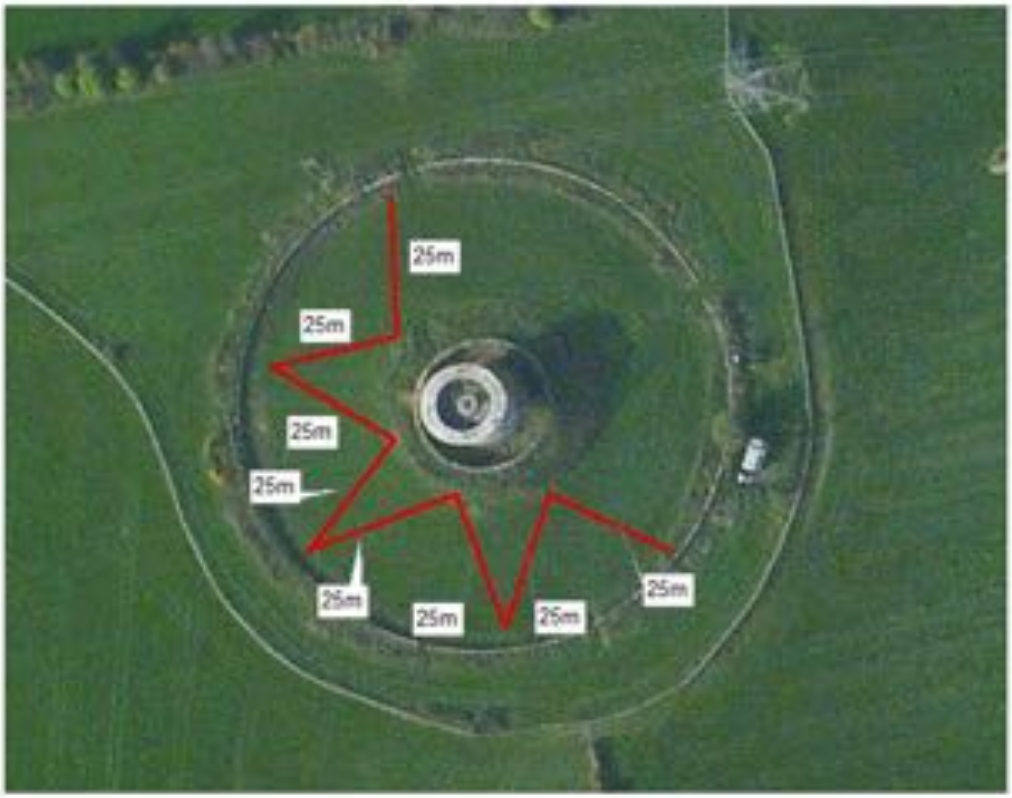
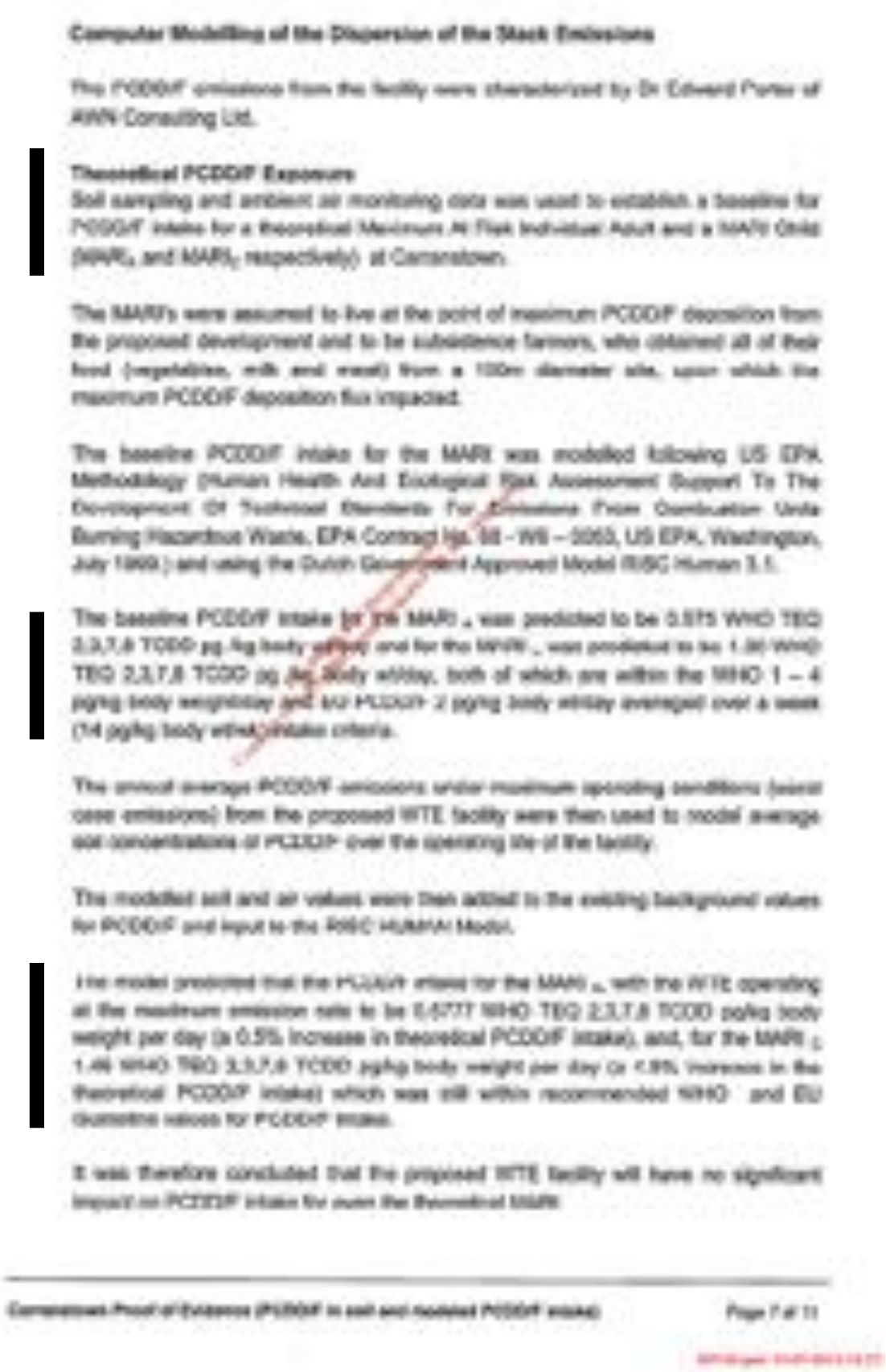


