Appendix 14

Sampling and Analysis of
Soil and Sediment Samples

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SAMPLING AND ANALYSIS OF SOIL AND SEDIMENT SAMPLES FOR PCDDs, PCDFs AND PCBs AT VARIOUS LOCATIONS AROUND CORK HARBOUR

Technical Report Prepared For

Indaver Ireland Ltd.

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EXECUTIVE SUMMARY

Soil and sediment sampling was conducted at 12 no. locations in the Cork Harbour Area and at EPA Iniscarra, with the aim of determining background concentrations of PCDD, PCDF and dioxin-like PCBs in the vicinity. Samples were analysed for dioxins and furans with results compared to previous data recorded by AWN and EPA sampling in 2000. The conclusions of the sampling and analysis programme were as follows:

Background concentrations of PCDD/Fs in soil samples were found to be reduced from samples measured at similar locations in 2001 and 2008. The concentration at Martello Tower (Location 3A) continues to be elevated above locations and in this recent round, the total PCDD/F concentration at Roche's Point Lighthouse (Location 7A) was found to be highest with a TEQ of 0.802 ng/kg. Dioxin-like PCB concentrations were typically similar to recorded concentrations in 2008 and remain well below Dutch limit value concentrations.

TEQ PCDD/F concentrations in beach sediment samples were shown to be slightly higher at three out of the four sampling locations in 2015 with the most elevated concentration (0.485 ng/kg) recorded at the strand in Whitegate Village to the east of the site (Beach 1A). PCDD/F concentrations in sediments were still well below EA UK limit values, however.

TOC and pH values were within expected ranges with slight alkalinity in the sediment samples as expected in marine conditions.

Heavy metal concentrations were recorded at each of the twelve locations with highest lead (110 mg/kg) and zinc (140 mg/kg) concentrations recorded at Locations 4A and 2A, respectively.

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1.0 INTRODUCTION

AWN Consulting Ltd. (AWN) was requested by Indaver Ireland Ltd. (Indaver) to undertake soil and sediment sampling in the Cork Harbour area as part of a submission of baseline environmental conditions in support of a planning application for a Resource Recovery Centre proposed for Ringaskiddy, Co. Cork.

The scope of work includes the collection of samples in the vicinity of the site, submission to a laboratory for environmental analysis and interpretation of the significance of the analysis results. The results are also considered against previous recorded concentrations in the vicinity of the site as well as existing data for Ireland and other countries to determine the significance of the background concentrations.

The principal contaminants being analysed for in the samples are polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) which can be formed by the combustion of materials that contain trace amounts of chlorine, including wood and straw material and the incineration of municipal and industrial waste. These chemical compounds are ubiquitous in the environment and are found at very low levels in many soils and sediments due to their diffuse atmospheric deposition and persistence. The natural occurrence of PCDDs and PCDFs, collectively known as PCDD/Fs (or dioxins and furans), in soils can be as a result of forest fires and volcanic activity[1].

Further details on the formation and presence of PCDD/Fs and dioxin-like PCBs are provided in Section 5 of this report.

2.0 SAMPLING LOCATIONS

Soil and sediment sampling was carried out at twelve locations by AWN in January 2015. There were eight soil sampling locations and four sediment sampling locations chosen in the vicinity of Cork Harbour around the site of the proposed Resource Recovery Centre. These locations were previously sampled by AWN for PCDD/F monitoring in July 2001, April 2008 and March 2009.

Additionally, the Environmental Protection Agency (EPA) undertook a soil dioxin sampling programme in the Cork Harbour area during December 2000, in order to determine background dioxin concentrations in soil in the area. Samples were taken at nine locations in the Cork Harbour area and at a control location at the EPA offices in Iniscarra, which was felt to be representative of a rural environment.

The AWN sampling locations are shown in Figure 1 and the EPA (2000) sampling locations are shown in Figures 2A and 2b.

The primary aims of the sampling programme carried out by AWN were as follows (where site refers to the proposed Resource Recovery Centre):

- Establish the current concentrations of PCDDs, PCDFs and dioxin-like PCBs in soil and sediments in the vicinity of the site;
- Discuss the relevance of recorded concentrations of PCDDs, PCDFs and dioxin-like PCBs; and
- Compare recorded concentrations in this round with soil and sediment dioxin and furan concentrations obtained for the site by AWN in 2001, 2008, 2009 and historically by the EPA and Cork County Council.

AWN Environmental Consultant, David Casey, conducted the sampling programme during January 2015.

2.1 Soil Sampling Locations

Insert 2.2 over identifies the eight soil sampling locations from the January 2015 sampling event. The sampling locations are referenced to locations from the previous AWN and EPA sampling events.

It should be noted that sampling locations were initially identified in 2001, following inspection of windrose data from Cork Airport (Met Éireann data) for the period 1993 to 1997, which showed that the two predominant wind directions were south-westerly and north-westerly. Subsequent sampling events, by AWN, have been carried out at the same locations to allow for representative comparison of recorded data, with the exception of soil sample Location B from 2001 (Location 8A in 2015 study) where the land has since been developed.

These locations were chosen initially, in the 2001 study, based on the following criteria:

Sampling ID (2015)	Sampling ID (2001)	Justification for Sampling Location
1A	H	EPA Iniscarra – comparison against EPA data and regional background levels
2A	F	Low ground at Indaver Site
3A	A	Compare with EPA data and background levels in vicinity of the Indaver Site
4A	E	High ground above Indaver Site
5A	D	Background levels in vicinity of Cobh (downwind of SW winds from Ringaskiddy)
6A	C	Compare with EPA data and background levels downwind of SW winds from Ringskiddy
7A	G	Background levels downwind of NW winds from Ringaskiddy (Roche's Point)
8A	B	Compare with EPA data and background levels in vicinity of Novartis and Pfizer

Insert 2.1 *Justification for soil sampling locations*

Sample ID (2015)	Sampling Date	General Location	2008 AWN Study		2001 AWN Study		Closest EPA Sampling Point
			Sample ID	GPS Reference	Sample ID	GPS Reference	
Location 1A	21 Jan 2015	EPA Offices Iniscarra	Location 1	51°54.067' N 8°40.279' W	H	51°54.115' N 8°40.208' W	Point 10
Location 2A	15 Jan 2015	Low Ground at Indaver Site	Location 2	51°49.860' N 8°18.205' W	F	51°49.851' N 8°18.191' W	Point 6
Location 3A	16 Jan 2015	Martello Tower, Ringaskiddy	Location 3	51°49.717' N 8°18.594' W	A	51°49.709' N 8°18.558' W	Point 6
Location 4A	15 Jan 2015	High Ground at Indaver Site	Location 4	51°49.729' N 8°18.616' W	E	51°49.751' N 8°18.565' W	Point 6
Location 5A	16 Jan 2015	Cobh Water Tower	Location 5	51°51.530' N 8°17.141' W	D	51°51.563' N 8°17.181' W	Point 9
Location 6A	20 Jan 2015	Cushkinny Nature Reserve	Location 6	51°51.535' N 8°15.867' W	C	51°51.540' N 8°15.891' W	Point 8
Location 7A	20 Jan 2015	Lighthouse, Roche's Point	Location 7	51°47.610' N 8°15.218' W	G	51°47.585' N 8°15.303' W	N/A
Location 8A	19 Jan 2015	Land overlooking Pfizer (OSP4) Plant and N28 Road	Location 8	51°50.034' N 8°20.138' W	N/A	N/A	Point 7
N/A*	N/A*	IDA Land overlooking Pfizer	N/A*	N/A*	B	51°49.915' N 8°20.091' W	Point 7

Insert 2.2 *Soil Sampling Locations*

** Note: Land developed since 2001 and could not be sampled – alternative nearby Location 8/8A used as replacement*

2.2 Sediment Sampling Locations

Insert 2.3 below identifies the locations of the four sediment samples collected during the 2015 sampling event. These locations were the same as those used during the March 2009 sampling event by AWN.

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

Insert 2.3 *Sediment Sampling Locations*

** Grid Reference to Irish Transverse Mercator (ITM) (Source: OSI online mapping)*

Three of the sediment sampling locations (excluding Beach 2A) are located within either a Special Protection Area (SPA) or proposed Natural Heritage Area (pNHA). Beach 1A, 2A and 3A are located within the Cork Harbour SPA (Site Code 004030). Beach 4A is located within the Lough Beg pNHA (Site Code 001066), Beach 3A is located within the Monkstown Creek pNHA (Site Code 001979) and Beach 1A is located within the Whitegate Bay pNHA (001084). The locations of these areas of ecological significance are presented in Figure 3.

The location of Beach 2A was chosen based on the knowledge that local people use this beach area for recreational purposes i.e. it is a local amenity.

By sampling in these areas, PCDD/F concentrations in the sediment of these designated areas can be determined and used to establish any potential impacts on species which may breed, feed, roost or winter there. In addition, all sediment sampling sites chosen were in areas of muddy sediment which can provide bird feeding habitats and which are known, or which have an apparent potential, to accumulate contaminants.

3.0 SAMPLING METHODOLOGY

The aim of the sampling programme was to establish a background topsoil concentration for each individual sampling location. In order to provide consistency for comparative purposes, the methodology used by AWN for the 2001, 2008 and 2009 studies was applied during soil sample collection for this study.

US EPA guidance (as presented in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM) (1997)[2], was followed in the selection and design of the sampling methodology. The EISOPQAM Areal Composite Methodology[3] was selected as the method most applicable for determining background soil concentrations for an area. This method ensures the sample collected is representative of an area. Briefly, the methodology consists of taking a number of samples in an identical manner and of an identical size and then combining these samples to form a composite sample, which is then thoroughly mixed. A sample of this composite material is then sent for analysis.

The procedure followed by the EPA during soil sampling in the Cork Harbour area was incorporated into the sampling methodology, to ensure direct comparability between the AWN and the EPA analysis results. This procedure also followed the Areal Composite Methodology.

3.1 Sampling Depth and Pattern

Sampling was conducted by marking out an area of approximately 100m x 100m, where possible, at the determined location. A "W" pattern was outlined with 25m long legs, where possible. The sampling depth was to 14cm at 5m intervals along the "W" pattern.

The layout of the sampling grid at each sampling location is shown on aerial imagery in Appendix A. Pictorial records of the sampling areas are presented in Appendix B.

3.2 Sample Acquisition and Handling

The sediment samples were taken using a 4cm diameter corer along the "W" pattern legs with a 5m sampling interval, where possible. Due to restrictions in suitable sampling soil, some of the sampling layouts were limited.

A significant number of samples were taken at each site and each composite sample weighed between 5kg and 6kg. Samples were thoroughly mixed in a clean plastic basin and then a 1kg aliquot was extracted from the mixed sample. The 1kg sample was divided evenly between two (acetone rinsed) amber glass jars, which were supplied by Scientific Analysis Laboratories (SAL) in the UK. One of the samples served as a duplicate in the event of breakage of the main sample during transportation to the laboratory or in the event of a requirement to carry out additional future analysis.

In order to avoid cross contamination between each composite sample, the soil corer and trowel (used for mixing the composite sample) were cleaned after each location, using the following procedure:

- The soil auger and trowel were cleaned using a scrubbing brush (to remove any remaining soil) and Decon90, which is a phosphate free detergent and is widely accepted for use in decontaminating equipment required for environmental sampling. This helped removed any organic residues that may have been present on the soil corer or trowel from the previous composite sample;

- The soil auger and trowel were rinsed using clean bottled water. This helped remove any traces of detergent remaining on the sampling tools;

- The soil corer and trowel were then wiped using a clean cloth and acetone. A new cloth was used during each decontamination process. This helped remove any remaining organic residues present on the sampling tools;

- The soil auger and trowel were again rinsed using clean bottled water. This helped remove any traces of acetone remaining on the sampling tools; and

- A new, clean bucket was used for the collection of each composite sample and cleaned in accordance with the above procedure to avoid cross contamination between the samples.

Soil sample containers were labelled as Locations 1A – 8A and sediment samples were labelled as Beach 1A – 4A. The analysis required for each sample was listed on a standard Chain of Custody form supplied to the laboratory.

The samples were sent by courier to SAL Laboratories, a UKAS Accredited laboratory, in the UK for analysis. The samples were kept chilled and secured by AWN prior to transportation to the laboratory.

For future sampling events, it should be noted that all of the sediment sample sites are located in muddy or soft sand areas, which makes for difficult underfoot conditions and the risk of becoming stuck. It is important to keep moving and not stand in one location for too long. Where possible, at least two persons should be involved in carrying out the sediment sampling with one person based on the shore in constant contact with the sampler.

Additionally, the sediment sites were only accessible for approximately one and half hours either side of low tide and the sampler had to be in position two hours before low tide and ready to "follow the tide out" to the sampling location.

3.3 Analysis Suite

All twelve samples were scheduled for analysis for the following parameters:

- PCDD/Fs – 7 no. PCDD and 10 no. PCDF congeners by GC/MS (HR);
- PCBs (WHO 12) – 12 no. dioxin-like PCB congeners by GC/MS (HR)(Soxhlet);
- Heavy Metals;
- Total Organic Carbon (TOC); and
- pH.

SAL holds UKAS Accreditation for all of the above parameter analysis, with the exception of TOC.

4.0 RESULTS OF SAMPLING

4.1 PCDD/F and Dioxin-Like PCB Results

The results of laboratory analysis for PCDD/Fs and dioxin-like PCBs on the twelve soil and sediment samples, as presented in the SAL report, are summarised in Insert 4.1 below.

In considering the significance of reported concentrations, it is necessary to determine the toxic equivalence (TEQ) of individual PCDD/F congeners compared against 2,3,7,8-tetrachloro-*p*-benzodioxin (2,3,7,8-TCDD), a proven human carcinogen, which is considered to be the most potent congener. The TEQ of 17 no. PCDD/F congeners (which are considered to have the potential to be a risk to human health) are determined by multiplying the recorded concentration of each compound by a toxic equivalency factor (TEF). The TEQ values presented in Insert 4.1 use TEFs according to the World Health Organisation (WHO) system[4]. The toxicity of compounds showing dioxin-like modes of action is considered to be additive so the TEQ values in Insert 4.1 are total PCDD/F for all 17 no. congeners[1].

Additionally, it is worth noting the significance of the concentration of individual congeners which are reported at being below the laboratory limit of detection (LOD). Some laboratories exclude values which are below the LOD in calculating toxic equivalent, however, other laboratories have assumed that any value recorded as being below the LOD should be assigned a value for the relevant congener of 50% of the LOD. This can lead to slight discrepancies in total PCDD/F between laboratories.

The laboratory report issued by SAL for this sampling event provides an upper bound (assuming the actual concentration is equal to LOD value) and lower bound (assuming the actual concentration is zero) for the toxic equivalent of individual congeners. Previous laboratory reports issued for AWN sampling events in 2001, 2008 and 2009 assumed a concentration of zero where the value was below the LOD. To allow for accurate comparison against the previous recorded concentrations, the lower bound value has been used in this report.

Further detail on the basis for PCDD/F analysis and the development of TEFs is discussed in the following section.

The laboratory report issued by SAL is included in Appendix C.

