.01	37.28941	0.01	0.0311	0.011597	0.00116
1,2,3,7,8,9 HxCDF	0.1	0.2150	0.01	21.50024	0.04	0.0311	0.026746	0.002675
2,3,4,6,7,8 HpCDF	0.1	0.3406	0.01	34.0623	0.05	0.0311	0.052967	0.005297
1,2,3,7,8 PeCDF	0.1	0.2463	0.01	24.63014	0.01	0.0311	0.00766	0.000766
2,3,7,8 TCDF	0.1	0.4916	0.01	49.15541	0.12	0.0311	0.183448	0.018345
1,2,3,4,6,7,8 HpCDF	0.01	2.2377	0.01	223.7724	0.001	0.0311	0.006959	6.96E-05
1,2,3,4,7,8,9 HpCDF	0.01	0.4558	0.01	45.58382	0.03	0.0311	0.04253	0.000425
1,2,3,6,7,8 HxCDF	0.1	0.2361	0.01	23.60847	0.01	0.0311	0.007342	0.000734
OCDF	0.0001	2.2041	0.01	220.4148	0.001	0.0311	0.006855	6.85E-07
Sum								0.26

Table 2.5 Predicted Increase in otter exposure based on forage fish dioxin concentration

The predicted increase for a fish eating bird is a 4% increase in egg dioxin concentration, still well below the 50,000 pg/g value described above.

As previously discussed, no direct limit exists for an otter exposed to forage fish, however the predicted increase is from 0.25 to 0.26 pg/g (a 5% increase) of fish with regard to exposure from forage fish dioxin over the lifetime of the facility, and given that this is for an unrealistically conservative assumption, with respect to deposition, it can be assumed that the increase is not significant.

3.0 CONCLUSIONS

- Baseline dioxin concentrations in the eggs of fish eating birds and in otters considered to be low and well within limit values for the eggs of fish eating birds.

- The predicted change in dioxin concentrations is considered to be insignificant for both fish eating birds eggs and otters, based on exposure to forage fish.

REFERENCES

1. Framework for the Application of the Toxic Equivalency Methodology, Polychlorinated Dioxins, Furans and BiPhenyls in Ecological Risk Assessment, US EPA 2003

2 Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, US EPA, 1999.

3. AWN Consulting Ltd Air Dispersion Modelling Report for Ringaskiddy Resource Recovery Centre EIS, 2019

4. AWN Consulting Ltd PCDD/F Sampling and Analysis in Soil and Sediment Report for RIngaskiddy Resource Recovery Centre EIS, 2015

END OF REPORT