Location 4A: Each leg is 25m with 10m sample intervals – Sampled Thursday, 15th January 2015

Location3A: Each leg is 25m with 10m sample intervals – Sampled Friday, 16th January 2015

Fig. 1. Sample sites as used for the dioxin/furan soil sampling reported in the Indaver EIS, Appendix 6.3. Site 4A was used in the MARI dioxin/furan uptake modelling; site 3A, although closer to the point of maximum deposition from the proposed incinerator and with higher baseline dioxin/furan concentrations, was ignored in the modelling.

Fig. 2. Distances from sample sites to the location of maximum deposition, as stated in the Indaver EIS. Site 4A, 356 m from the point of maximum deposition, was the site used for the MARI modelling, while a closer sample site (site 3A, 330 m from the point of maximum deposition) was ignored in the MARI modelling. This is important because soil from site 3A had higher dioxin/furan concentrations than site 4A, which would result in a higher modelled intake for MARI.



Computer Modelling of the Dispersion of the Stack Emissions

The PCDD/F emissions from the facility were characterized by Dr Edward Porter of AWN Consulting Ltd.

Theoretical PCDD/F Exposure

Soil sampling and ambient air monitoring data was used to establish a baseline for PCDD/F intake for a theoretical Maximum At Risk Individual Adult and a MARI Child (MAR_A and MAR_C respectively) at Carranstown.

The MARI's were assumed to live at the point of maximum PCDD/F deposition from the proposed development and to be subsistence farmers, who obtained all of their food (vegetables, milk and meat) from a 100m diameter site, upon which the maximum PCDD/F deposition flux impacted.

The baseline PCDD/F intake for the MARI was modelled following US EPA Methodology (Human Health And Ecological Risk Assessment Support To The Development Of Technical Standards For Emissions From Combustion Units Burning Hazardous Waste, EPA Contract No. 68 - W8 – 3053, US EPA, Washington, July 1998) and using the Dutch Government Approved Model RISC Human 3.1.

The baseline PCDD/F intake for the MAR_A was predicted to be 0.575 WHO TEQ 2,3,7,8 TCDD pg /kg body weight/ and for the MAR_C was predicted to be 1.36 WHO TEQ 2,3,7,8 TCDD pg /kg /body wt/day, both of which are within the WHO 1 – 4 pg/kg body weight/day and EU PCDD/F 2 pg/kg body wt/day averaged over a week (14 pg/kg body wt/wk) intake criteria.