Sample ID	Location	PCDD/F TEQ* (ng/kg)	PCB TEQ* (ng/kg)
Location 1A	EPA Offices Iniscarra	0.022	0.0024
Location 2A	Low Ground at Indaver Site	0.041	0.0057
Location 3A	Martello Tower, Ringaskiddy	0.680	0.1100
Location 4A	High Ground at Indaver Site	0.310	0.0030
Location 5A	Cobh Water Tower	0.350	0.0030
Location 6A	Cushkinny Nature Reserve	0.170	0.0039
Location 7A	Lighthouse, Roche's Point	0.750	0.0037
Location 8A	Land overlooking Pfizer (OSP4) Plant and N28 Road	0.290	0.0035
Beach 1A	Strand at Whitegate Village	0.480	0.0064
Beach 2A	Ringaskiddy – beach adjacent to road to Haulbowline Island	0.014	0.0031
Beach 3A	Mud Flats at Buncoille	0.260	0.0046
Beach 4A	Mud Flats in bay to east of Hovione facility, Loughbeg	0.210	0.0042

Insert 4.1 *Summary of PCDD/F and dioxin-like PCB concentrations (*by WHO2006 TEF)*

4.2 Metals, pH and TOC Results

The heavy metals, pH and TOC results for the twelve sampling locations are presented in Table 1.

5.0 DISCUSSION OF RESULTS

As mentioned in the previous section, there are a number of factors which need to be outlined when considering the significance and context of PCDD/F and dioxin-like PCB concentrations in soils and sediments. Primarily, clarification is required on the derivation of TEFs.

5.1 Background of PCDD/F TEFs and Potential Discrepancies

Polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) are a group of tricyclic aromatic compounds with similar chemical and physical

properties and are ubiquitous in the modern environment. Mixtures of the two groups of compounds are normally referred to as PCDD/F[5].

The ability of chlorine atoms to substitute at various positions on the benzene ring structures of these compounds allows numerous positional isomers to be formed. In total, there are 210 no. positional isomers of both groups, 75 no. for PCDD and 135 no. for PCDF. The majority of these compounds are of no concern with respect to ecological and human toxicity, with the exception of 17 no. compounds (7 no. PCDD and 10 no. PCDF) which have chlorine substitution in the 2,3,7,8 positions[6]. These are:

- PCDDs - Dioxins (7 no.):
  - 2,3,7,8-TCDD
  - 1,2,3,7,8-PeCDD
  - 1,2,3,4,7,8-HxCDD
  - 1,2,3,6,7,8-HxCDD
  - 1,2,3,7,8,9-HxCDD
  - 1,2,3,4,6,7,8-HpCDD
  - OCDD
- PCDFs - Furans (10 no.):
  - 2,3,7,8-TCDF
  - 1,2,3,7,8-PeCDF
  - 2,3,4,7,8-PeCDF
  - 1,2,3,4,7,8-HxCDF
  - 1,2,3,6,7,8-HxCDF
  - 2,3,4,6,7,8-HxCDF
  - 1,2,3,7,8,9-HxCDF
  - 1,2,3,4,6,7,8-HpCDF
  - 1,2,3,4,7,8,9-HpCDF
  - OCDF

2,3,7,8-tetrachloro-*p*-benzodioxin (2,3,7,8-TCDD) is the most studied dioxin and is considered to be the most toxic by far of the 17 no. congeners.

As data began to accumulate in the 1970's and early 1980's of the toxic effects of 2,3,7,8-TCDD, a number of systems for assessing the toxicity of other PCDD/Fs were developed, all using the concept of toxic equivalence (TEQ)[6]. This concept assess' the toxicity of other PCDD/F congeners and assigns a weighting compared to the known toxicity of 2,3,7,8-TCDD. Examples of the systems which developed at that time include the Swiss system (published in 1982), the German system (published in 1985), the Danish system (published in 1984) and the Canadian system (published in 1983)[7,8,9,10]. However, these systems applied slightly different weighting factors for calculating TEQ expressed as units of 2,3,7,8-TCDD. For example, 1,2,3,4,6,7,8 HpCDD (non-2,3,7,8) was assigned a Toxic Equivalency Factor (TEF) of 0.1 by the Swiss system but was given a TEF of 0.001 by the German system, two orders of magnitude difference.

In recent years, TEFs developed by the US EPA, the North Atlantic Treaty Organisation Committee on the Challenges of Modern Society (NATO/CCMS), the European Community (EC) and the WHO have been aligned allowing for easier comparability of TEQ values[11]. The NATO/CCMS TEFs (giving a result identified as I-TEQ), which correspond exactly with the US EPA and EC TEFs, were used in the previous reports submitted by AWN.

A re-evaluation of the TEFs by the WHO in 2005 made some slight changes to individual compounds and these TEFs have been used by the environmental laboratory in this monitoring round to determine the TEQ concentrations.

Discrepancies between reported results can also arise when comparing soil samples taken with a hand corer, or similar instrument, as the greater the depth of the core, the greater the potential for dilution of the sample by cleaner soil. As dioxin concentrations in soil are influenced by airborne deposition rates, a concentration gradient will exist in the soil, with the greatest concentrations in the upper layer and decreasing concentrations being measured as depth increases and the influence of surface deposition decreases.

5.1.1 Dioxin-Like PCBs

There are also a number of polychlorinated biphenyls (PCBs) that are considered to possess dioxin-like toxicity and are known as *'dioxin-like PCBs'*. Dioxin-like PCB compounds or congeners have a flat molecular structure (hence they are also referred to as *'coplanar PCBs'*), with no or only one chlorine atom at the ortho position. The twelve dioxin-like PCBs which have been assigned TEFs are:

- Dioxin-Like PCBs (12 no.):
    - 3,3',4,4'-TCB (PCB-77)
    - 3,4,4',5-TCB (PCB-81)
    - 3,3',4,4',5-PeCB (PCB-126)
    - 3,3',4,4',5,5'-HxCB (PCB-169)
    - 2,3,3',4,4'-PeCB (PCB-105)
    - 2,3,4,4',5-PeCB (PCB-114)
    - 2,3',4,4',5-PeCB (PCB-118)
    - 2,3,4,4',5-PeCB (PCB-123)
    - 2,3,3'4,4',5-HxCB (PCB-156)
    - 2,3,3',4,4',5'-HxCB (PCB-157)
    - 2,3',4,4',5,5'-HxCB (PCB-167)
    - 2,3,3',4,4',5,5'-HxCB (PCB-189)

5.2 Analysis of measured PCDD/F and Dioxin-Like PCB Values

5.2.1 Soil Samples

To allow suitable comparison of PCDD/F and dioxin-like PCB concentrations in the 2015 soil sampling event against previous studies carried out by AWN and the EPA, it will be necessary to multiply the measured concentration of the individual compounds by the NATO/CCMS I-TEFs to calculate I-TEQ values.

The measured concentrations, I-TEFs and corresponding I-TEQs for each compound at each location are presented in Table 2 at the end of this report.

The toxicity of compounds showing dioxin-like modes of action is considered to be additive, therefore, Insert 5.1 below provides a summary of total PCDD/Fs and dioxin-like PCBs at each soil sampling location.

Sample ID	Location	PCDD/F I-TEQ* (ng/kg)	PCB I-TEQ* (ng/kg)
Location 1A	EPA Offices Iniscarra	0.033	0.002
Location 2A	Low Ground at Indaver Site	0.052	0.006
Location 3A	Martello Tower, Ringaskiddy	0.749	0.113
Location 4A	High Ground at Indaver Site	0.373	0.003
Location 5A	Cobh Water Tower	0.413	0.003
Location 6A	Cushkinny Nature Reserve	0.219	0.004
Location 7A	Lighthouse, Roche's Point	0.802	0.004
Location 8A	Land overlooking Pfizer (OSP4) Plant and N28 Road	0.344	0.004

Insert 5.1 *Summary of PCDD/F and dioxin-like PCB concentrations (*by NATO/CCMS I-TEF)*

5.2.2 Sediment Samples

In the case of the samples taken in sediment materials at four locations in Cork Harbour, it is necessary to consider a different approach to assigning TEFs. Marine sediment has numerous properties, which contribute to the accumulation and concentration levels of dioxins. Grain size distribution has been attributed to dioxin levels in sediments. Results of studies show that TEQ concentrations of dioxins increased with decreasing grain size in sediment fractions. Small sized grains (<2µm fraction) of sediment is one of the major sinks for contaminants introduced to waters, largely due to the presence of mineral clays with organic coatings and iron and manganese hydroxide coatings.

In addition, the location of sediment sampling may have an effect on the level of contaminants in an area, with previous studies outlining that sites can be subject to enhanced anthropogenic impacts as a result of restricted transport and dispersal of contaminants.

In order to compare the measured PCDD/F concentrations with appropriate limit values, it is necessary to determine the TEQ using ecotoxicological TEF values developed by the UK Environment Agency (UK EA) for risks to aquatic organisms. Limit values have been proposed by the UK EA and are considered to be the most appropriate limit values for PCDD/F in marine sediments[12].

Insert 5.2 below provides a summary of total PCDD/Fs at each sediment sampling location. A summary of the measured concentrations and I-TEF values used are presented in Table 3 at the end of this report.

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

Insert 5.2 *Summary of PCDD/F concentrations (*by UK EA TEFs)*

5.3 Comparison with AWN Sampling Results 2001, 2008 and 2009

5.3.1 Soil Sampling in 2001, 2008 and 2015

AWN carried out sampling for PCDD/F and dioxin-like PCBs on soil samples at eight locations during sampling rounds in July 2001, April 2008 and January 2015. Comparison of the TEQ values for PCDD/Fs of samples collected at each location are presented in Insert 5.3 and comparison of dioxin-like PCB TEQ values are presented in Table 5.4.

Note: All raw data has been converted to I-TEQ values using NATO/CCMS I-TEFs

Sample ID	Location	I-TEQ 2015 (ng/kg)	I-TEQ 2008 (ng/kg)	I-TEQ 2001 (ng/kg)
Location 1A	EPA Offices Iniscarra	0.033	0.230	<0.500
Location 2A	Low Ground at Indaver Site	0.052	2.100	3.400
Location 3A	Martello Tower, Ringaskiddy	0.749	1.900	3.000
Location 4A	High Ground at Indaver Site	0.373	0.460	0.650
Location 5A	Cobh Water Tower	0.413	1.200	1.000
Location 6A	Cushkinny Nature Reserve	0.219	0.580	1.800
Location 7A	Lighthouse, Roche's Point	0.802	0.130	1.400
Location 8A	Land overlooking Pfizer (OSP4) Plant and N28 Road	0.344	0.086	0.550

Insert 5.3 *Soil sample PCDD/F I-TEQ values*

Comparison of the results for PCDD/F TEQ show that concentrations at all locations were less in 2015 than in 2001 and 2008 with the exception of the concentration at Roche's Point Lighthouse (Location 8A) (0.802 ng/kg) which was slightly increased from the 2008 concentration (0.130 ng/kg) and at the land overlooking the Pfizer plant (Location 8A) which increased from 0.086 ng/kg in 2008 to 0.344 ng/kg in 2015. The general reduction in the PCDD/F concentrations in the topsoil in the study area is likely to be attributed to the implementation of a number of regulations and technological advances in recent years regarding the improvement of air quality, elimination of leaded petrol and the closure of the iron smelting facility in Cork.

The most significant reductions in concentration were recorded at the low ground to the east of the site (Location 2A) where there was a 98% reduction in measured

concentration in 2015 against 2008. This location had historically recorded the most elevated PCDD/F concentrations, predominantly due to HGV road traffic nearby, but in the 2015 round recorded the lowest urban concentration. This reduction is most likely due to reduced activities on Haulbowline Island since the closure of a former steel plant in the early 2000's.

The most elevated concentrations of PCDD/F were recorded at the Martello Tower in Ringaskiddy (Location 3A) (0.749 ng/kg) and the lighthouse at Roche's Point (Location 8A) (0.802 ng/kg). Concentrations have historically been elevated at the Martello Tower which is at the top of a hill and elevated above the other sampling locations. Location 7A is also an elevated site and the congener profiles of both samples are similar indicating that they may both be influenced by a common source. Significantly, OCDD concentration was considerably higher at Location 7A than anywhere else and this was a significant contributor to the total PCDD/F concentration.

It is interesting to note that historically, PCDD/F concentrations at Locations 3A and 4A were considerably different, despite being very close to each other. However, the concentrations measured were much closer in level in the 2015 round.

The lowest concentration (0.033 ng/kg) was recorded at the EPA offices site in Iniscarra (Location 1A), which would be expected of a rural location. This location historically recorded low concentrations along with the site overlooking the N28 road and the IDA business park (Location 8A). The congener profile at Location 8A is similar to the profile at Location 3A which may indicate a similar source.

Sample ID	Location	TEQ 2015 (ng/kg)	TEQ 2008 (ng/kg)	2001 (µg/kg)*
Location 1A	EPA Offices Iniscarra	0.002	0.0003	<1
Location 2A	Low Ground at Indaver Site	0.006	0.163	2
Location 3A	Martello Tower, Ringaskiddy	0.113	0.004	<1
Location 4A	High Ground at Indaver Site	0.003	0.001	<1
Location 5A	Cobh Water Tower	0.003	0.002	<1
Location 6A	Cushkinny Nature Reserve	0.004	0.022	<1
Location 7A	Lighthouse, Roche's Point	0.004	0.001	<1
Location 8A	Land overlooking Pfizer (OSP4) Plant and N28 Road	0.004	0.001	<1

Insert 5.4 *Soil sample dioxin-like PCB I-TEQ values*

** Note: 2001 PCB concentrations were presented in µg/kg and were not factored using I-TEF values. Total PCBs in 2001 was based on EC7 PCB, as opposed to WHO12 PCB in 2008 and 2015.*

The concentration of dioxin-like PCBs in 2015 was generally similar to the 2008 recorded values. It may not be appropriate to compare against the 2001 results, which were based on EC7 PCB congeners. Again, the concentration at the Martello Tower (0.113 ng/kg) was the highest concentration recorded mirroring the elevated sample concentration of PCDD/F at the same location. Dioxin-like concentrations have historically been elevated at Location 3A.

5.3.2 Sediment Sampling in 2009 and 2015

AWN carried out sampling for PCDD/F and dioxin-like PCBs on sediment samples at four locations during the 2015 sampling round. Analysis for PCDD/F congeners was carried out at the same four locations previously in March 2009. Comparison of the TEQ values for PCDD/Fs of samples collected at each location are presented in Insert 5.5.

Note: All raw data has been converted to TEQ values developed by the UK EA based on risk to aquatic organisms

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)*

Insert 5.5 above shows that PCDD/F concentrations in beach sediments were generally higher in the 2015 sampling event than in the 2009 event with the exception of levels at location Beach 2A which reduced from 0.035 ng/kg to 0.015 ng/kg. The concentration at Beach 1A in Whitegate Village was significantly higher in 2015 with an increase in concentration of more than ten times that of 2009.

5.4 Comparison with EPA Soil Testing during December 2000

The EPA carried out soil sampling in the Cork Harbour area in December 2000 at a number of locations which correspond with the AWN sampling locations from this and previous monitoring rounds. The EPA used NATO/CCMS TEFs to determine the TEQ of PCDD/Fs, so these results can be directly compared against the AWN sampling results.

Insert 5.6 below gives a summary of comparable concentrations between the EPA study and the most recent AWN study.

EPA (2000)			AWN (2015)		
Location	Location ID	PCDD/F I-TEQ (ng/kg)	Location	Location ID	PCDD/F I-TEQ (ng/kg)
Church Area	Point 1	28	N/A	N/A	N/A
Main Square	Point 2	7.1	N/A	N/A	N/A
Area beside football field	Point 3	11.8	N/A	N/A	N/A
Cdr. Daly Area	Point 4	3.1	N/A	N/A	N/A
Football Pitch (dockyard)	Point 5	1.6	N/A	N/A	N/A

West of Martello Tower	Point 6	0.8	Base of Martello Tower	Location 3A	0.749
Pfizer/ADM (to south of site)	Point 7	0.7	Land overlooking Pfizer (OSP4) Plant and N28 Road	Location 8A	0.344
Ballymore (south-west face field)	Point 8	1	Cushkinny Nature Reserve	Location 6A	0.219
Carignafoy GAA Ground	Point 9	1	Cobh Water Tower	Location 5A	0.413
Iniscarra WTW	Point 10	0.6	EPA Offices Iniscarra	Location 1A	0.033

Insert 5.6 *Soil sample PCDD/F concentrations from EPA (2000) compared to AWN (2015)*

Recorded concentrations of PCDD/F were lower at any of the locations in the 2015 sampling round which corresponded to sampling sites from the EPA study in 2000. Samples collected close to the site at Locations 3A and 8A were similar to the samples collected at EPA Points 6 and 7.

5.5 Comparison of PCDD/F, dioxin-like PCBs, pH and Heavy Metal Concentrations with Relevant Standards

There is no Irish statutory threshold values for PCDD/F or dioxin-like PCBs in soils or sediments. However, there are Dutch Target and Intervention values assigned to sum value of the EC7 PCB congeners and in the absence of Irish guidance, these values are typically used.

The Dutch Government have set a national target value of 20 µg/kg PCB in soil and a threshold value (the concentration above which remedial action should be considered) of 1000 µg/kg.

The highest measured concentration in the Cork Harbour area are in the 2015 sampling round was 0.113 ng/kg at Location 3A (Martello Tower) which is well below even the target value, therefore the recorded concentrations can be considered as insignificant.

The UK EA published a document in 2004 entitled “UK Proposed Environmental Quality Guidelines for Dioxins and Furans in Water and Sediments” which applies the concept of using a 2000 ng/kg as a TEQ x fraction of organic carbon to determine an appropriate limit value for dioxin concentration in sediments. The measured concentrations are compared against the limit value in Insert 5.7 below and are all shown to be less than the assigned limits.

Sample ID	Total Organic Carbon (TOC) %	I-TEQ Dioxin Limit Value (ng/kg)	Measured TEQ 2015 (ng/kg)
Beach 1A	1.0	20	0.485
Beach 2A	0.1	2	0.015
Beach 3A	0.8	8	0.292
Beach 4A	0.7	7	0.193

Insert 5.7 *Sediment samples compared against UK EA limit values*

TOC values in soil ranged from 2.3% at Location 2A to 7.6% at Location 6A. The three highest TOC values were recorded at the furthest most points in each direction from the site in the Cork Harbour area indicating that elevated organic matter content in the soil is widespread across the area. TOC values in the sediment were lower ranging from 0.1% at Beach 2A to 1% at Beach 1A.

The pH of soil samples taken at each of the eight locations in the 2015 sampling round ranged from 5.9 to 7.2, indicating a range that is slightly acidic to neutral. Sediment samples were slightly more alkaline ranging from 8.0 to 8.3, which would be typical of marine environments.

There were nine heavy metals analysed for at each location with varying levels recorded. There are no Irish statutory limit values for heavy metal concentrations in soils with Dutch and UK EA guidance often used for comparison, where available. The highest lead concentration (110 mg/kg) was recorded at Location 4A on high ground close to the site. The most elevated zinc concentration was 140 mg/kg and was recorded in the composite sample taken at Location 2A on low ground to the east of the site.

6.0 CONCLUSIONS

Background concentrations of PCDD/Fs in soil samples were found to be reduced from samples measured at similar locations in 2001 and 2008. The concentration at Martello Tower (Location 3A) continues to be elevated above locations and in this recent round, the total PCDD/F concentration at Roche's Point Lighthouse (Location 7A) was found to be highest with a TEQ of 0.802 ng/kg. Dioxin-like PCB concentrations were typically similar to recorded concentrations in 2008 and remain well below Dutch limit value concentrations.

TEQ PCDD/F concentrations in beach sediment samples were shown to be slightly higher at three out of the four sampling locations in 2015 with the most elevated concentration (0.485 ng/kg) recorded at the strand in Whitegate Village to the east of the site (Beach 1A). PCDD/F concentrations in sediments were still well below UK EA limit values, however.

TOC and pH values were within expected ranges with slight alkalinity in the sediment samples as expected in marine conditions.

Heavy metal concentrations were recorded at each of the twelve locations with highest lead (110 mg/kg) and zinc (140 mg/kg) concentrations recorded at Locations 4A and 2A, respectively.

7.0 REFERENCES

1. *Soil Guideline Values for dioxins, furans and dioxin-like PCBs in Soil*, EA UK, Bristol (2009).

2. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM)*, US EPA, Athens Georgia, (1997).

3. Section 5-2, (1) *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM),* US EPA, Athens Georgia, (1997).

4. Toxicological Sciences 93, 223–241. *The 2005 World Health Organization re-evaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds.* Van den Berg, M., Birnbaum, L.S., Denison, M., de Vito, M., Farland, W., Feeley, M., Fiedler, H., Hakansson, H., Hanberg, A., Haws, L., Rose, M., Safe, S., Schrenk, D., Tohyama, C., Tritscher, A., Tuomisto, J., Tysklind, M., Walker, N., Peterson, R.E. (2006).

5. *A Review of Dioxin Releases to Land and Water in the UK*, EA UK, Bristol (1997).

6. *Polychlorinated dibenzo-p-dioxins and dibenzofurans, WHO EHC 88, (1989).*

7. *Environmental pollutants due to dioxins and furans from chemical rubbish incineration plants,* Bern, Ministry of Environment, Federal Swiss Government (1982).

8. *Formation and emission of dioxins especially in connection with waste incineration: supplement*, Copenhagen, Miljostyrelsen (1984).

9. *Review of dioxins, Berlin*, Erich Schmidt Verlag, Federal Office of the Environment, Report 5/85, November (1984).

10. *Scientific criteria document for standard development. Polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzo-p-difurans (PCDF),* Toronto, Ontario Ministry of the Environment, Report No. 4-84 (1985).

11. *Toxic Equivalency Factors (TEFs) for PCBS, PCDDs, PCDFs, for humans and wildlife*, Van den Berg et al., Environmental Health Perspective, 106 (12) 775 – 792 (1998).

12. *UK EA Proposed Environmental Quality Guidelines for Dioxins and Furans in Water and Sediments*, Environment Agency (UK) (2000).

FIGURES

Figure 1 – Site Location Map and Sampling Locations

Figures 2a and 2b – EPA (2000) Sampling Locations

Figure 3 – Designated Sites of Ecological Significance in the Cork Harbour Area (from NPWS)



N

Soil Sampling Locations (L1A-L8A)

Sediment Sampling Locations (B1A-B4A)

Ringaskiddy Resource Recovery Centre Site Location



Source: Google Earth

Drawing is for illustrative purposes only. Do not use to scale.

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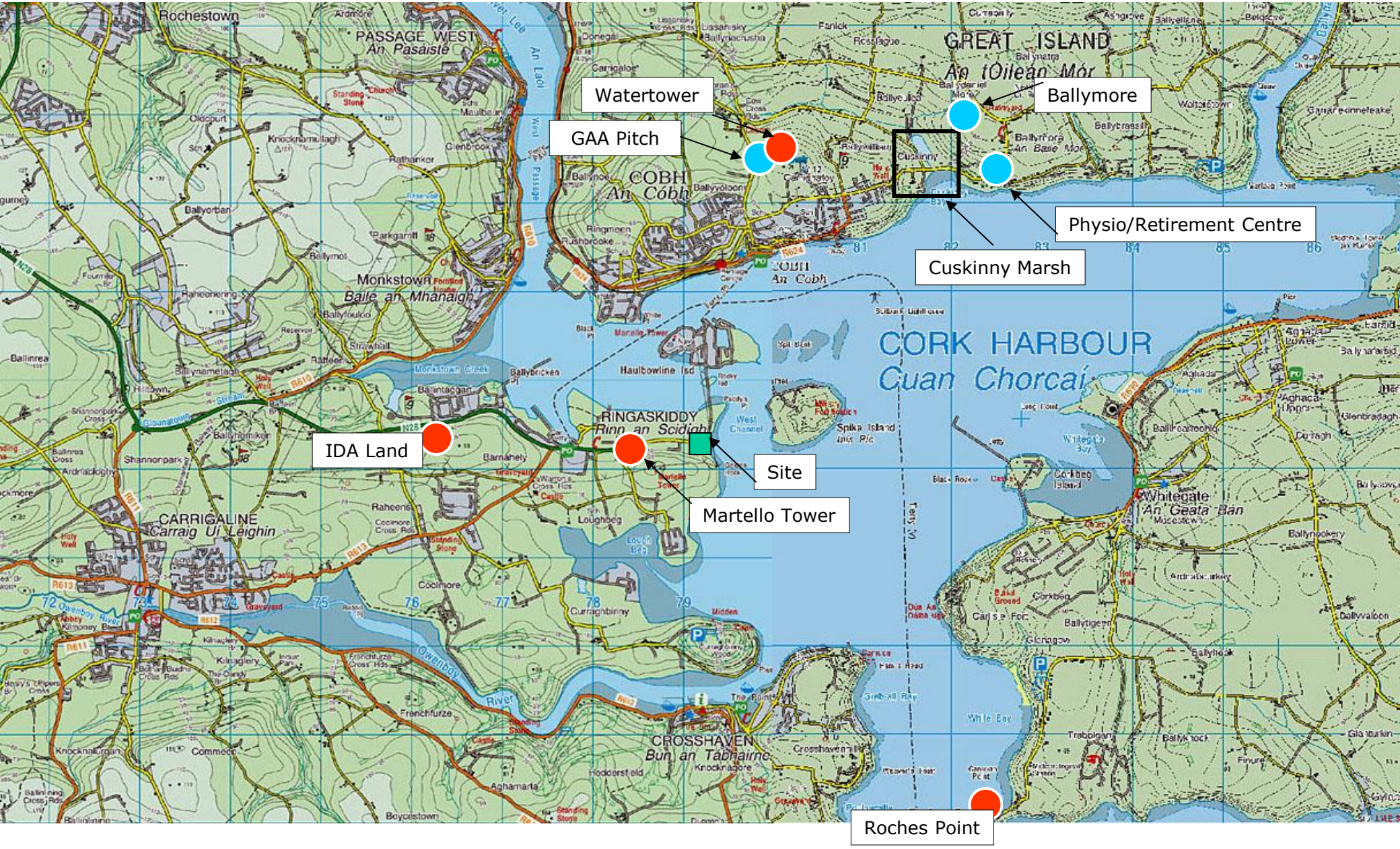
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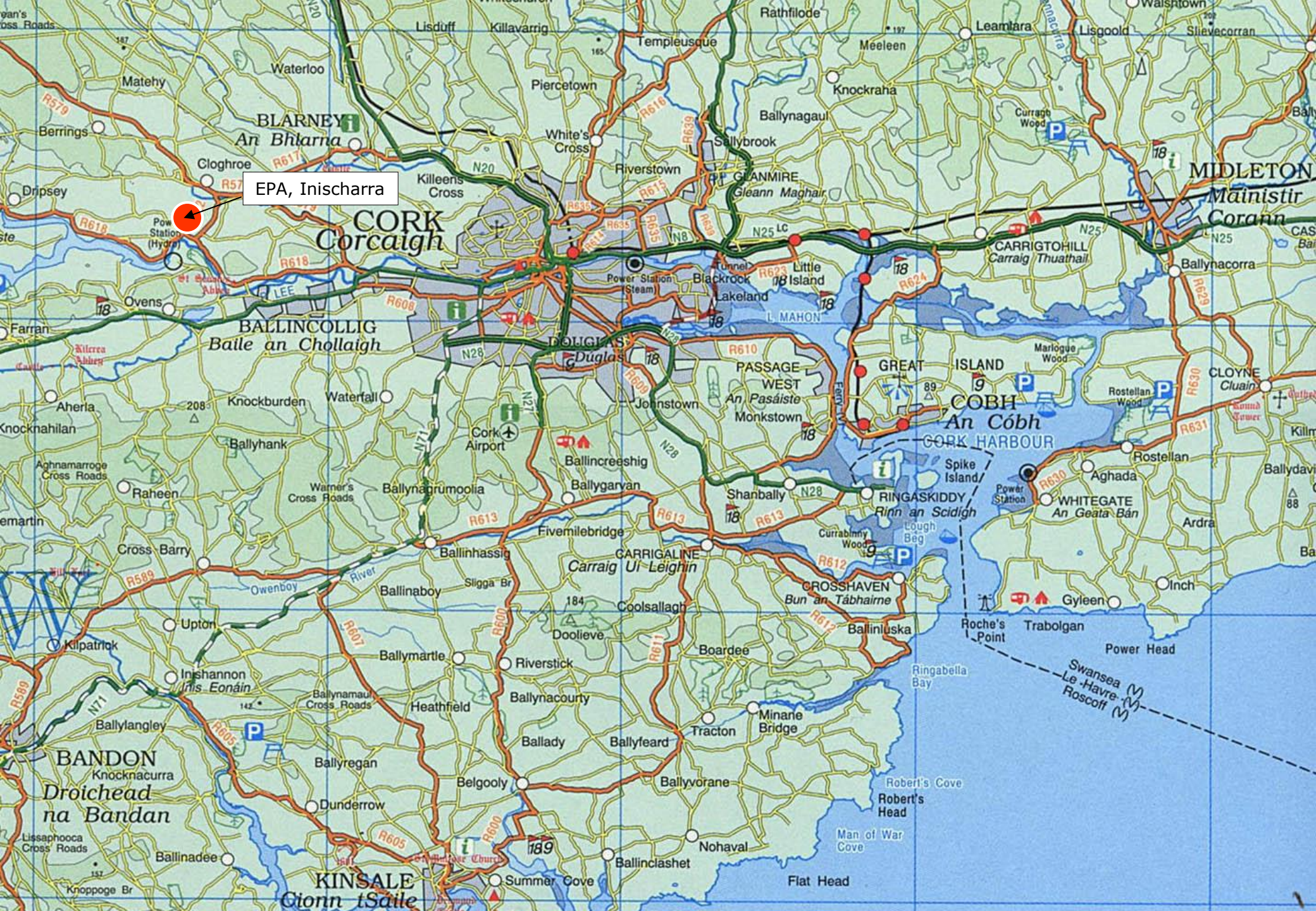
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Indaver Ireland Ltd.