The annual average PCDD/F emissions under maximum operating conditions (worst case emissions) from the proposed IWTE facility were then used to model average soil concentrations of PCDD/F over the operating life of the facility.

The modelled soil and air values were then added to the existing background values for PCDD/F and input to the RISC HUMAN Model.

The model predicted that the PCDD/F intake for the MAR_C with the IWTE operating at the maximum emission rate to be 0.5777 WHO TEQ 2,3,7,8 TCDD pg/kg body weight per day (a 0.5% increase in theoretical PCDD/F intake), and, for the MAR_C 1.46 WHO TEQ 3,3,7,8 TCDD pg/kg body weight per day (a 1.8% increase in the theoretical PCDD/F intake) which was still within recommended WHO and EU Guideline values for PCDD/F intake.

It was therefore concluded that the proposed IWTE facility will have no significant impact on PCDD/F intake for even the theoretical MARI.

Fig. 3a. Extract from Dr Fergal Callaghan's presentation to the oral hearing on the EPA licence application for the Indaver Carranstown incinerator, showing his consideration of the MARI child's intake of dioxins and furans separately from the adult's. Bars show relevant text.

Adult, f		PCDD/F	PCDD/F	PCDD/F	Adult	PCDD/F
	kg/day	ng/kg	ng/day	pg/day	Body wt	pg/kg/day
Mean	0.259	0.062	0.0159998	15.998	60	0.2666
MAR	0.423	0.01	0.00423	4.23	60	0.0705
Sum						0.337403

Child, 8		PCDD/F	PCDD/F	PCDD/F	Child	PCDD/F
	kg/day	ng/kg	ng/day	pg/day	Body wt	pg/kg/day
Mean	0.259	0.062	0.0159998	15.9998	34	0.4705
MAR	0.423	0.01	0.00423	4.23	30	0.141667
Sum						0.671667

The predicted dose is 0.337 and 0.671 pg/kg bw/day for an adult and child respectively. This is over 100 times the PCDD/F dose through inhalation predicted for the WTE facility. This puts in context the insignificant PCDD/F exposure from the WTE facility.

Summary of Assessment

The background soil PCDD/F in the Carranstown area was found to be low when compared with data from other countries. The predicted impact of the facility was found to be insignificant for both the theoretical MAR (for both adult and child).

We would like to address a specific objection at this point, which was raised by Dundalk Town Council. We feel that all of the other objections and comments have been addressed by the preceding text.

The comment specifically refers to the potential risk to the unborn and proposes to calculate a toxic dose to a theoretical "unborn" of 4 pg, assuming a theoretical body weight of 1 kg. It is important to point out the flaws and misunderstandings inherent in this submission. Firstly, the predicted increased dose to even a MARI receptor adult is calculated to be 0.0037 pg/kg body weight/day, as discussed in the previous sections of this report.

Secondly the WHO chose the 1 – 4 pg/kg bw/day limit to include for protection of full grown healthy adults, children and the un born, who of course do not directly inhale the atmosphere but will be exposed to PCDD/F through the PCDD/F concentration within the mothers body.

The 1 – 4 pg/kg bw/day range was chosen based on the NOAEL (no observable effect) and LOAEL (lowest observable effect) values from numerous studies and then a safety factor of 10 was instituted as a precaution. Hence the argument contained in this objection has no substance.

Fig. 3b. Extract from Dr Fergal Callaghan's presentation to the oral hearing on the EPA licence application for the Indaver Carranstown incinerator, showing his consideration of the MARI child's intake of dioxins and furans separately from the adult's. Bar shows relevant text/table.