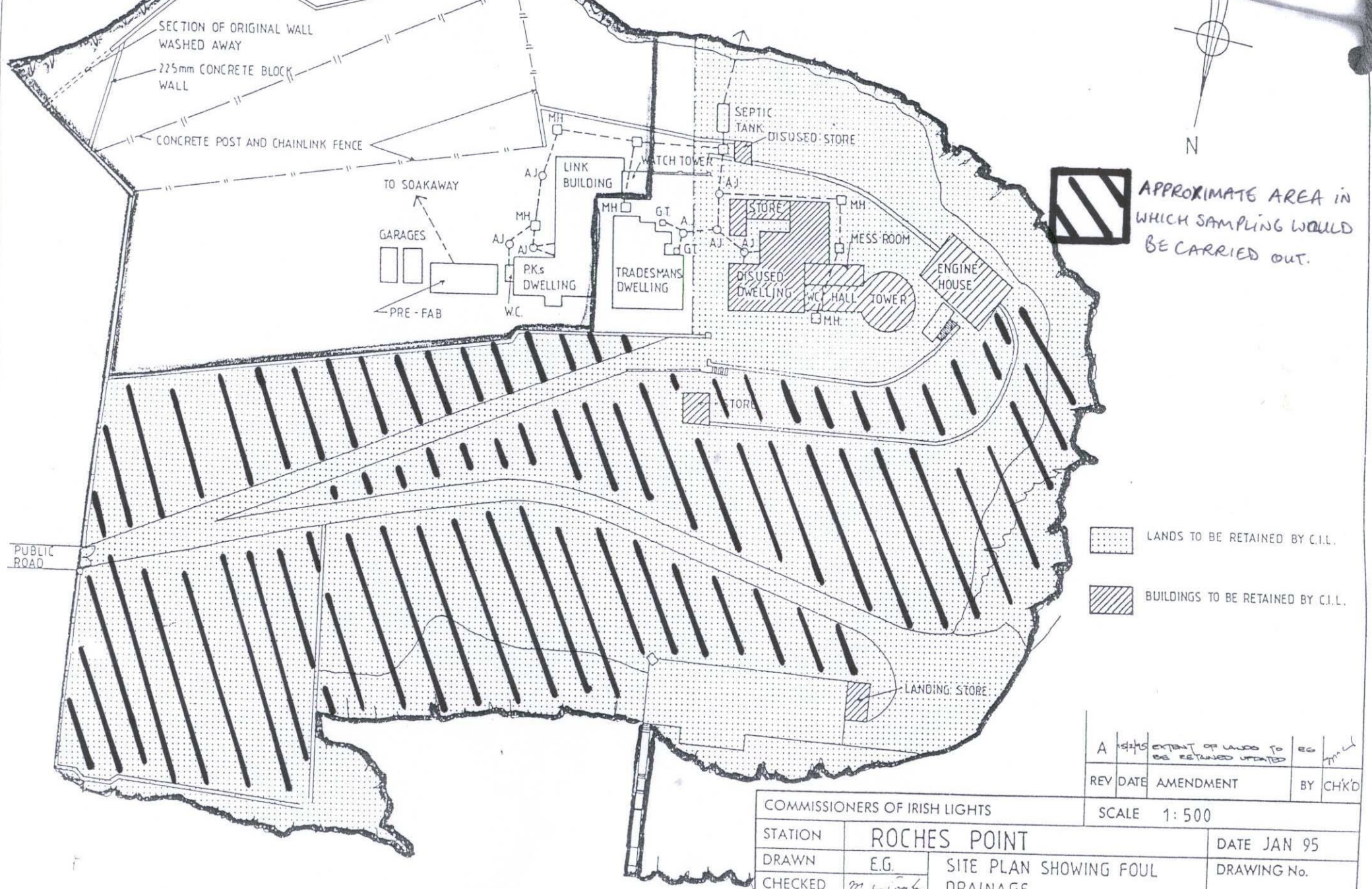
Reference:
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Drawing:
Site Location Map and Sampling Locations

Figure 1


Watertower
GAA Pitch
Ballymore
Physio/Retirement Centre
Cuskinny Marsh
IDA Land
Site
Martello Tower
Roches Point
CORK HARBOUR
Cuan Chorcaí
GREAT ISLAND
An tOileán Mór
COBH
An Cóbh
RINGASKIDDY
Rinn an Scidiúil
CARRIGALINE
Carraig Uí Leighin
CROSSHAVEN
Bun an Tábhairne
Monkstown
Baile an Mhanaigh
PASSAGE WEST
An Pasáiste
Rochestown
Whitegate
An Geata Bán


EPA, Inischarra
CORK
Corcaigh
BLARNEY
An Bhlarna
BALLINCOLLIG
Baile an Chollaigh
DOUGLAS
Dúglas
COBH
An Cóbh
CORK HARBOUR
MIDLETON
Mainistir Corann
CARRIGTOHILL
Carraig Thuathail
GLANMIRE
Gleann Maghair
PASSAGE WEST
An Pasáiste
GREAT ISLAND
CARRIGALINE
Carraig Uí Leighin
CROSSHAVEN
Bun an Tábhairne
RINGASKIDDY
Rinn an Scidigh
WHITEGATE
An Geata Bán
BANDON
Droichead na Bandan
KINSALE
Cionn tSáile
Cork Airport
Power Station (Hydro)
Power Station (Steam)
Tunnel
Ferry
Swansea
Le Havre
Roscoff
Ringabella Bay
Robert's Cove
Robert's Head
Man of War Cove
Flat Head
Roche's Point
Power Head
Lough Beg
L. MAHON
LEE
Owenboy River
Sligga Br
Warner's Cross Roads
Aghnamarroge Cross Roads
Ballynamaul Cross Roads
Lissaphooca Cross Roads
Knoppoge Br
Currabinny Wood
Currane Wood
Marlogue Wood
Rostellan Wood
Spike Island
Little Island
Blackrock
Lakeland
Monkstown
Johnstown
Ballincreeshig
Ballygarvan
Shanbally
Fivemilebridge
Ballinhassig
Ballinaboy
Coolsallagh
Doolieve
Boardee
Ballinluska
Riverstick
Ballymartle
Ballynacourty
Heathfield
Tracton
Minane Bridge
Ballyfeard
Ballyvorane
Ballyregan
Belgooly
Nohaval
Ballinclashet
Summer Cove
Ballinadee
Dunderrow
Ballylangley
Inishannon
Inis Eonáin
Kilpatrick
Upton
Cross Barry
Raheen
Ballyhank
Knockburden
Waterfall
Aherla
Knocknahilan
Farran
Ovens
Dripsey
Cloghroe
Berrings
Matehy
Waterloo
Lisduff
Killavarrig
Templeusque
Piercetown
White's Cross
Killeens Cross
Riverstown
Sallybrook
Ballynagaul
Knockraha
Rathfilode
Meeleen
Leamlara
Lisgoold
Slievecorran
Waishtown
Ballynacorra
Aghada
Rostellan
CLOYNE
Cluain
Ardra
Inch
Gyleen
Trabolgan
Ballydavi
Killm
Ba
Bal
CAS
Bai



REV	DATE	AMENDMENT	BY	CH'K'D
A	15/7/95	EXTENT OF LANDS TO BE RETAINED UPDATED	EG	

COMMISSIONERS OF IRISH LIGHTS		SCALE 1:500	
STATION	ROCHES POINT		DATE JAN 95
DRAWN	E.G.	SITE PLAN SHOWING FOUL DRAINAGE	DRAWING No. 95/140/152/A
CHECKED			
TRACED			
APPROVED			

1 901592



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Designated Special Protection Areas (SPAs)

Proposed Natural Heritage Areas (pNHAs)

Source: National Parks and Wildlife Services (online mapping)

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Project:
Soil and Sediment Sampling for PCDDs, PCDFs and PCBs

Client:
Indaver Ireland Ltd.

Reference:
RH/14/8104SR01

Drawing:
Designated Sites of Ecological Significance

Figure 3

TABLES

Table 1 – Summary of Heavy Metals, pH and TOC (January 2015)

Table 2 – PCDD/F and PCB Soil Concentrations Summary (January 2015)

Table 3 – PCDD/F Sediment Concentrations Summary (January 2015)

Table 1 - Summary of Heavy Metals, pH and TOC (January 2015)

Parameter	LOD	Units	Location 1A	Location 2A	Location 3A	Location 4A	Location 5A	Location 6A	Location 7A	Location 8A	Beach 1A	Beach 2A	Beach 3A	Beach 4A
Heavy Metals														
Arsenic	1	mg/kg	5	17	16	18	8	8	7	18	8	5	8	5
Cadmium	1	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	1	mg/kg	26	22	21	22	23	17	15	20	20	9	21	13
Copper	1	mg/kg	13	25	35	37	20	11	22	20	11	3	13	8
Lead	1	mg/kg	15	59	99	110	78	55	160	63	27	13	27	19
Mercury	1	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Nickel	1	mg/kg	24	31	26	26	16	18	11	19	18	11	19	15
Selenium	3	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	1	mg/kg	71	140	120	130	100	70	53	90	96	40	88	71
pH	N/A	pH Units	6.4	7.2	6.4	6	6.9	7.1	6.3	5.9	8	8.3	8	8.1
Total Organic Carbon (TOC)	0.1	%	4.7	2.3	3	3.5	5	7.6	5.8	5.3	1	0.1	0.8	0.7

Note: - means concentration is below the laboratory limit of detection (LOD)

Table 2 - PCDD/F and Dioxin-Like PCB Concentrations Summary (January 2015)

Parameter	LOD	Units	TEF (NATO/CCMS I-TEF)	Location 1A		Location 2A		Location 3A		Location 4A		Location 5A		Location 6A		Location 7A		Location 8A	
				Result	I-TEQ	Result	I-TEQ	Result	I-TEQ	Result	I-TEQ	Result	I-TEQ	Result	I-TEQ	Result	I-TEQ	Result	I-TEQ
Dioxins (PCDDs)																			
2,3,7,8-TCDD	Varies	ng/kg	1	<0.05	0	<0.041	0	<0.059	0	<0.061	0	<0.058	0	<0.043	0	<0.069	0	<0.040	0
1,2,3,7,8-PeCDD		ng/kg	0.5	<0.057	0	<0.063	0	0.14	0.07	<0.085	0	<0.091	0	<0.062	0	0.17	0.085	<0.055	0
1,2,3,4,7,8-HxCDD		ng/kg	0.1	<0.071	0	<0.14	0	0.12	0.012	<0.094	0	0.12	0.012	<0.12	0	0.23	0.023	0.13	0.013
1,2,3,6,7,8-HxCDD		ng/kg	0.1	<0.14	0	<0.20	0	0.35	0.035	0.2	0.02	0.26	0.026	<0.15	0	0.7	0.07	0.34	0.034
1,2,3,7,8,9-HxCDD		ng/kg	0.1	<0.083	0	<0.16	0	0.22	0.022	0.13	0.013	0.19	0.019	<0.13	0	0.58	0.058	0.29	0.029
1,2,3,4,6,7,8-HpCDD		ng/kg	0.01	1.7	0.017	2.5	0.025	2.2	0.022	2.2	0.022	2.1	0.021	1.1	0.011	7.5	0.075	1.9	0.019
OCDD		ng/kg	0.001	16	0.016	15	0.015	15	0.015	17	0.017	8.8	0.0088	5.8	0.0058	86	0.086	11	0.011
Total Dioxins		**ng/kg**			**0.033**		**0.04**		**0.176**		**0.072**		**0.0868**		**0.0168**		**0.397**		**0.106**
Furans (PCDFs)																			
2,3,7,8-TCDF	Varies	ng/kg	0.1	<0.28	0	<0.31	0	0.64	0.064	0.33	0.033	0.48	0.048	0.39	0.039	0.61	0.061	0.37	0.037
1,2,3,7,8-PeCDF		ng/kg	0.05	<0.12	0	<0.12	0	0.47	0.0235	0.24	0.012	0.26	0.013	0.18	0.009	0.33	0.0165	0.19	0.0095
2,3,4,7,8-PeCDF		ng/kg	0.5	<0.10	0	<0.13	0	0.58	0.29	0.24	0.12	0.27	0.135	0.18	0.09	0.33	0.165	0.2	0.1
1,2,3,4,7,8-HxCDF		ng/kg	0.1	<0.14	0	<0.20	0	0.68	0.068	0.39	0.039	0.4	0.04	0.21	0.021	0.48	0.048	0.28	0.028
1,2,3,6,7,8-HxCDF		ng/kg	0.1	<0.13	0	<0.20	0	0.49	0.049	0.31	0.031	0.31	0.031	0.15	0.015	0.37	0.037	0.24	0.024
2,3,4,6,7,8-HxCDF		ng/kg	0.1	<0.14	0	<0.26	0	0.55	0.055	0.42	0.042	0.36	0.036	0.19	0.019	0.46	0.046	0.26	0.026
1,2,3,7,8,9-HxCDF		ng/kg	0.1	<0.050	0	<0.20	0	<0.10	0	<0.13	0	<0.091	0	<0.15	0	<0.10	0	<0.12	0
1,2,3,4,6,7,8-HpCDF		ng/kg	0.01	<0.60	0	1.1	0.011	2.2	0.022	2.2	0.022	2.1	0.021	0.84	0.0084	2.9	0.029	1.3	0.013
1,2,3,4,7,8,9-HpCDF		ng/kg	0.01	<0.057	0	<0.10	0	<0.20	0	<0.24	0	<0.22	0	<0.10	0	<0.26	0	<0.11	0
OCDF		ng/kg	0.001	<0.63	0	0.79	0.00079	1.4	0.0014	1.9	0.0019	1.9	0.0019	0.65	0.00065	2.7	0.0027	0.97	0.00097
Total Furans		**ng/kg**			**0**		**0.01179**		**0.5729**		**0.3009**		**0.3259**		**0.20205**		**0.4052**		**0.23847**
Total Dioxins and Furans (PCDD/Fs)		**ng/kg**			**0.033**		**0.052**		**0.749**		**0.373**		**0.413**		**0.219**		**0.802**		**0.344**
Dioxin-Like PCBs																			
3,3',4,4'-TCB (PCB-77)	Varies	ng/kg	0.0001	8.7	0.00087	14	0.0014	9.5	0.00095	10	0.001	7.9	0.00079	9.9	0.00099	12	0.0012	8.2	0.00082
3,4,4',5-TCB (PCB-81)		ng/kg	0.0003	<0.5	0	<2.4	0	<0.8	0	<1.4	0	<3.2	0	<1.9	0	<3.3	0	<0.5	0
3,3',4,4',5-PeCB (PCB-126)		ng/kg	0.1	<0.6	0	<2.1	0	1.1	0.11	<1.2	0	<2.5	0	<2.8	0	<2.5	0	<0.8	0
3,3',4,4',5,5'-HxCB (PCB-169)		ng/kg	0.03	<0.5	0	<2.8	0	<0.5	0	<0.5	0	<3.1	0	<2.9	0	<3.1	0	<0.5	0
2,3,3',4,4'-PeCB (PCB-105)		ng/kg	0.00003	16	0.00048	48	0.00144	26	0.00078	21	0.00063	19	0.00057	29	0.00087	27	0.00081	28	0.00084
2,3,4,4',5-PeCB (PCB-114)		ng/kg	0.00003	<2.9	0	<2.5	0	<3.3	0	<2.2	0	<2.4	0	<2.7	0	<2.6	0	<2.8	0
2,3',4,4',5-PeCB (PCB-118)		ng/kg	0.00003	32	0.00096	78	0.00234	49	0.00147	38	0.00114	38	0.00114	60	0.0018	41	0.00123	50	0.0015
2,3,4,4',5-PeCB (PCB-123)		ng/kg	0.00003	<4.4	0	<6.5	0	<6.2	0	<5.7	0	<6.3	0	<5.6	0	<6.2	0	<4.8	0
2,3,3'4,4',5-HxCB (PCB-156)		ng/kg	0.00003	4	0.00012	16	0.00048	8.5	0.000255	5.7	0.000171	10	0.0003	6.8	0.000204	8.9	0.000267	7.5	0.000225
2,3,3',4,4',5'-HxCB (PCB-157)		ng/kg	0.00003	<3.0	0	<3.7	0	<3.5	0	<2.9	0	<3.1	0	<3.1	0	<3.4	0	<3.4	0
2,3',4,4',5,5'-HxCB (PCB-167)		ng/kg	0.00003	<2.6	0	<8.9	0	<4.5	0	3	0.00009	5.2	0.000156	<3.9	0	5	0.00015	4.1	0.000123
2,3,3',4,4',5,5'-HxCB (PCB-189)		ng/kg	0.00003	<2.4	0	<3.2	0	<3.6	0	<2.9	0	<4.1	0	<3.2	0	<3.5	0	<3.6	0
Total Dioxin-Like PCBs		**ng/kg**			**0.002**		**0.006**		**0.113**		**0.003**		**0.003**		**0.004**		**0.004**		**0.004**

*Limit of Detection varies and where values are preceeded by <, this indicates the LOD for that particular congener

** As per previous reports, where the concentration is below the LOD, a value of 0 is assigned

Table 3 - PCDD/F Sediment Concentrations Summary (January 2015)

Parameter	LOD	Unit	TEF (NATO/CCMS I-TEF)	Beach 1A		Beach 2A		Beach 3A		Beach 4A	
				Result	I-TEQ	Result	I-TEQ	Result	I-TEQ	Result	I-TEQ
Dioxins (PCDDs)											
2,3,7,8-TCDD	Varies	ng/kg	1	<0.053	0	<0.055	0	<0.049	0	<0.045	0
1,2,3,7,8-PeCDD		ng/kg	0.73	0.11	0.0803	<0.064	0	<0.061	0	<0.057	0
1,2,3,4,7,8-HxCDD		ng/kg	0.319	0.17	0.05423	<0.067	0	0.1	0.0319	<0.093	0
1,2,3,6,7,8-HxCDD		ng/kg	0.024	0.36	0.00864	<0.070	0	0.19	0.00456	0.21	0.00504
1,2,3,7,8,9-HxCDD		ng/kg	0.1	0.25	0.025	<0.070	0	0.18	0.018	0.14	0.014
1,2,3,4,6,7,8-HpCDD		ng/kg	0.002	4.4	0.0088	1	0.002	3.1	0.0062	2.1	0.0042
OCDD		ng/kg	0.001	35	0.035	13	0.013	28	0.028	16	0.016
Total Dioxins		**ng/kg**			**0.21197**		**0.015**		**0.08866**		**0.03924**
Furans (PCDFs)											
2,3,7,8-TCDF	Varies	ng/kg	0.028	0.49	0.01372	<0.24	0	0.41	0.01148	0.43	0.01204
1,2,3,7,8-PeCDF		ng/kg	0.024	0.24	0.00576	<0.097	0	0.14	0.00336	0.13	0.00312
2,3,4,7,8-PeCDF		ng/kg	0.359	0.25	0.08975	<0.097	0	0.19	0.06821	0.15	0.05385
1,2,3,4,7,8-HxCDF		ng/kg	0.28	0.32	0.0896	<0.065	0	0.24	0.0672	0.15	0.042
1,2,3,6,7,8-HxCDF		ng/kg	0.1	0.21	0.021	<0.056	0	0.18	0.018	0.13	0.013
2,3,4,6,7,8-HxCDF		ng/kg	0.1	0.3	0.03	<0.093	0	0.19	0.019	0.19	0.019
1,2,3,7,8,9-HxCDF		ng/kg	0.1	<0.19	0	<0.050	0	<0.050	0	<0.068	0
1,2,3,4,6,7,8-HpCDF		ng/kg	0.01	2.1	0.021	<0.42	0	1.4	0.014	1	0.01
1,2,3,4,7,8,9-HpCDF		ng/kg	0.01	<0.44	0	<0.060	0	<0.10	0	<0.10	0
OCDF		ng/kg	0.001	2.1	0.0021	<0.62	0	1.7	0.0017	0.99	0.00099
Total Furans		**ng/kg**			**0.27293**		**0**		**0.20295**		**0.154**
Total Dioxins and Furans (PCDD/Fs)		**ng/kg**			**0.485**		**0.015**		**0.292**		**0.193**

*Limit of Detection varies and where values are preceeded by <, this indicates the LOD for that particular congener

** As per previous reports, where the concentration is below the LOD, a value of 0 is assigned

APPENDIX A – Sampling Area Layouts (January 2015)



Beach 1A: Each leg is 25m with 5m sample intervals – Sampled Tuesday, 20th January 2015



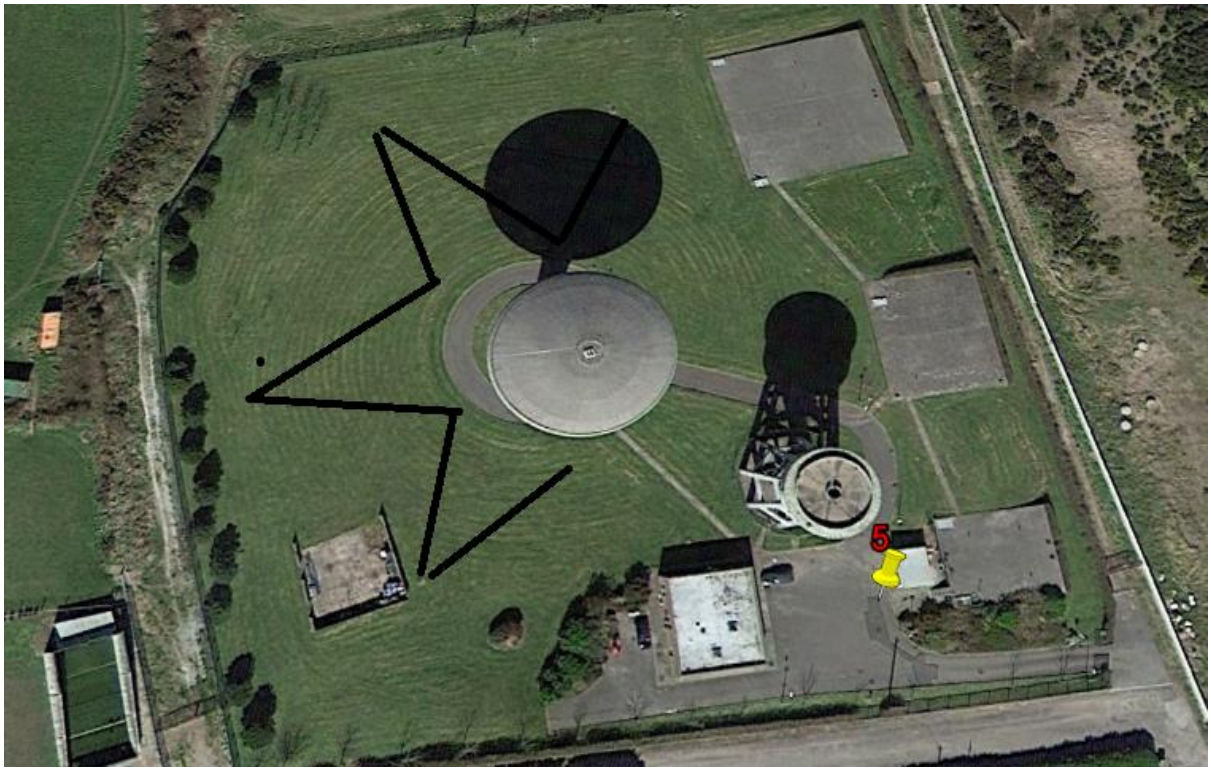
Beach 2A: Each leg is 25m with 5m sample intervals – Sampled Monday, 19th January 2015



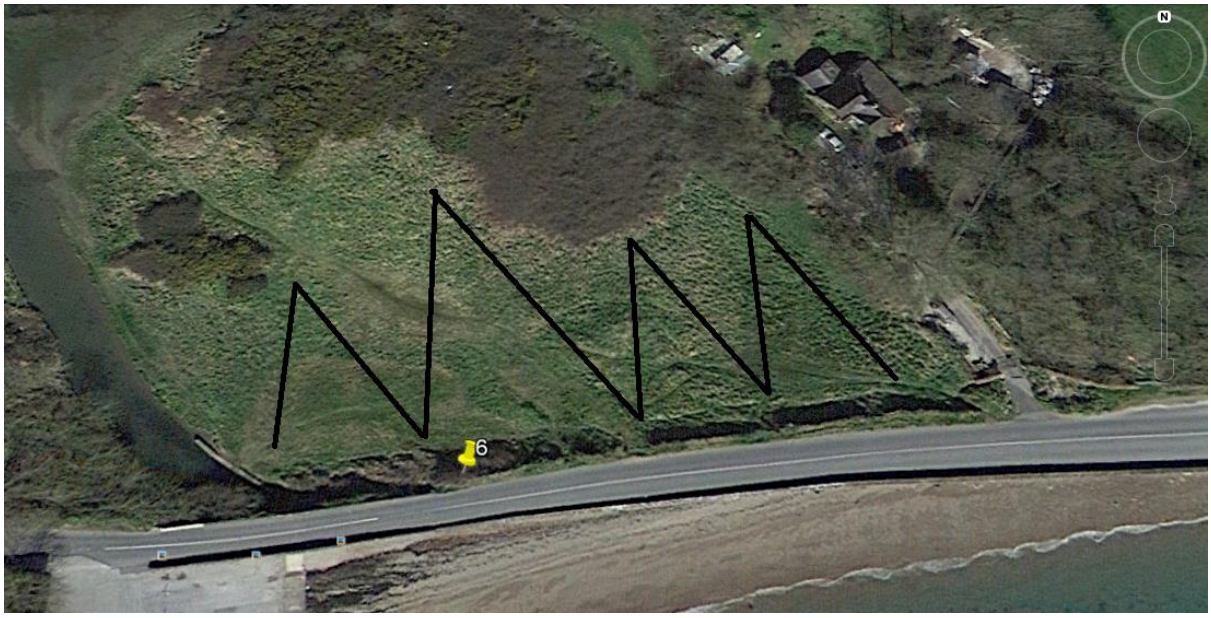
Beach 3A: Each leg is 25m with 5m sample intervals – Sampled Wednesday, 21st January 2015



Beach 4A: Each leg is 25m with 5m sample intervals – Sampled Tuesday, 20th January 2015



Location 5A: Each leg is 25m with 5m sample intervals – Sampled Friday, 16th January 2015



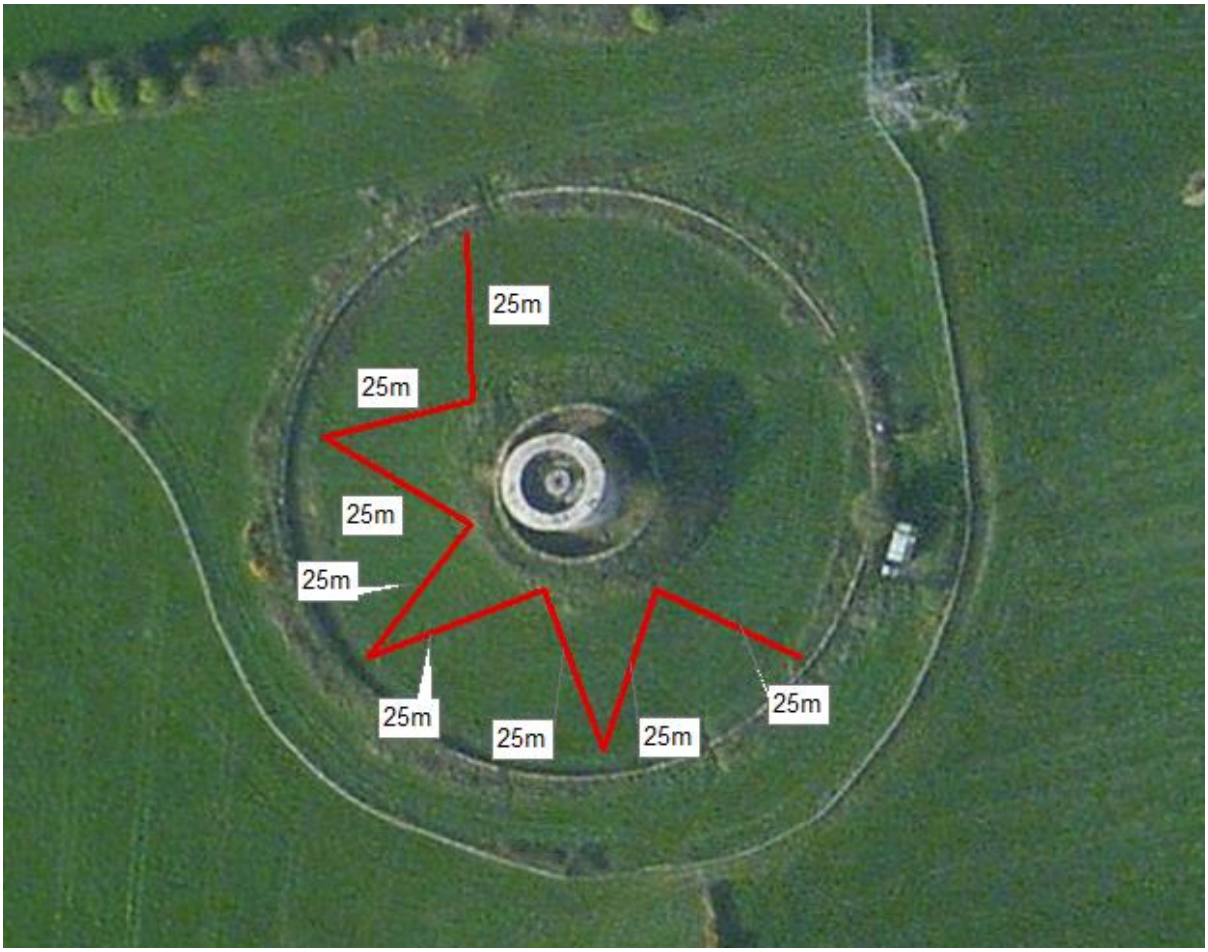
Location 6A: Each leg is 25m with 5m sample intervals – Sampled Tuesday, 20th January 2015