Table 7.2 Modelled baseline + WTE PCDD/F intake using WHO TEF

	WHO TEF	mg/kg/d	TEQ mg/kg/day	TEQ g/kg/day	TEQ pg/kg/day
2,3,7,8-TCDD	1	6.35E-12	6.35E-12	6.35E-15	6.35E-03
1,2,3,7,8-PeCDD	1	7.22E-11	7.22E-11	7.22E-14	7.22E-02
1,2,3,6,7,8-HxCDD	0.1	1.82E-10	1.82E-11	1.82E-14	1.82E-02
1,2,3,4,7,8-HxCDD	0.1	1.12E-10	1.12E-11	1.12E-14	1.12E-02
1,2,3,7,8,9-HxCDD	0.1	2.18E-10	2.18E-11	2.18E-14	2.18E-02
1,2,3,4,6,7,8-HpCDD	0.01	1.45E-09	1.45E-11	1.45E-14	1.45E-02
OCDD	0.0001	6.33E-08	6.33E-12	6.33E-15	6.33E-03
2,3,7,8-TCDF	0.1	5.49E-12	5.49E-13	5.49E-16	5.49E-04
1,2,3,7,8-PeCDF	0.05	9.40E-11	4.70E-12	4.70E-15	4.70E-03
2,3,4,7,8-PeCDF	0.5	1.20E-10	6.00E-11	6.00E-14	6.00E-02
1,2,3,4,7,8-HxCDF	0.1	2.54E-10	2.54E-11	2.54E-14	2.54E-02
1,2,3,6,7,8 HxCDF	0.1	1.84E-10	1.84E-11	1.84E-14	1.84E-02
2,3,4,6,7,8-HpCDF	0.1	1.78E-10	1.78E-11	1.78E-14	1.78E-02
1,2,3,7,8,9-HxCDF	0.1	5.33E-11	5.33E-12	5.33E-15	5.33E-03
1,2,3,4,6,7,8-HpCDF	0.01	1.06E-09	1.06E-11	1.06E-14	1.06E-02
1,2,3,4,7,8,9-HpCDF	0.01	1.56E-10	1.56E-12	1.56E-15	1.56E-03
OCDF	0.0001	1.27E-09	1.27E-13	1.27E-16	1.27E-04
SUM					2.95E-01

As mentioned in Section 5, Mono and Ortho PCB intake has not been modelled as part of this study, as the US EPA advise that PCBs have not been detected in the emissions from waste to energy facilities and the proposed facility will therefore have no impact on the PCB fraction of PCDD/F and PCDD/F like compounds.

However studies have shown that PCB intake can contributes approximately 45 - 55% of dietary exposure of PCDD/F like compounds [5]. Therefore actual PCDD/F and PCDD/F like compound exposure, expressed as WHO I-TEQ is predicted to be, at worst, 0.527 – 0.642 pg/kg/day (note that there is no predicted PCB emission from the proposed facility and that PCB component of the predicted exposure is the background component only).

The predicted increased PCDD/F intake for the MARI, is therefore still well below the recommended WHO range of 1 - 4 pg/kg body weight/day I-TEQ and is even below the ideal WHO target of 1 pg/kg body weight/day I-TEQ.

Fig. 4. Extract from Dr Fergal Callaghan's section of the EIS for EPA licence application for the Indaver Ringaskiddy incinerator (2001), showing his inclusion of dioxin-like PCBs in the baseline intake of dioxin-like toxicity, as well as his claim that the US EPA states that waste incinerators do not emit PCBs (contradicted by our citation from a US EPA publication; see text). Bar shows relevant text.

Food Consumption

Foods and Beverages

During the course of the survey, respondents recorded 3,060 individual food items into the 7-day food diary. Each of these foods was allocated to one of 68 food groups. **Table 3** summarises some of the data from the report on average food group intakes in the total population and in consumers only.

TABLE 3

MEAN AND SD OF FOOD GROUP INTAKES (g/DAY) IN THE TOTAL SAMPLE, PERCENTAGE CONSUMERS OF FOOD GROUPS, AND MEAN AND SD OF FOOD GROUP INTAKES (g/DAY) IN CONSUMERS ONLY

	Population (n=1379)			Consumers only	
	Mean	SD	% consumers	Mean	SD
1 Rice & Pasta, Flours, Grains & Starches	20	32	44	46	33
2 Savouries	24	40	56	43	46
3 White Breads & Rolls	78	59	94	83	57
4 Wholemeal & Brown Breads & Rolls	45	58	73	61	60
5 Other Breads	15	25	52	30	29
6 "Ready To Eat" Breakfast Cereals	19	23	67	29	23
7 Other Breakfast Cereals	16	52	15	105	92
8 Biscuits	14	18	76	19	18
9 Cakes, Pastries & Buns	17	25	60	29	26
10 Wholemilk	150	188	73	205	192
11 Low Fat, Skimmed & Fortified Milks	88	140	45	194	152
12 Other Milks	5	32	6	88	101
13 Creams	2	5	23	7	9
14 Cheeses	12	15	74	17	16
15 Yoghurts	16	33	32	49	41
16 Icecreams	7	13	37	20	14
17 Puddings & Chilled Desserts	16	27	50	32	31
18 Milk Puddings	6	16	16	34	26
19 Eggs & Egg Dishes	17	21	68	25	22
20 Butter	6	12	47	12	15
21 Low Fat Spreads	4	11	28	16	15
22 Other Spreading Fats	12	14	68	17	15
23 Oils*	0	1	14	2	2
24 Hard Cooking Fats	0	1	1	3	4
25 Potatoes	158	165	95	167	165
26 Processed & Homemade Potato Products	7	17	28	25	26
27 Chipped, Fried & Roasted Potatoes	59	59	82	72	58
28 Vegetable & Pulse Dishes	17	43	50	34	56
29 Peas, Beans & Lentils	23	27	75	30	27