Location 7A: Each leg is 25m with 5m sample intervals – Sampled Tuesday, 20th January 2015



Location 1A: Each leg is 25m with 5m sample intervals – Sampled Wednesday, 21st January 2015



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



Location 2A: Each leg is 25m with 5m sample intervals – Sampled Thursday, 15th January 2015



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



Location 8A: Each leg is 25m with 10m sample intervals – Sampled Monday 19th January 2015

APPENDIX B – Photographs from Sampling Locations (January 2015)



Beach 1A: Sampled 20th January 2015



Beach 2A: Sampled 19th January 2015



Beach 3A: Sampled 21st January 2015



Beach 4A: Sampled 21st January 2015



Location 5A: Sampled 16th January 2015



Location 6A: Sampled 20th January 2015



Location 7A: Sampled 20th January 2015



Location 1A: Sampled 21st January 2015



Location 4A: Sampled 15th January 2015



Location 2A: Sampled 15th January 2015



Location 3A: Sampled 16th January 2015



Location 8A: Sampled 19th January 2015

APPENDIX C – SAL Report Ref. 450877-1 (February 2015)

Hadfield House
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Scientific Analysis Laboratories Ltd

Certificate of Analysis

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

Report Number: 450877-1

Date of Report: 05-Feb-2015

Customer: AWN Consultants
Tecpro Building
Clonshaugh Industrial Estate
Dublin 17

Customer Contact: Ms Elaine Neary

Customer Job Reference: 8905
Customer Purchase Order: N/A
Date Job Received at SAL: 23-Jan-2015
Date Analysis Started: 26-Jan-2015
Date Analysis Completed: 05-Feb-2015

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with QP22

1549

Report checked and authorised by :
Emma Spear
Project Management

Issued by :
Natasha Wild
Project Manager

Summary Of Results

Soil

Dioxins and Dioxin-like PCBs

				WHO2005 Toxic Equivalents ng/kg	
SAL Reference	**Customer Sample Reference**	**Analysis**	**Symbol**	**Lower Bound**	**Upper Bound**
450877 001	BEACH 1A	Dioxins and Furans (Based on US EPA 1613)	U	0.48	**0.55**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0064	**0.12**
			Sum :	0.48	**0.68**
450877 003	BEACH 2A	Dioxins and Furans (Based on US EPA 1613)	U	0.014	**0.24**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0031	**0.48**
			Sum :	0.017	**0.72**
450877 005	BEACH 3A	Dioxins and Furans (Based on US EPA 1613)	U	0.26	**0.38**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0046	**0.47**
			Sum :	0.27	**0.85**
450877 007	BEACH 4A	Dioxins and Furans (Based on US EPA 1613)	U	0.21	**0.33**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0042	**0.10**
			Sum :	0.21	**0.43**
450877 009	LOCATION 1A	Dioxins and Furans (Based on US EPA 1613)	U	0.022	**0.27**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0024	**0.078**
			Sum :	0.024	**0.35**
450877 011	LOCATION 2A	Dioxins and Furans (Based on US EPA 1613)	U	0.041	**0.36**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0057	**0.30**
			Sum :	0.046	**0.66**
450877 013	LOCATION 3A	Dioxins and Furans (Based on US EPA 1613)	U	0.68	**0.75**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.11	**0.13**
			Sum :	0.80	**0.88**
450877 015	LOCATION 4A	Dioxins and Furans (Based on US EPA 1613)	U	0.31	**0.48**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0030	**0.14**
			Sum :	0.31	**0.62**
450877 017	LOCATION 5A	Dioxins and Furans (Based on US EPA 1613)	U	0.35	**0.51**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0030	**0.35**
			Sum :	0.35	**0.85**
450877 019	LOCATION 6A	Dioxins and Furans (Based on US EPA 1613)	U	0.17	**0.34**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0039	**0.37**
			Sum :	0.18	**0.71**
450877 021	LOCATION 7A	Dioxins and Furans (Based on US EPA 1613)	U	0.75	**0.83**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0037	**0.35**
			Sum :	0.76	**1.2**
450877 023	LOCATION 8A	Dioxins and Furans (Based on US EPA 1613)	U	0.29	**0.40**
		Poly-Chlorinated Biphenyls (WHO 12)	U	0.0035	**0.10**
			Sum :	0.30	**0.50**

Soil

Customer Sample Reference : BEACH 1A
SAL Sample Reference : 450877 001
Date Sampled : 20-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.053	<0.053	0.0	**0.053**
1,2,3,7,8-PeCDD	U	0.10	**0.11**	0.11	**0.11**
1,2,3,4,7,8-HxCDD	U	0.15	**0.17**	0.017	**0.017**
1,2,3,6,7,8-HxCDD	U	0.21	**0.36**	0.036	**0.036**
1,2,3,7,8,9-HxCDD	U	0.21	**0.25**	0.025	**0.025**
1,2,3,4,6,7,8-HpCDD	U	0.36	**4.4**	0.044	**0.044**
OCDD	U	0.81	**35**	0.011	**0.011**
			Dioxins Totals :	0.24	**0.30**
2,3,7,8-TCDF	U	0.21	**0.49**	0.049	**0.049**
1,2,3,7,8-PeCDF	U	0.19	**0.24**	0.0072	**0.0072**
2,3,4,7,8-PeCDF	U	0.21	**0.25**	0.075	**0.075**
1,2,3,4,7,8-HxCDF	U	0.20	**0.32**	0.032	**0.032**
1,2,3,6,7,8-HxCDF	U	0.21	**0.21**	0.021	**0.021**
2,3,4,6,7,8-HxCDF	U	0.21	**0.30**	0.030	**0.030**
1,2,3,7,8,9-HxCDF	U	0.19	<0.19	0.0	**0.019**
1,2,3,4,6,7,8-HpCDF	U	0.46	**2.1**	0.021	**0.021**
1,2,3,4,7,8,9-HpCDF	U	0.44	<0.44	0.0	**0.0044**
OCDF	U	0.69	**2.1**	0.00063	**0.00063**
			Furans Totals :	0.24	**0.26**
			Totals :	**0.48**	**0.55**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	0.9000	<0.9	0.0	**0.00027**
PCB BZ#77	U	2.400	**15.0**	0.0015	**0.0015**
PCB BZ#105	U	3.600	**40.0**	0.0012	**0.0012**
PCB BZ#114	U	2.400	<2.4	0.0	**0.00007**
PCB BZ#118	U	4.800	**91.0**	0.0027	**0.0027**
PCB BZ#123	U	7.300	<7.3	0.0	**0.00022**
PCB BZ#126	U	1.000	<1.0	0.0	**0.10**
PCB BZ#156	U	3.100	**12.0**	0.00036	**0.00036**
PCB BZ#157	U	2.800	**3.2**	0.00010	**0.00010**
PCB BZ#167	U	2.700	**16.0**	0.00048	**0.00048**
PCB BZ#169	U	0.5000	<0.5	0.0	**0.015**
PCB BZ#189	U	2.900	<2.9	0.0	**0.00009**
			Totals :	**0.0064**	**0.12**

Soil

Customer Sample Reference : BEACH 2A
SAL Sample Reference : 450877 003
Date Sampled : 19-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.055	<0.055	0.0	**0.055**
1,2,3,7,8-PeCDD	U	0.064	<0.064	0.0	**0.064**
1,2,3,4,7,8-HxCDD	U	0.067	<0.067	0.0	**0.0067**
1,2,3,6,7,8-HxCDD	U	0.070	<0.070	0.0	**0.0070**
1,2,3,7,8,9-HxCDD	U	0.070	<0.070	0.0	**0.0070**
1,2,3,4,6,7,8-HpCDD	U	0.34	**1.0**	0.010	**0.010**
OCDD	U	0.76	**13**	0.0039	**0.0039**
			Dioxins Totals :	0.014	**0.15**
2,3,7,8-TCDF	U	0.24	<0.24	0.0	**0.024**
1,2,3,7,8-PeCDF	U	0.097	<0.097	0.0	**0.0029**
2,3,4,7,8-PeCDF	U	0.097	<0.097	0.0	**0.029**
1,2,3,4,7,8-HxCDF	U	0.065	<0.065	0.0	**0.0065**
1,2,3,6,7,8-HxCDF	U	0.056	<0.056	0.0	**0.0056**
2,3,4,6,7,8-HxCDF	U	0.093	<0.093	0.0	**0.0093**
1,2,3,7,8,9-HxCDF	U	0.050	<0.050	0.0	**0.0050**
1,2,3,4,6,7,8-HpCDF	U	0.42	<0.42	0.0	**0.0042**
1,2,3,4,7,8,9-HpCDF	U	0.060	<0.060	0.0	**0.00060**
OCDF	U	0.62	<0.62	0.0	**0.00019**
			Furans Totals :	0.0	**0.087**
			Totals :	**0.014**	**0.24**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	4.300	<4.3	0.0	**0.0013**
PCB BZ#77	U	6.000	**10.0**	0.0010	**0.0010**
PCB BZ#105	U	3.600	**22.0**	0.00066	**0.00066**
PCB BZ#114	U	2.900	<2.9	0.0	**0.00009**
PCB BZ#118	U	5.100	**42.0**	0.0013	**0.0013**
PCB BZ#123	U	4.400	<4.4	0.0	**0.00013**
PCB BZ#126	U	3.300	<3.3	0.0	**0.33**
PCB BZ#156	U	3.200	**4.7**	0.00014	**0.00014**
PCB BZ#157	U	3.200	<3.2	0.0	**0.00010**
PCB BZ#167	U	2.800	<2.8	0.0	**0.00008**
PCB BZ#169	U	4.900	<4.9	0.0	**0.15**
PCB BZ#189	U	2.500	<2.5	0.0	**0.00007**
			Totals :	**0.0031**	**0.48**

Soil

Customer Sample Reference : BEACH 3A
SAL Sample Reference : 450877 005
Date Sampled : 21-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.049	<0.049	0.0	**0.049**
1,2,3,7,8-PeCDD	U	0.061	<0.061	0.0	**0.061**
1,2,3,4,7,8-HxCDD	U	0.093	**0.10**	0.010	**0.010**
1,2,3,6,7,8-HxCDD	U	0.099	**0.19**	0.019	**0.019**
1,2,3,7,8,9-HxCDD	U	0.098	**0.18**	0.018	**0.018**
1,2,3,4,6,7,8-HpCDD	U	0.33	**3.1**	0.031	**0.031**
OCDD	U	0.74	**28**	0.0084	**0.0084**
			Dioxins Totals :	0.086	**0.20**
2,3,7,8-TCDF	U	0.18	**0.41**	0.041	**0.041**
1,2,3,7,8-PeCDF	U	0.13	**0.14**	0.0042	**0.0042**
2,3,4,7,8-PeCDF	U	0.15	**0.19**	0.057	**0.057**
1,2,3,4,7,8-HxCDF	U	0.17	**0.24**	0.024	**0.024**
1,2,3,6,7,8-HxCDF	U	0.15	**0.18**	0.018	**0.018**
2,3,4,6,7,8-HxCDF	U	0.15	**0.19**	0.019	**0.019**
1,2,3,7,8,9-HxCDF	U	0.050	<0.050	0.0	**0.0050**
1,2,3,4,6,7,8-HpCDF	U	0.43	**1.4**	0.014	**0.014**
1,2,3,4,7,8,9-HpCDF	U	0.10	<0.10	0.0	**0.0010**
OCDF	U	0.62	**1.7**	0.00051	**0.00051**
			Furans Totals :	0.18	**0.18**
			Totals :	**0.26**	**0.38**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	1.800	<1.8	0.0	**0.00054**
PCB BZ#77	U	4.700	**12.0**	0.0012	**0.0012**
PCB BZ#105	U	3.400	**31.0**	0.00093	**0.00093**
PCB BZ#114	U	2.400	<2.4	0.0	**0.00007**
PCB BZ#118	U	4.900	**73.0**	0.0022	**0.0022**
PCB BZ#123	U	8.400	<8.4	0.0	**0.00025**
PCB BZ#126	U	3.300	<3.3	0.0	**0.33**
PCB BZ#156	U	3.400	**9.5**	0.00028	**0.00028**
PCB BZ#157	U	2.600	<2.6	0.0	**0.00008**
PCB BZ#167	U	5.100	<5.1	0.0	**0.00015**
PCB BZ#169	U	4.500	<4.5	0.0	**0.13**
PCB BZ#189	U	2.500	<2.5	0.0	**0.00007**
			Totals :	**0.0046**	**0.47**

Soil

Customer Sample Reference : BEACH 4A
SAL Sample Reference : 450877 007
Date Sampled : 20-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.045	<0.045	0.0	**0.045**
1,2,3,7,8-PeCDD	U	0.057	<0.057	0.0	**0.057**
1,2,3,4,7,8-HxCDD	U	0.093	<0.093	0.0	**0.0093**
1,2,3,6,7,8-HxCDD	U	0.12	**0.21**	0.021	**0.021**
1,2,3,7,8,9-HxCDD	U	0.11	**0.14**	0.014	**0.014**
1,2,3,4,6,7,8-HpCDD	U	0.37	**2.1**	0.021	**0.021**
OCDD	U	0.79	**16**	0.0048	**0.0048**
			Dioxins Totals :	0.061	**0.17**
2,3,7,8-TCDF	U	0.20	**0.43**	0.043	**0.043**
1,2,3,7,8-PeCDF	U	0.11	**0.13**	0.0039	**0.0039**
2,3,4,7,8-PeCDF	U	0.12	**0.15**	0.045	**0.045**
1,2,3,4,7,8-HxCDF	U	0.11	**0.15**	0.015	**0.015**
1,2,3,6,7,8-HxCDF	U	0.11	**0.13**	0.013	**0.013**
2,3,4,6,7,8-HxCDF	U	0.13	**0.19**	0.019	**0.019**
1,2,3,7,8,9-HxCDF	U	0.068	<0.068	0.0	**0.0068**
1,2,3,4,6,7,8-HpCDF	U	0.48	**1.0**	0.010	**0.010**
1,2,3,4,7,8,9-HpCDF	U	0.10	<0.10	0.0	**0.0010**
OCDF	U	0.68	**0.99**	0.00030	**0.00030**
			Furans Totals :	0.15	**0.16**
			Totals :	**0.21**	**0.33**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	0.6000	<0.6	0.0	**0.00018**
PCB BZ#77	U	3.100	**12.0**	0.0012	**0.0012**
PCB BZ#105	U	3.700	**28.0**	0.00084	**0.00084**
PCB BZ#114	U	1.900	<1.9	0.0	**0.00006**
PCB BZ#118	U	5.300	**63.0**	0.0019	**0.0019**
PCB BZ#123	U	5.600	<5.6	0.0	**0.00017**
PCB BZ#126	U	0.8000	<0.8	0.0	**0.080**
PCB BZ#156	U	3.400	**9.1**	0.00027	**0.00027**
PCB BZ#157	U	3.000	<3.0	0.0	**0.00009**
PCB BZ#167	U	3.900	<3.9	0.0	**0.00012**
PCB BZ#169	U	0.5000	<0.5	0.0	**0.015**
PCB BZ#189	U	3.400	<3.4	0.0	**0.00010**
			Totals :	**0.0042**	**0.10**

Soil

Customer Sample Reference : LOCATION 1A
SAL Sample Reference : 450877 009
Date Sampled : 21-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.050	<0.050	0.0	**0.050**
1,2,3,7,8-PeCDD	U	0.057	<0.057	0.0	**0.057**
1,2,3,4,7,8-HxCDD	U	0.071	<0.071	0.0	**0.0071**
1,2,3,6,7,8-HxCDD	U	0.14	<0.14	0.0	**0.014**
1,2,3,7,8,9-HxCDD	U	0.083	<0.083	0.0	**0.0083**
1,2,3,4,6,7,8-HpCDD	U	0.32	**1.7**	0.017	**0.017**
OCDD	U	0.65	**16**	0.0048	**0.0048**
			Dioxins Totals :	0.022	**0.16**
2,3,7,8-TCDF	U	0.28	<0.28	0.0	**0.028**
1,2,3,7,8-PeCDF	U	0.12	<0.12	0.0	**0.0036**
2,3,4,7,8-PeCDF	U	0.10	<0.10	0.0	**0.030**
1,2,3,4,7,8-HxCDF	U	0.14	<0.14	0.0	**0.014**
1,2,3,6,7,8-HxCDF	U	0.13	<0.13	0.0	**0.013**
2,3,4,6,7,8-HxCDF	U	0.14	<0.14	0.0	**0.014**
1,2,3,7,8,9-HxCDF	U	0.050	<0.050	0.0	**0.0050**
1,2,3,4,6,7,8-HpCDF	U	0.60	<0.60	0.0	**0.0060**
1,2,3,4,7,8,9-HpCDF	U	0.057	<0.057	0.0	**0.00057**
OCDF	U	0.63	<0.63	0.0	**0.00019**
			Furans Totals :	0.0	**0.11**
			Totals :	**0.022**	**0.27**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	0.5000	<0.5	0.0	**0.00015**
PCB BZ#77	U	2.800	**8.7**	0.00087	**0.00087**
PCB BZ#105	U	4.400	**16.0**	0.00048	**0.00048**
PCB BZ#114	U	2.900	<2.9	0.0	**0.00009**
PCB BZ#118	U	6.100	**32.0**	0.00096	**0.00096**
PCB BZ#123	U	4.400	<4.4	0.0	**0.00013**
PCB BZ#126	U	0.6000	<0.6	0.0	**0.060**
PCB BZ#156	U	3.400	**4.0**	0.00012	**0.00012**
PCB BZ#157	U	3.000	<3.0	0.0	**0.00009**
PCB BZ#167	U	2.600	<2.6	0.0	**0.00008**
PCB BZ#169	U	0.5000	<0.5	0.0	**0.015**
PCB BZ#189	U	2.400	<2.4	0.0	**0.00007**
			Totals :	**0.0024**	**0.078**

Soil

Customer Sample Reference : LOCATION 2A
SAL Sample Reference : 450877 011
Date Sampled : 15-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.041	<0.041	0.0	**0.041**
1,2,3,7,8-PeCDD	U	0.063	<0.063	0.0	**0.063**
1,2,3,4,7,8-HxCDD	U	0.14	<0.14	0.0	**0.014**
1,2,3,6,7,8-HxCDD	U	0.20	<0.20	0.0	**0.020**
1,2,3,7,8,9-HxCDD	U	0.16	<0.16	0.0	**0.016**
1,2,3,4,6,7,8-HpCDD	U	0.39	**2.5**	0.025	**0.025**
OCDD	U	0.80	**15**	0.0045	**0.0045**
			Dioxins Totals :	0.029	**0.18**
2,3,7,8-TCDF	U	0.31	<0.31	0.0	**0.031**
1,2,3,7,8-PeCDF	U	0.12	<0.12	0.0	**0.0036**
2,3,4,7,8-PeCDF	U	0.13	<0.13	0.0	**0.039**
1,2,3,4,7,8-HxCDF	U	0.20	<0.20	0.0	**0.020**
1,2,3,6,7,8-HxCDF	U	0.20	<0.20	0.0	**0.020**
2,3,4,6,7,8-HxCDF	U	0.26	<0.26	0.0	**0.026**
1,2,3,7,8,9-HxCDF	U	0.20	<0.20	0.0	**0.020**
1,2,3,4,6,7,8-HpCDF	U	0.50	**1.1**	0.011	**0.011**
1,2,3,4,7,8,9-HpCDF	U	0.10	<0.10	0.0	**0.0010**
OCDF	U	0.68	**0.79**	0.00024	**0.00024**
			Furans Totals :	0.011	**0.17**
			Totals :	**0.041**	**0.36**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	2.400	<2.4	0.0	**0.00072**
PCB BZ#77	U	4.000	**14.0**	0.0014	**0.0014**
PCB BZ#105	U	3.500	**48.0**	0.0014	**0.0014**
PCB BZ#114	U	2.500	<2.5	0.0	**0.00007**
PCB BZ#118	U	4.800	**78.0**	0.0023	**0.0023**
PCB BZ#123	U	6.500	<6.5	0.0	**0.00019**
PCB BZ#126	U	2.100	<2.1	0.0	**0.21**
PCB BZ#156	U	3.300	**16.0**	0.00048	**0.00048**
PCB BZ#157	U	3.700	<3.7	0.0	**0.00011**
PCB BZ#167	U	8.900	<8.9	0.0	**0.00027**
PCB BZ#169	U	2.800	<2.8	0.0	**0.084**
PCB BZ#189	U	3.200	<3.2	0.0	**0.00010**
			Totals :	**0.0057**	**0.30**

Soil

Customer Sample Reference : LOCATION 3A
SAL Sample Reference : 450877 013
Date Sampled : 16-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.059	<0.059	0.0	**0.059**
1,2,3,7,8-PeCDD	U	0.098	**0.14**	0.14	**0.14**
1,2,3,4,7,8-HxCDD	U	0.10	**0.12**	0.012	**0.012**
1,2,3,6,7,8-HxCDD	U	0.11	**0.35**	0.035	**0.035**
1,2,3,7,8,9-HxCDD	U	0.11	**0.22**	0.022	**0.022**
1,2,3,4,6,7,8-HpCDD	U	0.35	**2.2**	0.022	**0.022**
OCDD	U	0.78	**15**	0.0045	**0.0045**
			Dioxins Totals :	0.24	**0.29**
2,3,7,8-TCDF	U	0.21	**0.64**	0.064	**0.064**
1,2,3,7,8-PeCDF	U	0.20	**0.47**	0.014	**0.014**
2,3,4,7,8-PeCDF	U	0.22	**0.58**	0.17	**0.17**
1,2,3,4,7,8-HxCDF	U	0.18	**0.68**	0.068	**0.068**
1,2,3,6,7,8-HxCDF	U	0.18	**0.49**	0.049	**0.049**
2,3,4,6,7,8-HxCDF	U	0.19	**0.55**	0.055	**0.055**
1,2,3,7,8,9-HxCDF	U	0.10	<0.10	0.0	**0.010**
1,2,3,4,6,7,8-HpCDF	U	0.45	**2.2**	0.022	**0.022**
1,2,3,4,7,8,9-HpCDF	U	0.20	<0.20	0.0	**0.0020**
OCDF	U	0.65	**1.4**	0.00042	**0.00042**
			Furans Totals :	0.45	**0.46**
			Totals :	**0.68**	**0.75**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	0.8000	<0.8	0.0	**0.00024**
PCB BZ#77	U	2.400	**9.5**	0.00095	**0.00095**
PCB BZ#105	U	4.600	**26.0**	0.00078	**0.00078**
PCB BZ#114	U	3.300	<3.3	0.0	**0.00010**
PCB BZ#118	U	6.600	**49.0**	0.0015	**0.0015**
PCB BZ#123	U	6.200	<6.2	0.0	**0.00019**
PCB BZ#126	U	1.000	**1.1**	0.11	**0.11**
PCB BZ#156	U	3.500	**8.5**	0.00025	**0.00025**
PCB BZ#157	U	3.500	<3.5	0.0	**0.00010**
PCB BZ#167	U	4.500	<4.5	0.0	**0.00013**
PCB BZ#169	U	0.5000	<0.5	0.0	**0.015**
PCB BZ#189	U	3.600	<3.6	0.0	**0.00011**
			Totals :	**0.11**	**0.13**

Soil

Customer Sample Reference : LOCATION 4A
SAL Sample Reference : 450877 015
Date Sampled : 15-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.061	<0.061	0.0	**0.061**
1,2,3,7,8-PeCDD	U	0.085	<0.085	0.0	**0.085**
1,2,3,4,7,8-HxCDD	U	0.094	<0.094	0.0	**0.0094**
1,2,3,6,7,8-HxCDD	U	0.11	**0.20**	0.020	**0.020**
1,2,3,7,8,9-HxCDD	U	0.10	**0.13**	0.013	**0.013**
1,2,3,4,6,7,8-HpCDD	U	0.37	**2.2**	0.022	**0.022**
OCDD	U	0.78	**17**	0.0051	**0.0051**
			Dioxins Totals :	0.060	**0.22**
2,3,7,8-TCDF	U	0.21	**0.33**	0.033	**0.033**
1,2,3,7,8-PeCDF	U	0.18	**0.24**	0.0072	**0.0072**
2,3,4,7,8-PeCDF	U	0.18	**0.24**	0.072	**0.072**
1,2,3,4,7,8-HxCDF	U	0.19	**0.39**	0.039	**0.039**
1,2,3,6,7,8-HxCDF	U	0.20	**0.31**	0.031	**0.031**
2,3,4,6,7,8-HxCDF	U	0.17	**0.42**	0.042	**0.042**
1,2,3,7,8,9-HxCDF	U	0.13	<0.13	0.0	**0.013**
1,2,3,4,6,7,8-HpCDF	U	0.43	**2.2**	0.022	**0.022**
1,2,3,4,7,8,9-HpCDF	U	0.24	<0.24	0.0	**0.0024**
OCDF	U	0.65	**1.9**	0.00057	**0.00057**
			Furans Totals :	0.25	**0.26**
			Totals :	**0.31**	**0.48**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	1.400	<1.4	0.0	**0.00042**
PCB BZ#77	U	2.000	**10.0**	0.0010	**0.0010**
PCB BZ#105	U	4.500	**21.0**	0.00063	**0.00063**
PCB BZ#114	U	2.200	<2.2	0.0	**0.00007**
PCB BZ#118	U	5.800	**38.0**	0.0011	**0.0011**
PCB BZ#123	U	5.700	<5.7	0.0	**0.00017**
PCB BZ#126	U	1.200	<1.2	0.0	**0.12**
PCB BZ#156	U	2.900	**5.7**	0.00017	**0.00017**
PCB BZ#157	U	2.900	<2.9	0.0	**0.00009**
PCB BZ#167	U	2.600	**3.0**	0.00009	**0.00009**
PCB BZ#169	U	0.5000	<0.5	0.0	**0.015**
PCB BZ#189	U	2.900	<2.9	0.0	**0.00009**
			Totals :	**0.0030**	**0.14**

Soil

Customer Sample Reference : LOCATION 5A
SAL Sample Reference : 450877 017
Date Sampled : 16-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.058	<0.058	0.0	**0.058**
1,2,3,7,8-PeCDD	U	0.091	<0.091	0.0	**0.091**
1,2,3,4,7,8-HxCDD	U	0.11	**0.12**	0.012	**0.012**
1,2,3,6,7,8-HxCDD	U	0.13	**0.26**	0.026	**0.026**
1,2,3,7,8,9-HxCDD	U	0.13	**0.19**	0.019	**0.019**
1,2,3,4,6,7,8-HpCDD	U	0.30	**2.1**	0.021	**0.021**
OCDD	U	0.67	**8.8**	0.0026	**0.0026**
			Dioxins Totals :	0.081	**0.23**
2,3,7,8-TCDF	U	0.19	**0.48**	0.048	**0.048**
1,2,3,7,8-PeCDF	U	0.14	**0.26**	0.0078	**0.0078**
2,3,4,7,8-PeCDF	U	0.17	**0.27**	0.081	**0.081**
1,2,3,4,7,8-HxCDF	U	0.17	**0.40**	0.040	**0.040**
1,2,3,6,7,8-HxCDF	U	0.18	**0.31**	0.031	**0.031**
2,3,4,6,7,8-HxCDF	U	0.17	**0.36**	0.036	**0.036**
1,2,3,7,8,9-HxCDF	U	0.091	<0.091	0.0	**0.0091**
1,2,3,4,6,7,8-HpCDF	U	0.38	**2.1**	0.021	**0.021**
1,2,3,4,7,8,9-HpCDF	U	0.22	<0.22	0.0	**0.0022**
OCDF	U	0.54	**1.9**	0.00057	**0.00057**
			Furans Totals :	0.27	**0.28**
			Totals :	**0.35**	**0.51**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	3.200	<3.2	0.0	**0.00096**
PCB BZ#77	U	3.700	**7.9**	0.00079	**0.00079**
PCB BZ#105	U	3.400	**19.0**	0.00057	**0.00057**
PCB BZ#114	U	2.400	<2.4	0.0	**0.00007**
PCB BZ#118	U	5.000	**38.0**	0.0011	**0.0011**
PCB BZ#123	U	6.300	<6.3	0.0	**0.00019**
PCB BZ#126	U	2.500	<2.5	0.0	**0.25**
PCB BZ#156	U	3.200	**10.0**	0.00030	**0.00030**
PCB BZ#157	U	3.100	<3.1	0.0	**0.00009**
PCB BZ#167	U	3.000	**5.2**	0.00016	**0.00016**
PCB BZ#169	U	3.100	<3.1	0.0	**0.093**
PCB BZ#189	U	4.100	<4.1	0.0	**0.00012**
			Totals :	**0.0030**	**0.35**