Fig. 5a. Food intake table (first part) from the Irish Universities' Nutrition Alliance (IUNA) report "North/South Ireland Food Consumption Survey", which forms the basis for the diet of MARI. See text for the small range of food types initially included in the MARI adult intake of <1000 kcal/day, and the correction of the gaps in the food intake to reach a physiologically more realistic level of food intake.

	Population (n=1379)		Consumers only		
	Mean	SD	% consumers	Mean	SD
30 Green Vegetables	14	18	63	22	18
31 Carrots	15	20	66	22	22
32 Salad Vegetables	24	28	76	32	28
33 Other Vegetables	25	27	85	30	27
34 Tinned or Jarred Vegetables	3	8	23	12	14
35 Fruit Juices	33	60	41	81	70
36 Bananas	27	44	49	56	49
37 Other fruits	45	65	62	72	69
38 Citrus Fruit	22	50	31	71	68
39 Tinned Fruit	3	9	14	18	18
40 Nuts & Seeds, Herbs & Spices	1	5	18	7	11
41 Fish & Fish Products	23	27	66	35	26
42 Fish Dishes	3	13	7	40	27
43 Bacon & Ham	22	25	80	27	25
44 Beef & Veal	17	25	55	31	26
45 Lamb	7	16	26	27	21
46 Pork	10	19	35	29	20
47 Chicken, Turkey & Game	22	25	71	31	25
48 Offal & Offal Dishes	1	5	4	19	15
49 Beef & Veal Dishes	31	46	47	65	47
50 Lamb, Pork & Bacon Dishes	7	22	14	50	37
51 Poultry & Game Dishes	21	37	35	60	40
52 Burgers (Beef & Pork)	7	15	28	25	20
53 Sausages	10	13	59	16	14
54 Meat Pies & Pastries	5	16	19	29	24
55 Meat Products	19	24	70	27	24
56 Alcoholic Beverages	333	587	65	513	662
57 Sugars, Syrups, Preserves & Sweeteners	18	23	80	23	24
58 Chocolate Confectionery	12	20	63	19	23
59 Non-chocolate Confectionery	2	5	23	8	8
60 Savoury Snacks	6	11	48	12	13
61 Soups, Sauces & Miscellaneous Foods	46	52	93	50	52
62 Teas	561	409	91	619	385
63 Coffees	153	259	55	279	295
64 Other Beverages	258	386	77	335	410
65 Carbonated Beverages	86	152	54	158	177
66 Diet Carbonated Beverages	35	121	21	170	218
67 Squashes, Cordials & Fruit Juice Drinks	20	67	21	96	118

** Does not include oils consumed in recipes*

Fig. 5b. Food intake table (second part) from the IUNA report.

Sample ID	Location	TEQ 2015 (ng/kg)	TEQ 2009 (ng/kg)
Beach 1A	Strand at Whitegate Village	0.485	0.034
Beach 2A	Ringaskiddy – beach adjacent to road to Haulbowline Island	0.015	0.035
Beach 3A	Mud Flats at Buncoille	0.292	0.035
Beach 4A	Mud Flats in bay to east of Hovione facility, Loughbeg	0.193	0.043

Insert 5.5 *Sediment samples comparison of PCDD/F TEQ values (*by EA UK TEF)*

Fig. 6. Insert 5.5 from appendix 6.3 of the 2016 Indaver Ringaskiddy EIS, showing steep increases in dioxin and furan concentrations in mudflats (samples Beach 1A, Beach 3A and Beach 4A) when comparing 2015 sampling with 2009. This indicates a rising level of contamination with dioxin-like toxicity in Cork Harbour (specifically Cork Harbour SPA, of which the mudflats form part), in contrast to the worldwide pattern of falling dioxin levels.