Soil

Customer Sample Reference : LOCATION 6A
SAL Sample Reference : 450877 019
Date Sampled : 20-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.043	<0.043	0.0	**0.043**
1,2,3,7,8-PeCDD	U	0.062	<0.062	0.0	**0.062**
1,2,3,4,7,8-HxCDD	U	0.12	<0.12	0.0	**0.012**
1,2,3,6,7,8-HxCDD	U	0.15	<0.15	0.0	**0.015**
1,2,3,7,8,9-HxCDD	U	0.13	<0.13	0.0	**0.013**
1,2,3,4,6,7,8-HpCDD	U	0.33	**1.1**	0.011	**0.011**
OCDD	U	0.69	**5.8**	0.0017	**0.0017**
			Dioxins Totals :	0.013	**0.16**
2,3,7,8-TCDF	U	0.19	**0.39**	0.039	**0.039**
1,2,3,7,8-PeCDF	U	0.16	**0.18**	0.0054	**0.0054**
2,3,4,7,8-PeCDF	U	0.16	**0.18**	0.054	**0.054**
1,2,3,4,7,8-HxCDF	U	0.18	**0.21**	0.021	**0.021**
1,2,3,6,7,8-HxCDF	U	0.15	**0.15**	0.015	**0.015**
2,3,4,6,7,8-HxCDF	U	0.19	**0.19**	0.019	**0.019**
1,2,3,7,8,9-HxCDF	U	0.15	<0.15	0.0	**0.015**
1,2,3,4,6,7,8-HpCDF	U	0.40	**0.84**	0.0084	**0.0084**
1,2,3,4,7,8,9-HpCDF	U	0.10	<0.10	0.0	**0.0010**
OCDF	U	0.60	**0.65**	0.00020	**0.00020**
			Furans Totals :	0.16	**0.18**
			Totals :	**0.17**	**0.34**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

Determinand	Symbol	LOD ng/kg	Result ng/kg	WHO2005 Toxic Equivalents ng/kg	
				Lower Bound	Upper Bound
PCB BZ#81	U	1.900	<1.9	0.0	**0.00057**
PCB BZ#77	U	3.900	**9.9**	0.00099	**0.00099**
PCB BZ#105	U	3.600	**29.0**	0.00087	**0.00087**
PCB BZ#114	U	2.700	<2.7	0.0	**0.00008**
PCB BZ#118	U	5.300	**60.0**	0.0018	**0.0018**
PCB BZ#123	U	5.600	<5.6	0.0	**0.00017**
PCB BZ#126	U	2.800	<2.8	0.0	**0.28**
PCB BZ#156	U	3.200	**6.8**	0.00020	**0.00020**
PCB BZ#157	U	3.100	<3.1	0.0	**0.00009**
PCB BZ#167	U	3.900	<3.9	0.0	**0.00012**
PCB BZ#169	U	2.900	<2.9	0.0	**0.087**
PCB BZ#189	U	3.200	<3.2	0.0	**0.00010**
			Totals :	**0.0039**	**0.37**

Soil

Customer Sample Reference : LOCATION 7A
SAL Sample Reference : 450877 021
Date Sampled : 20-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

				WHO2005 Toxic Equivalents ng/kg	
Determinand	**Symbol**	**LOD ng/kg**	**Result ng/kg**	**Lower Bound**	**Upper Bound**
2,3,7,8-TCDD	U	0.069	<0.069	0.0	**0.069**
1,2,3,7,8-PeCDD	U	0.15	**0.17**	0.17	**0.17**
1,2,3,4,7,8-HxCDD	U	0.18	**0.23**	0.023	**0.023**
1,2,3,6,7,8-HxCDD	U	0.18	**0.70**	0.070	**0.070**
1,2,3,7,8,9-HxCDD	U	0.18	**0.58**	0.058	**0.058**
1,2,3,4,6,7,8-HpCDD	U	0.28	**7.5**	0.075	**0.075**
OCDD	U	0.53	**86**	0.026	**0.026**
			Dioxins Totals :	0.42	**0.49**
2,3,7,8-TCDF	U	0.18	**0.61**	0.061	**0.061**
1,2,3,7,8-PeCDF	U	0.16	**0.33**	0.0099	**0.0099**
2,3,4,7,8-PeCDF	U	0.17	**0.33**	0.099	**0.099**
1,2,3,4,7,8-HxCDF	U	0.18	**0.48**	0.048	**0.048**
1,2,3,6,7,8-HxCDF	U	0.19	**0.37**	0.037	**0.037**
2,3,4,6,7,8-HxCDF	U	0.18	**0.46**	0.046	**0.046**
1,2,3,7,8,9-HxCDF	U	0.10	<0.10	0.0	**0.010**
1,2,3,4,6,7,8-HpCDF	U	0.38	**2.9**	0.029	**0.029**
1,2,3,4,7,8,9-HpCDF	U	0.26	<0.26	0.0	**0.0026**
OCDF	U	0.46	**2.7**	0.00081	**0.00081**
			Furans Totals :	0.33	**0.34**
			Totals :	**0.75**	**0.83**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

				WHO2005 Toxic Equivalents ng/kg	
Determinand	**Symbol**	**LOD ng/kg**	**Result ng/kg**	**Lower Bound**	**Upper Bound**
PCB BZ#81	U	3.300	<3.3	0.0	**0.00099**
PCB BZ#77	U	3.600	**12.0**	0.0012	**0.0012**
PCB BZ#105	U	3.600	**27.0**	0.00081	**0.00081**
PCB BZ#114	U	2.600	<2.6	0.0	**0.00008**
PCB BZ#118	U	5.000	**41.0**	0.0012	**0.0012**
PCB BZ#123	U	6.200	<6.2	0.0	**0.00019**
PCB BZ#126	U	2.500	<2.5	0.0	**0.25**
PCB BZ#156	U	4.100	**8.9**	0.00027	**0.00027**
PCB BZ#157	U	3.400	<3.4	0.0	**0.00010**
PCB BZ#167	U	3.100	**5.0**	0.00015	**0.00015**
PCB BZ#169	U	3.100	<3.1	0.0	**0.093**
PCB BZ#189	U	3.500	<3.5	0.0	**0.00010**
			Totals :	**0.0037**	**0.35**

Soil

Customer Sample Reference : LOCATION 8A
SAL Sample Reference : 450877 023
Date Sampled : 19-JAN-2015

Dioxins and Furans (Based on US EPA 1613)

Technique : GC/MS (HR)

				WHO2005 Toxic Equivalents ng/kg	
Determinand	**Symbol**	**LOD ng/kg**	**Result ng/kg**	**Lower Bound**	**Upper Bound**
2,3,7,8-TCDD	U	0.040	<0.040	0.0	**0.040**
1,2,3,7,8-PeCDD	U	0.055	<0.055	0.0	**0.055**
1,2,3,4,7,8-HxCDD	U	0.084	**0.13**	0.013	**0.013**
1,2,3,6,7,8-HxCDD	U	0.099	**0.34**	0.034	**0.034**
1,2,3,7,8,9-HxCDD	U	0.093	**0.29**	0.029	**0.029**
1,2,3,4,6,7,8-HpCDD	U	0.34	**1.9**	0.019	**0.019**
OCDD	U	0.67	**11**	0.0033	**0.0033**
			Dioxins Totals :	0.098	**0.19**
2,3,7,8-TCDF	U	0.19	**0.37**	0.037	**0.037**
1,2,3,7,8-PeCDF	U	0.16	**0.19**	0.0057	**0.0057**
2,3,4,7,8-PeCDF	U	0.15	**0.20**	0.060	**0.060**
1,2,3,4,7,8-HxCDF	U	0.18	**0.28**	0.028	**0.028**
1,2,3,6,7,8-HxCDF	U	0.20	**0.24**	0.024	**0.024**
2,3,4,6,7,8-HxCDF	U	0.19	**0.26**	0.026	**0.026**
1,2,3,7,8,9-HxCDF	U	0.12	<0.12	0.0	**0.012**
1,2,3,4,6,7,8-HpCDF	U	0.43	**1.3**	0.013	**0.013**
1,2,3,4,7,8,9-HpCDF	U	0.11	<0.11	0.0	**0.0011**
OCDF	U	0.57	**0.97**	0.00029	**0.00029**
			Furans Totals :	0.19	**0.21**
			Totals :	**0.29**	**0.40**

Poly-Chlorinated Biphenyls (WHO 12)

Technique : GC/MS (HR)(Soxhlet)

				WHO2005 Toxic Equivalents ng/kg	
Determinand	**Symbol**	**LOD ng/kg**	**Result ng/kg**	**Lower Bound**	**Upper Bound**
PCB BZ#81	U	0.5000	<0.5	0.0	**0.00015**
PCB BZ#77	U	2.000	**8.2**	0.00082	**0.00082**
PCB BZ#105	U	4.300	**28.0**	0.00084	**0.00084**
PCB BZ#114	U	2.800	<2.8	0.0	**0.00008**
PCB BZ#118	U	5.500	**50.0**	0.0015	**0.0015**
PCB BZ#123	U	4.800	<4.8	0.0	**0.00014**
PCB BZ#126	U	0.8200	<0.8	0.0	**0.082**
PCB BZ#156	U	3.600	**7.5**	0.00022	**0.00022**
PCB BZ#157	U	3.400	<3.4	0.0	**0.00010**
PCB BZ#167	U	3.100	**4.1**	0.00012	**0.00012**
PCB BZ#169	U	0.5000	<0.5	0.0	**0.015**
PCB BZ#189	U	3.600	<3.6	0.0	**0.00011**
			Totals :	**0.0035**	**0.10**

SAL Reference: 450877
Customer Reference: 8905

Soil Analysed as Soil
Miscellaneous

				SAL Reference	**450877 001**	**450877 003**	**450877 005**	**450877 007**	**450877 009**
				Customer Sample Reference	**BEACH 1A**	**BEACH 2A**	**BEACH 3A**	**BEACH 4A**	**LOCATION 1A**
				Test Sample	**AR**	**AR**	**AR**	**AR**	**AR**
				Date Sampled	**20-JAN-2015**	**19-JAN-2015**	**21-JAN-2015**	**20-JAN-2015**	**21-JAN-2015**
Determinand	**Method**	**LOD**	**Units**	**Symbol**					
Total Organic Carbon	OX/IR	0.1	%	N	**1.0**	**0.1**	**0.8**	**0.7**	**4.7**
pH	Probe			U	**8.0**	**8.3**	**8.0**	**8.1**	**6.4**

SAL Reference: 450877
Customer Reference: 8905

Soil Analysed as Soil
Miscellaneous

				SAL Reference	**450877 011**	**450877 013**	**450877 015**	**450877 017**	**450877 019**
				Customer Sample Reference	**LOCATION 2A**	**LOCATION 3A**	**LOCATION 4A**	**LOCATION 5A**	**LOCATION 6A**
				Test Sample	**AR**	**AR**	**AR**	**AR**	**AR**
				Date Sampled	**15-JAN-2015**	**16-JAN-2015**	**15-JAN-2015**	**16-JAN-2015**	**20-JAN-2015**
Determinand	**Method**	**LOD**	**Units**	**Symbol**					
Total Organic Carbon	OX/IR	0.1	%	N	**2.3**	**3.0**	**3.5**	**5.0**	**7.6**
pH	Probe			U	**7.2**	**6.4**	**6.0**	**6.9**	**7.1**

SAL Reference: 450877
Customer Reference: 8905

Soil Analysed as Soil
Miscellaneous

				SAL Reference	**450877 021**	**450877 023**
				Customer Sample Reference	**LOCATION 7A**	**LOCATION 8A**
				Test Sample	**AR**	**AR**
				Date Sampled	**20-JAN-2015**	**19-JAN-2015**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Total Organic Carbon	OX/IR	0.1	%	N	**5.8**	**5.3**
pH	Probe			U	**6.3**	**5.9**

SAL Reference: 450877
Customer Reference: 8905

Soil Analysed as Soil
Heavy Metals(9)

				SAL Reference	**450877 001**	**450877 003**	**450877 005**	**450877 007**	**450877 009**
				Customer Sample Reference	**BEACH 1A**	**BEACH 2A**	**BEACH 3A**	**BEACH 4A**	**LOCATION 1A**
				Test Sample	**AR**	**AR**	**AR**	**AR**	**AR**
				Date Sampled	**20-JAN-2015**	**19-JAN-2015**	**21-JAN-2015**	**20-JAN-2015**	**21-JAN-2015**
Determinand	**Method**	**LOD**	**Units**	**Symbol**					
Arsenic	ICP/OES	1	mg/kg	U	**8**	**5**	**8**	**5**	**5**
Cadmium	ICP/OES	1	mg/kg	U	<1	<1	<1	<1	<1
Chromium	ICP/OES	1	mg/kg	U	**20**	**9**	**21**	**13**	**26**
Copper	ICP/OES	1	mg/kg	U	**11**	**3**	**13**	**8**	**13**
Lead	ICP/OES	1	mg/kg	U	**27**	**13**	**27**	**19**	**15**
Mercury	ICP/OES	1	mg/kg	U	<1	<1	<1	<1	<1
Nickel	ICP/OES	1	mg/kg	U	**18**	**11**	**19**	**15**	**24**
Selenium	ICP/OES	3	mg/kg	U	<3	<3	<3	<3	<3
Zinc	ICP/OES	1	mg/kg	U	**96**	**40**	**88**	**71**	**71**

SAL Reference: 450877
Customer Reference: 8905

Soil Analysed as Soil
Heavy Metals(9)

				SAL Reference	**450877 011**	**450877 013**	**450877 015**	**450877 017**	**450877 019**
				Customer Sample Reference	**LOCATION 2A**	**LOCATION 3A**	**LOCATION 4A**	**LOCATION 5A**	**LOCATION 6A**
				Test Sample	**AR**	**AR**	**AR**	**AR**	**AR**
				Date Sampled	**15-JAN-2015**	**16-JAN-2015**	**15-JAN-2015**	**16-JAN-2015**	**20-JAN-2015**
Determinand	**Method**	**LOD**	**Units**	**Symbol**					
Arsenic	ICP/OES	1	mg/kg	U	**17**	**16**	**18**	**8**	**8**
Cadmium	ICP/OES	1	mg/kg	U	<1	<1	<1	<1	<1
Chromium	ICP/OES	1	mg/kg	U	**22**	**21**	**22**	**23**	**17**
Copper	ICP/OES	1	mg/kg	U	**25**	**35**	**37**	**20**	**11**
Lead	ICP/OES	1	mg/kg	U	**59**	**99**	**110**	**78**	**55**
Mercury	ICP/OES	1	mg/kg	U	<1	<1	<1	<1	<1
Nickel	ICP/OES	1	mg/kg	U	**31**	**26**	**26**	**16**	**18**
Selenium	ICP/OES	3	mg/kg	U	<3	<3	<3	<3	<3
Zinc	ICP/OES	1	mg/kg	U	**140**	**120**	**130**	**100**	**70**

SAL Reference: 450877
Customer Reference: 8905

Soil Analysed as Soil
Heavy Metals(9)

				SAL Reference	**450877 021**	**450877 023**
				Customer Sample Reference	**LOCATION 7A**	**LOCATION 8A**
				Test Sample	**AR**	**AR**
				Date Sampled	**20-JAN-2015**	**19-JAN-2015**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Arsenic	ICP/OES	1	mg/kg	U	**7**	**18**
Cadmium	ICP/OES	1	mg/kg	U	<1	<1
Chromium	ICP/OES	1	mg/kg	U	**15**	**20**
Copper	ICP/OES	1	mg/kg	U	**22**	**20**
Lead	ICP/OES	1	mg/kg	U	**160**	**63**
Mercury	ICP/OES	1	mg/kg	U	<1	<1
Nickel	ICP/OES	1	mg/kg	U	**11**	**19**
Selenium	ICP/OES	3	mg/kg	U	<3	<3
Zinc	ICP/OES	1	mg/kg	U	**53**	**90**

Index to symbols used in 450877-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited