

# Provision of Statutory Shellfish Monitoring Services for Scotland- Chemical Contaminant Analysis of Shellfish from Classified Harvesting Areas (2018)

Report to Food Standards Scotland

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## Chemical Contaminant Analysis of Shellfish from Classified Harvesting Areas (2018)

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## Glossary of Main Terms

Term or Acronym	General Meaning of Term
EU	European Union
EC	European Commission
FSS	Food Standards Scotland
FSA	Food Standards Agency
WHO	World Health Organisation
PAHs	Polycyclic aromatic hydrocarbons
PAH4	Sum of 4 PAHs (benzo[a]pyrene; (BaP), benz[a]anthracene; (BaA), benzo[b]fluoranthene; (BbF), chrysene; (Chr))
PCB	Polychlorinated biphenyl
<i>Ortho</i> -PCB	Ortho-substituted PCB (non planar)
<i>Non-ortho</i> -PCB	Non-ortho-substituted PCB (co-planar)
PCDD/F	Polychlorinated dibenzo- <i>p</i> -dioxin/ polychlorinated dibenzofuran (dioxins)
TEF	Toxic Equivalency Factor – toxicity expressed for each dioxin-like compound as a fraction of 2,3,7,8-TCDD (2,3,7,8-TCDD = 1).
TEQ	Toxic Equivalence – product of the congener concentration and the TEF
Total TEQ	Total of the Sum of all the Toxic Equivalences (TEQs) for each group of compounds
Sum of ICES 6	Sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180
fat weight	Values relevant to the assessed fat content of the sample
whole weight	Values based on the sample as received 'whole' or wet
WHO-TEQ 2005	World Health Organisation - TEQ based on values as set in 2005
LOD	Limit of Detection
LOQ	Limit of Quantification
Lower bound	assumes values at less than the limit of detection are zero (e.g.<0.01=0)
Upper bound	assumes values at less than the limit of detection are equal to the limit of detection (e.g. <0.07=0.07)
Trace Element	An element in a sample that has an average concentration of less than 100 parts per million (less than 100 mg/kg)
Heavy Metals	A loosely defined subset of elements that exhibit metallic properties (some are toxic, some are a nutritional requirement in small amounts), (This survey includes, Cr, Mn, Co, Ni, Cu, Zn, As, Se, Ag, Cd, Hg & Pb, (Chromium, manganese, cobalt, nickel, copper, zinc, arsenic, selenium, silver, cadmium, mercury and lead)
ng/kg	Nanogram per kilogram (x10 <sup>-9</sup> / part per trillion)
µg/kg	Microgram per kilogram (x 10 <sup>-6</sup> / part per billion)
mg/kg	Milligram per kilogram (x 10 <sup>-3</sup> / part per million)
ICP-MS	Inductively coupled plasma-mass spectrometry
HRGC-HRMS	High resolution gas chromatography - high resolution mass spectrometry
HRGC-LRMS	High resolution gas chromatography – unit resolution mass spectrometry
LIMS	Laboratory Information Management System
GCMS	Gas chromatography-mass spectrometry

NRL	National Reference Laboratory (one NRL assigned/ awarded per member state)
EU-RL	European Union- Reference Laboratory
FAPAS	Proficiency testing scheme provider.

## Executive Summary

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This study on chemical contaminants in shellfish from Scottish classified shellfish production areas, fulfils part of the requirements of EU member states (EU Regulations (EC) No.1881/2006 and (EC) No. 854/2004) to adopt appropriate monitoring measures and carry out compliance checks on shellfish produced for human consumption. In comparison to earlier years, the scope of this study was widened to include production areas that had not been tested before. Marine shellfish bio-accumulate environmental contaminants because of their inability to metabolise these during feeding. The study determines concentrations of regulated environmental contaminants in the flesh of edible species with a view to determine current levels of occurrence and to allow estimation of consumer exposure.

The study analysed 13 composite samples of shellfish including Common mussels, Pacific oysters, Common cockles, and Razor clams for polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs, dioxins), polychlorinated biphenyls (PCBs). There were 28 samples tested for polycyclic aromatic hydrocarbons (PAHs), and 20 samples that include the aforementioned species as well as Surf clams and Native Oysters tested for heavy metals/trace elements. The methodologies used for the analyses were UKAS accredited to the ISO 17025 standard and follow EU commission regulations for data quality criteria.

The highest PAH values measured for benzo[a]pyrene (BaP) and for the total sum of the PAH4 compounds in the 28 samples as tested, all fall below the maximum permitted levels (MPL), of 5 µg/kg (BaP) and 30 µg/kg (PAH4 Sum) respectively. (Regulation (EC) No. 1881/2006 as amended) [3].

In the case of PCDD/Fs and PCBs in particular, contaminant concentrations were all below the regulatory maximum levels [3]. Concentrations of the regulated heavy metals, mercury, cadmium and lead were all below the set maximum limits [3]. Contaminant profiles from the 2018 current study are similar to the previous year's data in 2017.

# 1. Background to Study

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Marine shellfish are an excellent source of protein, are high in essential minerals, and low in calories and fat. In many parts of the UK and in Scotland in particular, the shellfish industry makes a significant contribution to the local economy. Shellfish have a recognised potential for bio-accumulating contaminants and some bivalve species such as mussels, are commonly used as early indicators of local pollution. Bivalves feed by filtering plankton from the surrounding water that washes through their habitat. This feeding mechanism leads to the bio-accumulation of pollutants of biogenic and anthropogenic origin such as polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), heavy metals (trace elements) and polycyclic aromatic hydrocarbons (PAHs), from the surrounding waters. The bio-accumulation potential of the shellfish species used for food is particularly relevant in the case of environmental contaminants with long half-lives such as chlorinated dioxins and biphenyls. These contaminants have been the subject of a number of studies (Garraud et al 2007, Lee et al 2007, Fernandes et al 2009, Fernandes et al 2012) relating to the occurrence and bio-accumulation in marine species and the resulting potential for human exposure arising from the consumption of the edible species.

In recognising the requirements of food safety the EU has, for a number of years, defined limits for the control of these contaminants in a range of foods including shellfish. (Commission Regulation (EC) No 1881/2006, as amended). EU member states are required to adopt appropriate monitoring measures and carry out compliance checks with regard to the occurrence of these contaminants in shellfish produced for human consumption.

PCDD/Fs and PCBs are recognised environmental and food contaminants that are known to bio-accumulate in fish and shellfish. The extent of this accumulation is evident by the levels of these contaminants detected in various studies. In Total Diet Studies (TDS) (e.g. FSA 2003, FSA 2012 -FD 12/04) carried out over the last two decades in the UK; fish (including shellfish) has consistently been one of the highest dioxin and PCB containing food groups. Human dietary exposure can therefore be significantly influenced by the fish and shellfish component of the diet, particularly in high level consumers and low body-weight individuals.

Although metabolised in many fish species, PAHs persist in shellfish as filter feeding species appear unable to affect bio-transformation of these contaminants. Other than this bio-accumulation pathway, PAHs can also arise in fish and shellfish through some food preparation and processing methods – e.g. smoked fish are known to contain elevated levels of PAHs. Some PAH compounds have been shown to be genotoxic and carcinogenic, the most studied of which (benzo[a]pyrene, or BaP) is

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regulated in a range of foods including shellfish, within the EU (SCF Opinion 2002, Commission Regulation (EC) No. 208/2005). However, more recent evaluation by EFSA's CONTAM panel, concluded that a set of 4 compounds, namely benzo[a]pyrene (BaP), chrysene, benz[a]anthracene and benzo[b]fluoranthene (collectively referred to as PAH4) were more suitable indicators of PAH toxicity in food (EFSA, 2008). These four compounds were subsequently included in the updated Commission Regulation (EC) No. 835/2011, which came into force from September 2012.

Some trace elements and in particular, heavy metals are established toxic contaminants. Some elements, such as copper, chromium, selenium and zinc are essential to health but may be toxic at high levels of exposure. Metals and other elements may enter marine and aquatic environments and bio-accumulate in species at any point during growth and harvesting. Some potentially toxic elements occur naturally as part of the local geology, but others may also be found in the location of certain industries, as a result of unauthorised discharge, or as a result of other anthropogenic activity.

As part of its monitoring requirements in support of EU regulations, Food Standards Scotland (FSS) has overseen the collection of shellfish each year, from classified shellfish production areas within relevant local authority areas. Shellfish from classified production areas are monitored, with the edible tissues analysed for the contaminants described above, and specified for dioxins, dioxin-like PCBs and non-dioxin-like PCBs for certain foodstuffs in Commission Regulation (EU) No 589/2014. Sampling officers from Scotland were required to obtain suitable shellfish samples from designated sampling points within classified shellfish production areas, as defined by the FSS. The collection of shellfish and transport logistics were co-ordinated by Cefas. Samples were taken and live shellfish sent to Fera, with the edible tissues analysed for the contaminants described above. The analysis is carried out at Fera Science Limited in York.

Fera has generated environmental contaminant data on shellfish collected from new and existing shellfish production areas in Scotland since 2007. This report collates the results of the individual analyses for dioxins, PAHs and heavy metals in samples of shellfish collected from classified Scottish production areas in the first quarter of 2018.



## 2. Method

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### 2.1 Sample Collection and Preparation

31 samples of shellfish, including species of common mussels, Pacific oysters, Native oysters, common cockles, surf clams, and razor clams were collected during January to March 2018. The sampling schedule was timed to coincide with the period before annual spawning. This point in the annual cycle contaminant levels would likely be at their highest for optimum detection.

Details on the locations, with descriptions of the samples and identification are given in Table 1.

On receipt at the laboratory each sample was given a unique laboratory reference number and the sample details were logged into a Nautilus LIMS database. The samples were stored frozen prior to analysis. Sample preparation consisted of shelling followed by thorough homogenisation and aliquots taken for PAH and heavy metal analysis and dioxins appropriately. PAH and Metals samples were analysed on the homogenised material, and Dioxins sample aliquots underwent further freeze-drying and re-homogenised prior to dioxin and PCB analysis.

### 2.2 Contaminants measured – Specific Analytes

The following analytes were determined: Regulated contaminants are highlighted in **bold**, and summarised regulation limits are listed below:

Maximum Regulatory levels relevant for live bivalve molluscs

	Maximum levels (wet weight)	Maximum levels (wet weight)	Maximum levels (fat)
Lead	1,5 mg/kg		
Cadmium	1,0 mg/kg		
Mercury	0,50 mg/kg		
Dioxins and PCBs	Sum of dioxins (WHO-PCDD/F-TEQ)	Sum of dioxins and dioxin-like PCBs (WHO-PCDD/F-PCB-TEQ)	Sum of PCB28, PCB52, PCB101, PCB138 and PCB180 (ICES – 6, / Indicator PCBs)
	3,5 pg/g	6,5 pg/g	75 ng/g
Polycyclic Aromatic Hydrocarbons (PAHs)	Benzo(a)pyrene	Sum of Benzo(a)pyrene, Benzanthracene, Benzo(b)fluoranthene and Chrysene)	
	5,0 µg/kg	30 µg/kg	

**Dioxins - all 17, 2378-Cl substituted PCDDs and PCDFs.**

**Dioxin-like PCBs - IUPAC no. 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169 and 189.**

Non Dioxin-like PCBs - IUPAC numbers 18, **28**, 31, 47, 49, 51, **52**, 99, **101**, 128, **138**, **153** and **180**.

PAHs -

acenaphthene, acenaphthylene, fluorene, phenanthrene, anthracene, fluoranthene, benzo[c]fluorene, pyrene, benzo[e]pyrene, benzo[b]naphtho[2,1-d]thiophene, anthanthrene, coronene, benzo[g,h,i]fluoranthene, **benz[a]anthracene**, **chrysene**, **benzo[b]fluoranthene**, benzo[j]fluoranthene, benzo[k]fluoranthene, **benzo[a]pyrene**, cyclopenta[c,d]pyrene, indeno[1,2,3-c,d]pyrene, dibenzo[a,h]anthracene, benzo[g,h,i]perylene, dibenzo[a,l]pyrene, dibenzo[a,e]pyrene, dibenzo[a,i]pyrene, dibenzo[a,h]pyrene and the substituted PAH, 5-methylchrysene.

Heavy Metals – Chromium (Cr), Manganese (Mn), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Arsenic (As), Selenium (Se), Silver (Ag), **Cadmium (Cd)**, **Mercury (Hg)**, **Lead (Pb)**.

### **2.3 PCDD/F and PCB - Analytical Methodology**

(Fera (UK NRL) SOPs FSG 401-414)

The method used for the preparation, extraction and analysis of samples has been reported previously (Fernandes et al 2004) and is part of the CEN EN16215:2012 standard. In brief, samples were fortified with <sup>13</sup>C-labelled analogues of target compounds and exhaustively extracted using mixed organic solvents. Ortho substituted PCBs were separated from non-ortho substituted PCBs and PCDD/Fs by fractionation on activated carbon. The two fractions were further purified using adsorption chromatography on alumina. Analytical measurement was carried out using high resolution gas chromatography-high resolution mass spectrometry (HRGC-HRMS) for the seventeen, 2,3,7,8-Cl substituted PCDD/F congeners and non-ortho substituted PCBs. HRGC-unit resolution mass spectrometry (HRGC-LRMS) was used for the measurement of the ortho substituted PCBs.

All analyses are UKAS accredited to ISO 17025 standards, with the inclusion of reference material and method blanks which were evaluated prior to reporting. Further quality assurance measures included the successful participation in international inter-comparison exercises such as POPs in Food-2016 and POPs in Food-2017, which contain dioxin and dioxin-like PCB proficiency testing elements. Quality control evaluation for the accompanying data follows the criteria specified for

chlorinated dioxins and PCBs (Commission Regulation (EU) No 589/2014). In addition, as NRL for chemical contaminants, Fera participates in PT exercises and other inter-laboratory exercises as organised by the EU-RL and achieves consistently good results.

## **2.4 Polycyclic Aromatic Hydrocarbons (PAH) - Analytical Methodology**

(Fera (UK NRL) SOP FSG 410)

The analytical methodology for the PAHs has been reported before (Rose et al, 2007) and is based on internal standardisation with GC-MS measurement (HRGC-LRMS). An aliquot of the homogenised sample was fortified with <sup>13</sup>C-labelled analogues of target compounds and saponified with methanolic potassium hydroxide. The extracted PAH solutions were purified in two stages with a DMF/cyclohexane partition followed by adsorption chromatography on activated silica. Purified extracts were sensitivity standardised and measured using high resolution gas chromatography-unit resolution mass spectrometry.

The analytical procedure for PAHs is UKAS accredited to ISO 17025 standard and includes the assessment of method blanks and reference materials, (e.g. T0658, PAHs in cocoa butter) for compliance with the accreditation criteria. The methodology also meets the criteria required for evaluating data against the maximum permitted limits for benzo[a]pyrene as specified in EU Commission Regulations. Fera regularly participates in FAPAS PT exercises for PAHs in food. In addition, as NRL for chemical contaminants, Fera participates in PT exercises and other inter-laboratory exercises as organised by the EU-RL and achieves consistently good results.

## **2.5 Trace Elements - Analytical Methodology**

(Fera (UK NRL) SOP FSG 461 and 457)

Aliquots of the homogenised sample were weighed into allotted digestion vessels and a mixture (4:1) of nitric acid and hydrochloric acid added. The vessels were capped and the contents digested using a high-pressure microwave digestion system. Reagent blanks, certified reference materials and a spiked sample were also taken through the procedure. The resulting solutions were transferred to pre-marked acid-clean plastic test tubes and diluted to 10 ml with deionised water. The digest solutions together with a set of standards covering the expected concentration range, were internally standardised with indium or rhodium in dilute nitric acid (1 % v/v). Measurements were made using an Agilent 7700x ICP-MS with collision cell.

In common with the other two sets of analyses, the analytical procedure is UKAS accredited to ISO 17025 standard. The criteria used to assess data included checks on instrument drift, spike recovery,

replicate agreement, limits of detection and certified reference material values. Regular, successful participation in FAPAS inter-comparison exercises provides further confidence in the data. In addition, as NRL for chemical contaminants, Fera participates in PT exercises and other inter-laboratory exercises as organised by the EU-RL and achieves consistently good results.

### 3. Results

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An overview of analysed samples and analyte concentrations are presented in Tables 1-12. These are reviewed and discussed below.

Concentration units reflect current convention as required by regulation, and data were rounded to two decimal places or as appropriate. The reporting limits (quoted as “<”) for dioxins, PCBs and PAHs are estimated as a dynamic parameter and therefore represent the limits of determination that prevail during the course of the measurement. For PCDD/Fs, PCBs, metals and PAHs, the reporting limits are consistent with the requirements of EU regulations. Data on the reference materials that were analysed concurrently with the samples, were within established acceptable limits, and are available if required. Measurement uncertainty (MU) was calculated and applied to data following guidelines and principals set out in Measurement Uncertainty for Persistent Organic Pollutants by Isotope-Dilution Mass Spectrometry (Epp, et al 2014). MU and reference material data can be made available if required.

In addition to the concentration of individual congeners, the dioxin-like toxicity of the samples arising from PCDD/Fs and dioxin-like PCBs has also been reported as a toxic equivalent (WHO-TEQ), which is calculated by multiplying the concentration of each congener of interest by its toxicity equivalency factor (WHO-TEF). The TEQs are presented in terms of the 2005 TEFs (van den Berg et al 2006). Additionally, as per the requirements of Regulation 1259/2011, the sum of the ICES-6 PCBs is also provided. The regulations for shellfish are based on whole weight concentrations; however, in keeping with previous reports to Food Standards Scotland, the results for PCDD/Fs and PCBs have also been reported on a fat weight basis.

PCDD/Fs and PCBs were detected in all samples at levels well within the regulatory limits. The combined PCDD/F + PCB TEQ (whole weight) ranged from 0.05 pg TEQ/g to 0.14 pg TEQ/g. In all samples, PCDD/Fs contributed at least half of the total TEQ. This is a slight reduction on the average TEQ sum from samples tested in 2017.

The concentration of ICES-6 PCB on an upper bound whole weight basis ranged from 0.06 µg/kg to 0.98 µg/kg, with the highest levels found in a sample (S18-016444 - Peninver Razorfish).

PAHs were detected in all 28 samples analysed. Benzo[a]pyrene concentrations ranged from <0.06 µg/kg to 1.99 µg/kg and the other PAH4 concentrations ranged from 0.08 µg/kg to 7.35 µg/kg. The single highest concentration for the regulated compounds was found in a sample of common mussels (S18-000847) collected from Loch Leven: Upper (benzo[b]fluoranthene at 7.35 µg/kg), which also had the highest value for benzo[a]pyrene at 1.99 µg/kg and a PAH4 Sum of 11.85 µg/kg

The sample with the highest concentration of chrysene at 3.27 µg/kg was observed in a sample of razors (S18-003670) collected from Stevenston Sands, (PAH4 Sum 10.99 µg/kg), This sample also had the second highest value for ICES 6 sum PCBs.

The sample with the highest concentration of benz(a)anthracene at 2.79 µg/kg was observed in a sample of razors (S18-003671) collected from North Bay: Barassie. (PAH4 Sum 10.77 µg/kg)

The sample with the overall highest PAH4 Sum was a sample of Pacific oysters (S18-001372) collected from Fairlie: Southannan Sands with a PAH4 Sum of 12.28 µg/kg.

All samples showed levels below the MPLs for BaP (set at 5 µg/kg) and PAH4 (set at 30 µg/kg).

Heavy metals were detected in all samples. The three most abundant heavy metals were zinc (Zn), manganese (Mn) and copper (Cu), with Zn present at the highest concentration. Concentrations of the regulated heavy metals mercury (Hg), cadmium (Cd) and lead (Pb) were all below the regulatory limits (Commission Regulation EC 1881/2006, as amended).

Two samples had three or more of the highest element values of those measured:

- The first sample was a sample of native oysters (S18-014965) collected from Loch Ryan: Leffnoll Point with Mn; 4.35 mg/kg, Cu; 27 mg/kg, Zn; 303 mg/kg, Ag; 1.75 mg/kg & Cd; 0.35 mg/kg.
- The second sample was a sample of Common cockles (S18-0015405) collected from Loch Craignish: Ardfarn with Ch; 0.24 mg/kg, Co; 0.148 mg/kg & Ni; 1.36 mg/kg.

Other highest value individual elements were found in mussels (S18-014597), from Loch Laxford: Weavers Bay with Se at 0.47 mg/kg, mussels from Seli Voe: Garderhouse (S18-000579) with As at 2.27 mg/kg, mussels from Loch Sunart: Liddisdale (S18-001371) with Pb at 1.18 mg/kg, and Razors from Stevenston Sands (S18-003670) with Hg at 0.02mg/kg.

Individual element levels detected this year were generally lower than those values from the last study in 2017, however with some exceptions. Values for copper (Cu) and zinc (Zn), being more than twice as high, and values for cadmium (Cd) and lead (Pb), being marginally higher. Three of these higher values were isolated in one sample of native oysters listed above. This rise in levels being confined mostly to one single sample in a year on year surveillance that has consistently shown a downward trend has low significance in this case.

In general, the patterns and levels of the three contaminant classes were consistent with those recorded last year or from previous years.

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## Table 1: Overview of all 2018 Samples (31)

Local Authority	Production Area	Sample Site Name	Site Identification No	Grid Reference	Species	Date Sample Taken	Date Sample Received at Fera	FERA LIMS No.
Argyll & Bute	Loch Fyne: Otter Ferry	Ballimore	AB-151-039-13	NR 92178 83502	Pacific Oyster	07/02/2018	08/02/2018	S18-001828
Argyll & Bute	Loch Craignish Cockles	Ardfern	AB-786-2028-04	NM 82050 05266	Common Cockles	21/03/2018	22/03/2018	S18-015405
Argyll & Bute	Peninver Razors	Peninver Razors	AB-766-1962-16	NR 74304 25007	Razors	26/03/2018	29/03/2018	S18-016444
Argyll & Bute	Loch Fyne: Stonefield oysters	North Bay Oysters	AB-435-840-13	NR 86492 72268	Pacific Oysters	20/02/2018	22/02/2018	S18-003669
Argyll & Bute	Lynn of Lorn: Sgear Liath	Sgear Liath	AB-318-068-13	NM 87161 38891	Pacific Oysters	13/03/2018	14/03/2018	S18-014598
Comhairle nan Eilean Siar - UB	Traigh Mhor	Traigh Mhor	UB-282-164-04	NF 7045 0548	Common Cockles	06/03/2018	07/03/2018	S18-004810
Comhairle nan Eilean Siar - UB)	Cidhe Eolaigearraidh	Sound of Barra: Pacific Oysters	UB-427-830-13	NF 7140 0799	Pacific Oysters	06/03/2018	07/03/2018	S18-004811
Dumfries & Galloway	Loch Ryan	Leffnoll Point	DG-191-174-12	NX 0660 2066	Native Oysters	19/03/2018	20/03/2018	S18-014965
Fife	Firth of Forth: North	Anstruther	FF-068-184-19	NO 5944 0475	Surf Clams	05/02/2018	07/02/2018	S18-001714
Highlands - Lochaber	Loch Leven: Upper	Upper	HL-171-223-08	NN1480 6168	Common Mussels	22/01/2018	24/01/2018	S18-000847
Highlands - Lochaber	Loch Leven: Lower	Lower	HL-170-222-08	NN0716 5905	Common Mussels	22/01/2018	24/01/2018	S18-000848
Highlands - Lochaber	Loch Eil: Fassfern	Fassfern	HL-136-219-08	NN02957815	Common Mussels	30/01/2018	31/01/2018	S18-001373
Highlands - Lochaber	Loch Eil	Duisky	HL-134-216-08	Not Supplied	Common Mussels	27/03/2018	28/03/2018	S18-016326
Highlands - Lochaber	Arisaig	Sgeirean Buidhe	HL-004-202-13	NM63877 85325	Pacific Oysters	05/03/2018	07/03/2018	S18-004812
Highlands - Lochaber	Loch Sunart	Liddisdale	HL-206-1237-08	NM7830 6012	Common Mussels	30/01/2018	31/01/2018	S18-001371
Highlands - Ross & Cromarty	Loch Kanaird	Ardmair	RC-625-1233-13	NH 11815 99204	Pacific Oysters	19/03/2018	20/03/2018	S18-014967
Highlands - Ross & Cromarty	Inner Loch Torridon	Dubh Aird	RC-090-1616-08	NG 8747 5496	Common Mussels	27/03/2018	28/03/2018	S18-016325

Local Authority	Production Area	Sample Site Name	Site Identification No	Grid Reference	Species	Date Sample Taken	Date Sample Received at Fera	FERA LIMS No.
Highlands - Sutherland	Loch Inchard	Loch Inchard – Site 1 – D. Ross	HS-162-311-08	NC 2393 5430	Common Mussels	16/01/2018	18/01/2018	S18-000581
Highlands - Sutherland	Loch Laxford	Weavers Bay	HS-167-320-08	LONGTITUDE: NC2134 4858	Common Mussels	13/03/2018	14/03/2018	S18-014597
North Ayrshire	Fairlie	Southannan Sands	NA-065-332-13	Not supplied	Pacific Oyster	29/01/2018	31/01/2018	S18-001372
North Ayrshire	Stevenston Sands Razors	Stevenston Sands Razors	NA-825-2169-16	NS 2629 4038	Razors	20/02/2018	22/02/2018	S18-003670
Shetland	West of Langa	Scalloway	SI-822-2160-08	HU 3714 3951	Common Mussels	17/01/2018	18/01/2018	S18-000577
Shetland	Swining Voe	North West of Cul Houb	SI-820-2156-08	HU 4645 6842	Common Mussels	17/01/2018	18/01/2018	S18-000578
Shetland	Seli Voe	Garderhouse	SI-815-2143-08	HU 3336 4692	Common Mussels	17/01/2018	18/01/2018	S18-000579
Shetland	Colla Firth	Colla Firth	SI-040-417-08	HU 4742 6925	Common Mussels	17/01/2018	18/01/2018	S18-000580
Shetland	Dales Voe: Muckle Ayre	Muckle Ayre	SI-049-419-08	HU4430 4433	Common Mussels	07/02/2018	08/02/2018	S18-001827
Shetland	Catfirth Mussels 1	East of Little Holm	SI-816-2144-08	HU 4557 5281	Common Mussels	07/02/2018	08/02/2018	S18-001829
Shetland	Aith Voe Sletta	Slyde	SI-326-733-08	HU 3480 5869	Common Mussels	19/03/2018	20/03/2018	S18-014966
Shetland	Laxfirth	Northwest of Skerby Ayre	SI-814-2142-08	HU 4445 4768	Common Mussels	07/02/2018	08/02/2018	S18-001830
Shetland	Catfirth Mussels 2	East of Brunt Hamarsland	SI-817-2147-08	HU 4471 5234	Common Mussels	07/02/2018	08/02/2018	S18-001831
South Ayrshire	North Bay	Barassie	SA-337-719-16	Incomplete reference supplied	Razors	20/02/2018	22/02/2018	S18-003671

*\*Quality statement: Information relating to the origin of the samples (place, date of collection and GR/NGR details) is as provided by sampling staff and has not undergone verification checks by Fera/Cefas.*

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## Table 2: Samples selected for Dioxins & PCB contaminant testing (13)

Local Authority	Production Area	Sample Site Name	Site Identification No	Grid Reference	Species	Date Sample Taken	Date Sample Received at Fera	FERA LIMS No.
Argyll & Bute	Loch Craignish Cockles	Ardfern	AB-786-2028-04	NM 82050 05266	Common Cockles	21/03/2018	22/03/2018	S18-015405
Argyll & Bute	Peninver Razors	Peninver Razors	AB-766-1962-16	NR 74304 25007	Razors	26/03/2018	29/03/2018	S18-016444
Highlands – Lochaber	Loch Eil: Fassfern	Fassfern	HL-136-219-08	NN02957815	Common Mussels	30/01/2018	31/01/2018	S18-001373
Highlands - Ross & Cromarty	Loch Kanaird	Ardmair	RC-625-1233-13	NH 11815 99204	Pacific Oysters	19/03/2018	20/03/2018	S18-014967
North Ayrshire	Stevenston Sands Razors	Stevenston Sands Razors	NA-825-2169-16	NS 2629 4038	Razors	20/02/2018	22/02/2018	S18-003670
Shetland	West of Langa	Scalloway	SI-822-2160-08	HU 3714 3951	Common Mussels	17/01/2018	18/01/2018	S18-000577
Shetland	Swining Voe	North West of Cul Houb	SI-820-2156-08	HU 4645 6842	Common Mussels	17/01/2018	18/01/2018	S18-000578
Shetland	Seli Voe	Garderhouse	SI-815-2143-08	HU 3336 4692	Common Mussels	17/01/2018	18/01/2018	S18-000579
Shetland	Colla Firth	Colla Firth	SI-040-417-08	HU 4742 6925	Common Mussels	17/01/2018	18/01/2018	S18-000580
Shetland	Dales Voe: Muckle Ayre	Muckle Ayre	SI-049-419-08	HU4430 4433	Common Mussels	07/02/2018	08/02/2018	S18-001827
Shetland	Catfirth Mussels 1	East of Little Holm	SI-816-2144-08	HU 4557 5281	Common Mussels	07/02/2018	08/02/2018	S18-001829
Shetland	Laxfirth	North West of Skerby Ayre	SI-814-2142-08	HU 4445 4768	Common Mussels	07/02/2018	08/02/2018	S18-001830
Shetland	Catfirth Mussels 2	East of Brunt Hamarsland	SI-817-2147-08	HU 4471 5234	Common Mussels	07/02/2018	08/02/2018	S18-001831

### Table 3: PCDD/Fs (dioxins) concentrations - Whole weight

Note: results marked with an "i" are indicative

FERA LIMS No.	S18-015405	S18-016444	S18-001373	S18-014967	S18-003670	S18-000577	S18-000578
Species	Common Cockles	Razors	Common Mussels	Pacific Oysters	Razors	Common Mussels	Common Mussels
Production Area	Loch Craignish Cockles	Peninver Razors	Loch Eil: Fassfern	Lock Kanaird	Stevenston Sands Razors	West of Langa	Swining Voe
Sample Site Name	Ardfern	Peninver Razors	Fassfern	Ardmair	Stevenston Sands Razors	Scalloway	North West of Cul Houb
<b>Whole weight</b>							
<b>pg/g</b>							
2,3,7,8-TCDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3,7,8-PeCDD	<0.01	<0.01	0.03i	0.01i	<0.01	0.02	0.02i
1,2,3,4,7,8-HxCDD	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
1,2,3,6,7,8-HxCDD	<0.01	0.01	0.03	0.01	<0.01	0.02	0.02
1,2,3,7,8,9-HxCDD	<0.01	<0.01	0.02	<0.01	<0.01	0.01	<0.01
1,2,3,4,6,7,8-HpCDD	0.03	0.08	0.10	0.03	0.05	0.09	0.08
OCDD	0.17	0.33	0.30	0.14	0.23	0.22	0.21
2,3,7,8-TCDF	0.01	0.12	0.14	0.09	0.13	0.13	0.11
1,2,3,7,8-PeCDF	<0.01	0.01	0.03	0.01	0.01	0.02	0.02
2,3,4,7,8-PeCDF	<0.01	0.03	0.06	0.03	0.03	0.05	0.06
1,2,3,4,7,8-HxCDF	<0.01	0.01	0.01	<0.01	0.01	<0.01	0.01
1,2,3,6,7,8-HxCDF	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
1,2,3,7,8,9-HxCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6,7,8-HxCDF	<0.01	<0.01	0.02	<0.01	<0.01	0.02	0.02
1,2,3,4,6,7,8-HpCDF	0.01	<0.03	0.01	<0.01	0.02	0.03	0.02
1,2,3,4,7,8,9-HpCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
OCDF	0.01	0.03	0.02	<0.01	0.02	0.03	0.02
<b>WHO TEQ (ng/kg whole) lower</b>	<b>&lt;0.01</b>	<b>0.02</b>	<b>0.08</b>	<b>0.03</b>	<b>0.02</b>	<b>0.05</b>	<b>0.06</b>
<b>WHO TEQ (ng/kg whole) upper</b>	<b>0.03</b>	<b>0.05</b>	<b>0.09</b>	<b>0.05</b>	<b>0.05</b>	<b>0.07</b>	<b>0.07</b>

<b>FERA LIMS No.</b>	<b>S18-000579</b>	<b>S18-000580</b>	<b>S18-001827</b>	<b>S18-001829</b>	<b>S18-001830</b>	<b>S18-001831</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1	Laxfirth	Catfirth Mussels 2
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm	North West of Skerby Ayre	East of Brunt Hamarsland
<b>Whole weight</b>						
<b>pg/g</b>						
2,3,7,8-TCDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3,7,8-PeCDD	0.03i	0.01i	0.02	0.01i	0.01i	0.02
1,2,3,4,7,8-HxCDD	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3,6,7,8-HxCDD	0.02	<0.01	<0.01	0.01	0.01	0.01
1,2,3,7,8,9-HxCDD	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3,4,6,7,8-HpCDD	0.09	0.04	0.04	0.04	0.04	0.04
OCDD	0.22	0.12	0.11	0.09	0.10	0.09
2,3,7,8-TCDF	0.14	0.04	0.06	0.05	0.05	0.05
1,2,3,7,8-PeCDF	0.02	0.01	<0.01	0.01	<0.01	<0.01
2,3,4,7,8-PeCDF	0.05	0.02	0.02	0.03	0.02	0.02
1,2,3,4,7,8-HxCDF	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3,6,7,8-HxCDF	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3,7,8,9-HxCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,3,4,6,7,8-HxCDF	0.03	0.01	<0.01	<0.01	<0.01	<0.01
1,2,3,4,6,7,8-HpCDF	0.03	0.01	0.01	<0.01	<0.01	<0.01
1,2,3,4,7,8,9-HpCDF	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
OCDF	0.03	0.01	0.01	<0.01	0.01	<0.01
<b>WHO TEQ (ng/kg whole) lower</b>	<b>0.07</b>	<b>0.02</b>	<b>0.03</b>	<b>0.03</b>	<b>0.02</b>	<b>0.03</b>
<b>WHO TEQ (ng/kg whole) upper</b>	<b>0.08</b>	<b>0.04</b>	<b>0.05</b>	<b>0.04</b>	<b>0.04</b>	<b>0.05</b>

## Table 4: PCDD/Fs (dioxins) concentrations - Lipid weight

FERA LIMS No.	S18-015405	S18-016444	S18-001373	S18-014967	S18-003670	S18-000577	S18-000578
Species	Common Cockles	Razors	Common Mussels	Pacific Oysters	Razors	Common Mussels	Common Mussels
Production Area	Loch Craignish Cockles	Peninver Razors	Loch Eil: Fassfern	Lock Kanaird	Stevenston Sands Razors	West of Langa	Swining Voe
Sample Site Name	Ardfern	Peninver Razors	Fassfern	Ardmair	Stevenston Sands Razors	Scalloway	North West of Cul Houb
Lipid weight							
pg/g							
2,3,7,8-TCDD	0.36	0.53	1.04	0.89	0.67	0.41	0.52
1,2,3,7,8-PeCDD	0.93i	0.86	3.06i	2.34i	0.96	2.30	2.16i
1,2,3,4,7,8-HxCDD	0.72i	0.55	2.04	1.23	0.41	0.92	0.94
1,2,3,6,7,8-HxCDD	1.90	1.55	3.62	1.72	1.10	2.09	1.96
1,2,3,7,8,9-HxCDD	1.47	0.80iR	1.81	1.50	0.72	0.99	1.02
1,2,3,4,6,7,8-HpCDD	10.58	10.48	11.38	5.21	6.94	8.46	8.16
OCDD	56.50	45.20	33.59	23.18	28.63	21.77	22.51
2,3,7,8-TCDF	4.52	16.35	15.85	14.43	16.24	13.28	11.51
1,2,3,7,8-PeCDF	1.25	1.88	3.85	2.32	1.44	1.75	2.41
2,3,4,7,8-PeCDF	2.51	3.69	6.81	4.98	3.91	5.24	5.90
1,2,3,4,7,8-HxCDF	1.76	2.00	1.57	<0.29	1.32	0.97	1.17
1,2,3,6,7,8-HxCDF	1.08	1.05	1.32	0.96	0.84	0.75	1.07
1,2,3,7,8,9-HxCDF	<0.43	<0.53	0.59	<0.16	0.26	0.37i	0.47i
2,3,4,6,7,8-HxCDF	1.79	1.30i	2.31	1.58	1.18	2.14	2.36
1,2,3,4,6,7,8-HpCDF	4.16	<4.41	1.60	1.34	3.15	2.56	2.42
1,2,3,4,7,8,9-HpCDF	0.50	0.44	0.32	<0.13	<0.5	0.36	0.40i
OCDF	3.62	3.88	2.12	1.09	2.38	2.93	2.57
<b>WHO TEQ (ng/kg fat) lower</b>	<b>3.57</b>	<b>5.04</b>	<b>9.31</b>	<b>7.01</b>	<b>5.16</b>	<b>6.61</b>	<b>6.69</b>
<b>WHO TEQ (ng/kg fat) upper</b>	<b>3.62</b>	<b>5.13</b>	<b>9.31</b>	<b>7.05</b>	<b>5.17</b>	<b>6.61</b>	<b>6.69</b>

<b>FERA LIMS No.</b>	<b>S18-000579</b>	<b>S18-000580</b>	<b>S18-001827</b>	<b>S18-001829</b>	<b>S18-001830</b>	<b>S18-001831</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1	Laxfirth	Catfirth Mussels 2
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm	North West of Skerby Ayre	East of Brunt Hamarsland
<b>Lipid weight</b>						
<b>pg/g</b>						
2,3,7,8-TCDD	0.36	0.29	0.37	0.72	0.61	0.70
1,2,3,7,8-PeCDD	2.95i	1.72i	3.38	3.41i	2.82i	4.74
1,2,3,4,7,8-HxCDD	0.99	0.77	0.85	0.97i	0.88	1.31
1,2,3,6,7,8-HxCDD	2.57	1.57	2.05	2.89	2.42	3.10
1,2,3,7,8,9-HxCDD	1.20	0.93	1.14	1.39	1.14	1.58
1,2,3,4,6,7,8-HpCDD	10.77	6.59	8.21	9.93	8.39	10.99
OCDD	25.62	19.60	23.89	22.89	24.26	26.93
2,3,7,8-TCDF	16.35	6.68	11.96	13.07	12.22	13.81
1,2,3,7,8-PeCDF	2.33	1.64	2.10	3.02	2.13	2.82
2,3,4,7,8-PeCDF	5.48	3.68	4.91	7.05	5.87	6.50
1,2,3,4,7,8-HxCDF	1.50	0.95	0.85	0.72i	0.93	0.94
1,2,3,6,7,8-HxCDF	1.29	0.79	0.74	0.97	0.88	0.94
1,2,3,7,8,9-HxCDF	0.60i	0.51	0.43	0.47i	0.45	0.55
2,3,4,6,7,8-HxCDF	3.30	1.72	1.88	2.33	2.10	2.43
1,2,3,4,6,7,8-HpCDF	3.47	1.82	2.41	1.53	1.97	2.19
1,2,3,4,7,8,9-HpCDF	0.53	<0.34	<0.6	<0.58	<0.56	<0.64
OCDF	3.49	2.04	2.50	2.25	2.50	2.67
<b>WHO TEQ (ng/kg fat) lower</b>	<b>7.96</b>	<b>4.65</b>	<b>7.39</b>	<b>8.74</b>	<b>7.47</b>	<b>10.08</b>
<b>WHO TEQ (ng/kg fat) upper</b>	<b>7.96</b>	<b>4.65</b>	<b>7.40</b>	<b>8.74</b>	<b>7.47</b>	<b>10.09</b>



**Table 5: Non-ortho PCB concentrations (whole and Lipid weight)**

<b>FERA LIMS No.</b>	<b>S18-015405</b>	<b>S18-016444</b>	<b>S18-001373</b>	<b>S18-014967</b>	<b>S18-003670</b>	<b>S18-000577</b>	<b>S18-000578</b>
<b>Species</b>	Common Cockles	Razors	Common Mussels	Pacific Oysters	Razors	Common Mussels	Common Mussels
<b>Production Area</b>	Loch Craignish Cockles	Peninver Razors	Loch Eil: Fassfern	Lock Kanaird	Stevenston Sands Razors	West of Langa	Swining Voe
<b>Sample Site Name</b>	Ardfern	Peninver Razors	Fassfern	Ardmair	Stevenston Sands Razors	Scalloway	North West of Cul Houb
<b>Whole Weight</b>							
<b>pg/g</b>							
PCB77	0.40	4.85	2.14	0.93	4.05	1.23	0.84
PCB81	0.02	0.24	0.12	0.07	0.20	0.07	0.05
PCB126	0.08	0.28	0.36	0.19	0.27	0.39	0.29
PCB169	0.04	0.03	0.11	0.05	0.04	0.09	0.09
<b>WHO TEQ (ng/kg whole) lower</b>	<b>0.01</b>	<b>0.03</b>	<b>0.04</b>	<b>0.02</b>	<b>0.03</b>	<b>0.04</b>	<b>0.03</b>
<b>WHO TEQ (ng/kg whole) upper</b>	<b>0.01</b>	<b>0.03</b>	<b>0.04</b>	<b>0.02</b>	<b>0.03</b>	<b>0.04</b>	<b>0.03</b>
<b>Lipid Weight</b>							
<b>pg/g</b>							
PCB77	130.13	663.51	237.03	157.11	511.74	120.58	89.38
PCB81	7.21	32.40	13.66	11.08	25.10	6.99	5.40
PCB126	27.68	38.77	39.25	32.45	34.13	38.26	31.05
PCB169	13.84	4.30	11.98	8.22	5.12	9.08	9.18
<b>WHO TEQ (ng/kg fat) lower</b>	<b>3.20</b>	<b>4.08</b>	<b>4.31</b>	<b>3.51</b>	<b>3.63</b>	<b>4.11</b>	<b>3.39</b>
<b>WHO TEQ (ng/kg fat) upper</b>	<b>3.20</b>	<b>4.08</b>	<b>4.31</b>	<b>3.51</b>	<b>3.63</b>	<b>4.11</b>	<b>3.39</b>

<b>FERA LIMS No.</b>	<b>S18-000579</b>	<b>S18-000580</b>	<b>S18-001827</b>	<b>S18-001829</b>	<b>S18-001830</b>	<b>S18-001831</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1	Laxfirth	Catfirth Mussels 2
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm	North West of Skerby Ayre	East of Brunt Hamarsland

### Whole Weight

#### pg/g

PCB77	1.00	0.30	2.09	0.62	0.83	0.52
PCB81	<0.07	0.02	0.15	0.04	0.06	0.03
PCB126	0.39	0.12	0.16	0.12	0.15	0.10
PCB169	0.10	0.04	0.04	0.04	0.04	0.03

**WHO TEQ (ng/kg whole) lower**

**0.04      0.01      0.02      0.01      0.02      0.01**

**WHO TEQ (ng/kg whole) upper**

**0.04      0.01      0.02      0.01      0.02      0.01**

### Lipid Weight

#### pg/g

PCB77	117.62	47.87	443.47	155.93	197.95	155.86
PCB81	<8.44	3.32	32.44	11.04	14.80	10.50
PCB126	45.73	19.48	34.60	30.16	35.92	31.24
PCB169	11.48	6.39	8.49	9.07	10.15	9.47

**WHO TEQ (ng/kg fat) lower**

**4.93      2.15      3.77      3.31      3.92      3.43**

**WHO TEQ (ng/kg fat) upper**

**4.93      2.15      3.77      3.31      3.92      3.43**

## Table 6: Ortho PCB concentrations – Whole weight

FERA LIMS No. Species Production Area Sample Site Name	S18-015405 Common Cockles Loch Craignish Cockles Ardfern	S18-016444 Razors Peninver Razors Peninver Razors	S18-001373 Common Mussels Loch Eil: Fassfern Fassfern	S18-014967 Pacific Oysters Lock Kanaird Ardmair	S18-003670 Razors Stevenston Sands Razors Stevenston Sands Razors	S18-000577 Common Mussels West of Langa Scalloway	S18-000578 Common Mussels Swining Voe North West of Cul Houb
<b>Whole weight</b>							
<b>µg/kg</b>							
PCB18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB28	<0.01	0.02	<0.01	0.01	0.01iR	<0.01	<0.01
PCB31	<0.01	0.01	<0.01	<0.01	0.01	<0.01	<0.01
PCB47	<0.01	0.01	<0.01	<0.01	0.01	<0.01	<0.01
PCB49	<0.01	0.02	<0.01	<0.01	0.02	<0.01	<0.01
PCB51	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB52	<0.01	0.03	0.01	<0.01	0.03	0.01	<0.01
PCB99	<0.01	0.05	0.03	0.01	0.04	0.02	0.02
PCB101	<0.01	0.16	0.05	0.02	0.08	0.05	0.04
PCB105	<0.01	0.04	0.02	<0.01	0.03	0.01	0.01
PCB114	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB118	<0.01	0.11	0.05	0.02	0.08	0.05	0.04
PCB123	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB128	<0.01	0.03	0.01	<0.01	0.02	0.01	<0.01
PCB138	<0.01	0.32	0.10	0.04	0.14	0.09	0.07
PCB153	0.01	0.38	0.13	0.07	0.15	0.11	0.09
PCB156	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
PCB157	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB167	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB180	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.01
PCB189	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
<b>SUM of ICES 6(µg/kg) lower</b>	<b>0.01</b>	<b>0.98</b>	<b>0.29</b>	<b>0.14</b>	<b>0.41</b>	<b>0.26</b>	<b>0.20</b>
<b>SUM of ICES 6(µg/kg) upper</b>	<b>0.06</b>	<b>0.98</b>	<b>0.31</b>	<b>0.16</b>	<b>0.42</b>	<b>0.28</b>	<b>0.23</b>
<b>WHO-TEQ 2005 (ng/kg) lower</b>	<b>&lt;0.01</b>	<b>0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>
<b>WHO-TEQ 2005 (ng/kg) upper</b>	<b>&lt;0.01</b>	<b>0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>

<b>FERA LIMS No.</b>	<b>S18-000579</b>	<b>S18-000580</b>	<b>S18-001827</b>	<b>S18-001829</b>	<b>S18-001830</b>	<b>S18-001831</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1	Laxfirth	Catfirth Mussels 2
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm	North West of Skerby Ayre	East of Brunt Hamarland
<b>Whole weight</b>						
<b>µg/kg</b>						
PCB18	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB28	<0.01	<0.01	0.02iR	<0.01	<0.01	<0.01
PCB31	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB47	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB49	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB51	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB52	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
PCB99	0.02	<0.01	0.01	<0.01	<0.01	<0.01
PCB101	0.04	0.01	0.02	0.01	0.01	<0.01
PCB105	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB114	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB118	0.04	0.01	0.02	0.01	0.01	0.01
PCB123	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB128	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB138	0.08	0.03	0.04	0.02	0.03	0.02
PCB153	0.12	0.04	0.05	0.04	0.05	0.03
PCB156	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB157	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB167	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB180	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB189	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
<b>SUM of ICES 6(µg/kg) lower</b>	<b>0.24</b>	<b>0.08</b>	<b>0.14</b>	<b>0.07</b>	<b>0.09</b>	<b>0.05</b>
<b>SUM of ICES 6(µg/kg) upper</b>	<b>0.27</b>	<b>0.11</b>	<b>0.15</b>	<b>0.10</b>	<b>0.12</b>	<b>0.09</b>
<b>WHO-TEQ 2005 (ng/kg) lower</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>
<b>WHO-TEQ 2005 (ng/kg) upper</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>	<b>&lt;0.01</b>

## Table 7: Ortho PCB concentrations – Lipid weight

FERA LIMS No. Species Production Area Sample Site Name	S18-015405 Common Cockles Loch Craignish Cockles Ardfern	S18-016444 Razors Peninver Razors Peninver Razors	S18-001373 Common Mussels Loch Eil: Fassfern Fassfern	S18-014967 Pacific Oysters Lock Kanaird Ardmair	S18-003670 Razors Stevenston Sands Razors Stevenston Sands Razors	S18-000577 Common Mussels West of Langa Scalloway	S18-000578 Common Mussels Swining Voe North West of Cul Houb
<b>Lipid weight µg/kg</b>							
PCB18	<0.72	<0.71	0.12	<0.37	0.38	0.09	0.17
PCB28	<1.07	2.10	0.77	2.01	1.55iR	0.62	0.66
PCB31	<0.93	1.77	0.39	<0.47	1.56	0.40	0.48
PCB47	0.46	1.82	0.68	0.89	1.65	0.45	0.37
PCB49	0.42	2.54	0.69	0.77	2.13	0.54	0.49
PCB51	<0.08	0.25	<0.02	0.13	0.24	<0.02	<0.03
PCB52	<1.02	4.21	1.23	1.68	3.47	1.24	1.04
PCB99	0.82	6.69	2.79	2.02	5.40	2.22	1.90
PCB101	1.35	21.28	5.69	3.58	10.51	5.11	3.82
PCB105	0.44	5.31	1.79	0.92	3.56	1.41	1.22
PCB114	<0.02	0.27	0.08	0.05	<0.1	0.04	0.05
PCB118	1.49	14.81	5.45	3.20	9.48	4.94	3.74
PCB123	0.06	0.76	0.09	0.04	<0.06	0.10	<0.05
PCB128	0.35	3.79	1.42	0.55	2.50	1.29	0.91
PCB138	2.86	44.00	10.90	6.90	17.08	9.10	7.38
PCB153	3.30	52.15	14.36	12.12	19.51	11.00	9.46
PCB156	0.14	2.14	0.57	0.19	0.50	0.39	0.34
PCB157	0.08	0.35i	0.23	0.11	0.22	0.19	0.15
PCB167	0.14	0.79	0.43	0.29	0.34	0.36	0.29
PCB180	0.86	9.01	0.96	1.04	0.46	0.40	0.39
PCB189	<0.16	<0.38	<0.08	<0.08	<0.15	0.05	<0.13
<b>SUM of ICES 6(ug/kg) lower</b>	<b>8.37</b>	<b>132.75</b>	<b>33.91</b>	<b>27.33</b>	<b>52.58</b>	<b>27.47</b>	<b>22.75</b>
<b>SUM of ICES 6(ug/kg) upper</b>	<b>10.46</b>	<b>132.75</b>	<b>33.91</b>	<b>27.33</b>	<b>52.58</b>	<b>27.47</b>	<b>22.75</b>
<b>WHO-TEQ 2005 (ng/kg) lower</b>	<b>0.07</b>	<b>0.73</b>	<b>0.26</b>	<b>0.14</b>	<b>0.42</b>	<b>0.22</b>	<b>0.17</b>
<b>WHO-TEQ 2005 (ng/kg) upper</b>	<b>0.08</b>	<b>0.74</b>	<b>0.26</b>	<b>0.15</b>	<b>0.43</b>	<b>0.22</b>	<b>0.18</b>

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<b>FERA LIMS No.</b>	<b>S18-000579</b>	<b>S18-000580</b>	<b>S18-001827</b>	<b>S18-001829</b>	<b>S18-001830</b>	<b>S18-001831</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1	Laxfirth	Catfirth Mussels 2
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm	North West of Skerby Ayre	East of Brunt Hamarsland
<b>Lipid weight</b>						
<b>µg/kg</b>						
PCB18	0.22	0.12	0.78	0.36	0.27	0.31
PCB28	0.67	0.43	3.34iR	1.01iR	1.03iR	1.01iR
PCB31	0.49	<0.36	1.86	0.84	0.75	<0.75
PCB47	0.50	0.32	1.55	0.48	0.59	0.54
PCB49	0.53	0.28	2.05	0.62	0.63	0.59
PCB51	<0.03	<0.05	<0.05	<0.05	<0.05	<0.05
PCB52	1.02	0.54	2.51	0.92	0.98	0.91
PCB99	2.27	0.97	2.38	1.45	1.77	1.49
PCB101	4.23	1.76	4.67	2.60	2.91	2.67
PCB105	1.23	0.61	1.82	<1.13	1.17	1.18
PCB114	0.04	<0.02	<0.05	<0.07	<0.09	<0.06
PCB118	4.67	1.99	4.57	2.96	3.56	3.12
PCB123	0.10	0.03	0.09	<0.1	0.06	<0.04
PCB128	1.27	0.49	1.22	0.90	1.10	1.02
PCB138	9.98	4.12	7.81	6.21	7.80	6.73
PCB153	14.13	5.61	11.58	9.34	12.05	10.17
PCB156	0.36	0.17	0.28	0.15	0.24	<0.24
PCB157	0.19	0.07	0.15	<0.1	0.14	<0.15
PCB167	0.40	0.2	0.36	0.25	0.31	0.29
PCB180	0.54	0.22	0.48	0.39	0.43	0.45
PCB189	<0.24	<0.17	<0.1	<0.42	<0.64	<0.93
<b>SUM of ICES 6(ug/kg) lower</b>	<b>30.57</b>	<b>12.68</b>	<b>30.39</b>	<b>20.47</b>	<b>25.20</b>	<b>21.94</b>
<b>SUM of ICES 6(ug/kg) upper</b>	<b>30.57</b>	<b>12.68</b>	<b>30.39</b>	<b>20.47</b>	<b>25.20</b>	<b>21.94</b>
<b>WHO-TEQ 2005 (ng/kg) lower</b>	<b>0.21</b>	<b>0.09</b>	<b>0.22</b>	<b>0.10</b>	<b>0.16</b>	<b>0.14</b>
<b>WHO-TEQ 2005 (ng/kg) upper</b>	<b>0.22</b>	<b>0.10</b>	<b>0.22</b>	<b>0.16</b>	<b>0.19</b>	<b>0.18</b>

**Table 8: Summary of PCDD/F and PCB WHO-TEQ, and ICES-6 concentrations**

FERA LIMS No.	S18-015405	S18-016444	S18-001373	S18-014967	S18-003670	S18-000577	S18-000578
<b>Species</b>	Common Cockles	Razors	Common Mussels	Pacific Oysters	Razors	Common Mussels	Common Mussels
<b>Production Area</b>	Loch Craignish Cockles	Peninver Razors	Loch Eil Fassfern	Lock Kanaird	Stevenson Sands Razors	West of Langa	Swining Voe
<b>Sample Site Name</b>	Ardfern	Peninver Razors	Fassfern	Ardmair	Stevenson Sands Razors	Scalloway	North West of Cul Houb
<b>Fat content (% whole)</b>	0.31	0.73	0.90	0.59	0.79	1.02	0.94
<b>WHO TEQ 2005 pg/g whole</b>							
Dioxin	0.03	0.05	0.09	0.05	0.05	0.07	0.07
non ortho-PCB	0.01	0.03	0.04	0.02	0.03	0.04	0.03
ortho-PCB	<0.01	0.01	<0.01	<0.01	0.01	<0.01	<0.01
<b>Sum of WHO TEQs (upper)</b>	<b>0.05</b>	<b>0.09</b>	<b>0.14</b>	<b>0.08</b>	<b>0.09</b>	<b>0.12</b>	<b>0.11</b>
<b>WHO TEQ 2005 pg/g Fat</b>							
Dioxin	3.62	5.13	9.31	7.05	5.17	6.61	6.69
non ortho-PCB	3.20	4.08	4.31	3.51	3.63	4.11	3.39
ortho-PCB	0.08	0.74	0.26	0.15	0.43	0.22	0.18
<b>Sum of WHO TEQs (upper)</b>	<b>6.90</b>	<b>9.95</b>	<b>13.88</b>	<b>10.71</b>	<b>9.23</b>	<b>10.94</b>	<b>10.26</b>
<b>SUM of ICES 6 µg/kg whole (upper)</b>	<b>0.06</b>	<b>0.98</b>	<b>0.31</b>	<b>0.16</b>	<b>0.42</b>	<b>0.28</b>	<b>0.23</b>
<b>SUM of ICES 6 µg/kg fat (upper)</b>	<b>10.46</b>	<b>132.75</b>	<b>33.91</b>	<b>27.33</b>	<b>52.58</b>	<b>27.47</b>	<b>22.75</b>

<b>FERA LIMS No.</b>	<b>S18-000579</b>	<b>S18-000580</b>	<b>S18-001827</b>	<b>S18-001829</b>	<b>S18-001830</b>	<b>S18-001831</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1	Laxfirth	Catfirth Mussels 2
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm	North West of Skerby Ayre	East of Brunt Hamarsland
<b>Fat content (% whole)</b>	0.85	0.63	0.47	0.39	0.42	0.33
<b>WHO TEQ 2005 pg/g whole</b>						
Dioxin	0.08	0.04	0.05	0.04	0.04	0.05
non ortho-PCB	0.04	0.01	0.02	0.01	0.02	0.01
ortho-PCB	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
<b>Sum of WHO TEQs (upper)</b>	<b>0.13</b>	<b>0.06</b>	<b>0.08</b>	<b>0.06</b>	<b>0.07</b>	<b>0.07</b>
<b>WHO TEQ 2005 pg/g Fat</b>						
Dioxin	7.96	4.65	7.40	8.74	7.47	10.09
non ortho-PCB	4.93	2.15	3.77	3.31	3.92	3.43
ortho-PCB	0.22	0.10	0.22	0.16	0.19	0.18
<b>Sum of WHO TEQs (upper)</b>	<b>13.11</b>	<b>6.90</b>	<b>11.39</b>	<b>12.21</b>	<b>11.58</b>	<b>13.70</b>
<b>SUM of ICES 6 µg/kg whole (upper)</b>	<b>0.27</b>	<b>0.11</b>	<b>0.15</b>	<b>0.10</b>	<b>0.12</b>	<b>0.09</b>
<b>SUM of ICES 6 µg/kg fat (upper)</b>	<b>30.57</b>	<b>12.68</b>	<b>30.39</b>	<b>20.47</b>	<b>25.20</b>	<b>21.94</b>



## Table 9: Samples selected for PAH contaminant testing (28)

Local Authority	Production Area	Sample Site Name	Site Identification No	Grid Reference	Species	Date Sample Taken	Date Sample Received at Fera	FERA LIMS No.
Argyll & Bute	Loch Fyne: Otter Ferry	Balliemore	AB-151-039-13	NR 92178 83502	Pacific Oyster	07/02/2018	08/02/2018	S18-001828
Argyll & Bute	Lynn of Lorn: Sgear Liath	Sgear Liath	AB-318-068-13	NM 87161 38891	Pacific Oysters	13/03/2018	14/03/2018	S18-014598
Argyll & Bute	Loch Craignish Cockles	Ardfern	AB-786-2028-04	NM 82050 05266	Common Cockles	21/03/2018	22/03/2018	S18-015405
Argyll & Bute	Peninver Razors	Peninver Razors	AB-766-1962-16	NR 74304 25007	Razors	26/03/2018	29/03/2018	S18-016444
Argyll & Bute	Loch Fyne: Stonefield oysters	North Bay Oysters	AB-435-840-13	NR 86492 72268	Pacific Oysters	20/02/2018	22/02/2018	S18-003669
Comhairle nan Eilean Siar - UB (CnES)	Traigh Mhor	Traigh Mhor	UB-282-164-04	NF 7045 0548	Cockles	06/03/2018	07/03/2018	S18-004810
Comhairle nan Eilean Siar - UB (CnES)	Cidhe Eolaigearraidh	Sound of Barra Oysters	UB-427-830-13	NF 7140 0799	Pacific Oysters	06/03/2018	07/03/2018	S18-004811
Dumfries & Galloway	Loch Ryan	Leffnoll Point	DG-191-174-12	NX 0660 2066	Native Oysters	19/03/2018	20/03/2018	S18-014965
Fife	Firth of Forth: North	Anstruther	FF-068-184-19	NO 5944 0475	Surf Clams	05/02/2018	07/02/2018	S18-001714
Highlands - Lochaber	Loch Leven: Upper	Upper	HL-171-223-08	NN1480 6168	Common Mussels	22/01/2018	24/01/2018	S18-000847
Highlands - Lochaber	Loch Leven: Lower	Lower	HL-170-222-08	NN0716 5905	Common Mussels	22/01/2018	24/01/2018	S18-000848
Highlands - Lochaber	Loch Eil: Fassfern	Fassfern	HL-136-219-08	NN02957815	Common Mussels	30/01/2018	31/01/2018	S18-001373
Highlands - Lochaber	Arisaig	Sgeirean Buidhe	HL-004-202-13	NM63877 85325	Pacific Oysters	05/03/2018	07/03/2018	S18-004812
Highlands - Lochaber	Loch Eil	Duisky	HL-134-216-08	Not Supplied Pod No: 34	Common Mussels	27/03/2018	28/03/2018	S18-016326
Highlands - Ross & Cromarty	Lock Kanaird	Ardmair	RC-625-1233-13	NH 11815 99204	Pacific Oysters	19/03/2018	20/03/2018	S18-014967
Highlands - Sutherland	Loch Inchard	Loch Inchard - Site 1 – D. Ross	HS-162-311-08	NC 2393 5430	Common Mussels	16/01/2018	18/01/2018	S18-000581

Local Authority	Production Area	Sample Site Name	Site Identification No	Grid Reference	Species	Date Sample Taken	Date Sample Received at Fera	FERA LIMS No.
North Ayrshire	Fairlie	Southannan Sands	NA-065-332-13	Not supplied	Pacific Oyster	29/01/2018	31/01/2018	S18-001372
North Ayrshire	Stevenston Sands Razors	Stevenston Sands Razors	NA-825-2169-16	NS 2629 4038	Razors	20/02/2018	22/02/2018	S18-003670
Shetland	West of Langa	Scalloway	SI-822-2160-08	HU 3714 3951	Common Mussels	17/01/2018	18/01/2018	S18-000577
Shetland	Swining Voe	North West of Cul Houb	SI-820-2156-08	HU 4645 6842	Common Mussels	17/01/2018	18/01/2018	S18-000578
Shetland	Seli Voe	Garderhouse	SI-815-2143-08	HU 3336 4692	Common Mussels	17/01/2018	18/01/2018	S18-000579
Shetland	Colla Firth	Colla Firth	SI-040-417-08	HU 4742 6925	Common Mussels	17/01/2018	18/01/2018	S18-000580
Shetland	Dales Voe: Muckle Ayre	Muckle Ayre	SI-049-419-08	HU4430 4433	Common Mussels	07/02/2018	08/02/2018	S18-001827
Shetland	Catfirth Mussels 1	East of Little Holm	SI-816-2144-08	HU 4557 5281	Common Mussels	07/02/2018	08/02/2018	S18-001829
Shetland	Laxfirth	North West of Skerby Ayre	SI-814-2142-08	HU 4445 4768	Common Mussels	07/02/2018	08/02/2018	S18-001830
Shetland	Catfirth Mussels 2	East of Brunt Hamarsland	SI-817-2147-08	HU 4471 5234	Common Mussels	07/02/2018	08/02/2018	S18-001831
Shetland	Aith Voe Sletta	Slyde	SI-326-733-08	HU 3480 5869	Common Mussels	19/03/2018	20/03/2018	S18-014966
South Ayrshire	North Bay	Barassie	SA-337-719-16	Incomplete reference supplied	Razors	20/02/2018	22/02/2018	S18-003671

**Table 10: PAH concentrations (µg/kg whole weight)**

<b>FERA LIMS No.</b>	<b>S18-001828</b>	<b>S18-014598</b>	<b>S18-015405</b>	<b>S18-016444</b>	<b>S18-003669</b>
<b>Species</b>	Pacific Oyster	Pacific Oysters	Common Cockles	Razors	Pacific Oysters
<b>Production Area</b>	Loch Fyne: Otter Ferry	Lynn of Lorn: Sgear Liath	Loch Craignish Cockles	Peninver Razors	Loch Fyne: Stonefield oysters
<b>Sample Site Name</b>	Balliemore	Sgear Liath	Ardfern	Peninver Razors	North Bay Oysters
<b>µg/kg whole weight</b>					
acenaphthylene	<0.15	0.07	<0.07	<0.18	0.32
acenaphthene	<0.32	<0.36	<0.36	<0.36	<0.36
fluorene	<0.43	<0.46	<0.44	0.52	<0.46
phenanthrene	1.20	0.82	0.63	1.90	0.82
anthracene	0.12	<0.05	<0.04	0.18	0.16i
fluoranthene	3.18	2.06	0.91	4.30	2.95
benzo[c]fluorene	0.16i	0.17	0.03	0.29i	0.22
pyrene	3.01i	1.24	0.44i	3.36	2.98i
benzo[ghi]fluoranthene	1.36	0.95	0.21	1.56	1.55
benz[a]anthracene	0.94	0.59	0.11	2.19	1.21
benzo[b]naphtho[2,1-d]thiophene	0.16	0.18	0.05	0.53	0.25
cyclopenta[c,d]pyrene	<0.05	0.08	<0.03	<0.03	0.09
chrysene	1.34	1.21	0.33	2.94	1.50
5-methylchrysene	<0.05	<0.05	<0.05	0.05	0.09
benzo[b]fluoranthene	2.34	2.46	0.32	2.03	4.22
benzo[j]fluoranthene	0.64	0.67	0.18	0.94	1.27
benzo[k]fluoranthene	1.01	0.99	0.22	1.11	1.95
benzo[e]pyrene	2.89	2.41	0.38	3.40	4.75
benzo[a]pyrene	0.41	0.26	<0.18	1.31	0.97
indeno[1,2,3-cd]pyrene	0.39	0.39	0.27	0.90	0.88
dibenz[a,h]anthracene	0.13	0.12	<0.06	0.18	0.27
benzo[g,h,i]perylene	0.52	0.46	0.24	1.05	1.16
anthanthrene	<0.1	<0.1	<0.1	<0.1	<0.1
dibenzo[a,l]pyrene	<0.1	<0.1	<0.1	0.20i	<0.1
dibenzo[a,e]pyrene	<0.1	<0.1	<0.1	<0.16	<0.1
dibenzo[a,i]pyrene	<0.1	<0.1	<0.1	<0.1	<0.1
dibenzo[a,h]pyrene	<0.1	<0.1	<0.1	<0.1	<0.1
coronene	<0.1	<0.1	<0.1	0.31	0.18
<b>PAH 4 Sum Lower µg/kg</b>	<b>5.03</b>	<b>4.52</b>	<b>0.76</b>	<b>8.47</b>	<b>7.90</b>
<b>PAH 4 Sum Upper µg/kg</b>	<b>5.03</b>	<b>4.52</b>	<b>0.94</b>	<b>8.47</b>	<b>7.90</b>

Where shown i= indicative

FERA LIMS No.	S18-004810	S18-004811	S18-014965	S18-001714	S18-000847
Species	Cockles	Pacific Oysters	Native Oysters	Surf Clams	Common Mussels
Production Area	Traigh Mhor	Cidhe Eolaigearraidh Sound of Barra: Pacific Oysters	Loch Ryan	Firth of Forth: North	Loch Leven: Upper
Sample Site Name	Traigh Mhor		Leffnoll Point	Anstruther	Upper
<b>µg/kg whole weight</b>					
acenaphthylene	<0.07	0.10	0.27	0.36	<0.13
acenaphthene	<0.36	<0.36	<0.35	<0.33	<0.32
fluorene	<0.44	<0.46	0.67	<0.44	<0.43
phenanthrene	<0.54	<0.62	3.81	2.16	1.04
anthracene	<0.05	0.05i	0.29i	0.27	0.17
fluoranthene	0.43	0.99	8.84	3.67	1.68
benzo[c]fluorene	0.02	0.05	0.60	0.16i	0.11
pyrene	<0.29	0.36i	4.23i	3.53i	2.25
benzo[ghi]fluoranthene	0.16	0.28	2.16	0.96	1.03
benz[a]anthracene	0.08	0.13	2.47	1.40	0.90
benzo[b]naphtho[2,1-d]thiophene	<0.04	0.05	0.64	0.16	0.24
cyclopenta[c,d]pyrene	<0.03	<0.05	0.11	<0.05	<0.05
chrysene	0.23	0.36	3.26	1.49	1.61
5-methylchrysene	<0.05	<0.05	0.12	<0.05	<0.05
benzo[b]fluoranthene	0.23	0.57	5.04	1.45	7.35
benzo[j]fluoranthene	0.13	0.12	2.06	0.75	1.91
benzo[k]fluoranthene	0.18	0.19	4.31	0.85	2.93
benzo[e]pyrene	0.22	0.45	3.78	2.37	9.61
benzo[a]pyrene	<0.18	<0.06	1.29	1.17	1.99
indeno[1,2,3-cd]pyrene	0.22	0.11	1.53	0.97	1.82
dibenz[a,h]anthracene	<0.05	<0.05	0.40	0.39	0.44
benzo[g,h,i]perylene	0.16	0.10	1.46	1.20	2.94
anthanthrene	<0.1	<0.1	<0.1	0.30	<0.1
dibenzo[a,l]pyrene	<0.1	<0.1	<0.17	0.59	0.30
dibenzo[a,e]pyrene	<0.1	<0.1	<0.13	0.56	0.25
dibenzo[a,i]pyrene	<0.1	<0.1	<0.1	0.52	<0.1
dibenzo[a,h]pyrene	<0.1	<0.1	<0.1	0.37	<0.1
coronene	<0.1	<0.1	0.31	0.75	0.42
<b>PAH 4 Sum Lower µg/kg</b>	<b>0.54</b>	<b>1.06</b>	<b>12.06</b>	<b>5.51</b>	<b>11.85</b>
<b>PAH 4 Sum Upper µg/kg</b>	<b>0.72</b>	<b>1.12</b>	<b>12.06</b>	<b>5.51</b>	<b>11.85</b>

<b>FERA LIMS No.</b>	<b>S18-000848</b>	<b>S18-001373</b>	<b>S18-004812</b>	<b>S18-016326</b>	<b>S18-014967</b>
<b>Species</b>	Common Mussels	Common Mussels	Pacific Oysters	Common Mussels	Pacific Oysters
<b>Production Area</b>	Loch Leven: Lower	Loch Eil: Fassfern	Arisaig	Loch Eil	Loch Kanaird
<b>Sample Site Name</b>	Lower	Fassfern	Sgeirean Buidhe	Duisky	Ardmair
<b>µg/kg whole weight</b>					
acenaphthylene	<0.15	<0.16	<0.06	<0.08	<0.06
acenaphthene	<0.33	<0.33	<0.34	<0.36	<0.35
fluorene	<0.44	<0.44	<0.45	<0.44	<0.46
phenanthrene	1.05	1.34	<0.59	0.99	<0.61
anthracene	0.15	0.14	<0.05	0.08	<0.05
fluoranthene	1.61	2.55	0.91	1.33	1.17
benzo[c]fluorene	0.10	0.11i	0.04	0.06	0.07
pyrene	2.07	2.54i	0.51i	0.97i	0.62
benzo[ghi]fluoranthene	0.91	1.26	0.28	0.58	0.53
benz[a]anthracene	0.67	0.98	0.11	0.51	0.27
benzo[b]naphtho[2,1-d]thiophene	0.18	<0.05	<0.04	0.10	0.08
cyclopenta[c,d]pyrene	<0.05	<0.05	<0.05	<0.03	<0.05
chrysene	1.26	1.32	0.25	0.77	0.43
5-methylchrysene	<0.05	<0.05	<0.04	<0.05	<0.04
benzo[b]fluoranthene	5.11	2.94	0.54	1.03	0.67
benzo[j]fluoranthene	1.45	0.99	0.12	0.45	0.15
benzo[k]fluoranthene	2.06	1.26	0.20	0.52	0.24
benzo[e]pyrene	7.18	5.98	0.46	2.07	0.59
benzo[a]pyrene	1.17	0.66	<0.06	0.25	<0.06
indeno[1,2,3-cd]pyrene	1.39	0.68	0.12	0.46	0.17
dibenz[a,h]anthracene	0.30	0.27	<0.05	<0.1	<0.05
benzo-[g,h,i]perylene	2.43	1.04	0.12	0.66	0.16
anthanthrene	<0.1	0.13	<0.1	<0.1	<0.1
dibenzo[a,l]pyrene	0.20	0.62	<0.1	<0.1	<0.1
dibenzo[a,e]pyrene	0.19	0.37	<0.1	<0.11	<0.1
dibenzo[a,i]pyrene	<0.1	0.48	<0.1	<0.1	<0.1
dibenzo[a,h]pyrene	<0.1	0.20	<0.1	<0.1	<0.1
coronene	0.34	0.45	<0.1	0.24	<0.1
<b>PAH 4 Sum Lower µg/kg</b>	<b>8.21</b>	<b>5.90</b>	<b>0.90</b>	<b>2.56</b>	<b>1.37</b>
<b>PAH 4 Sum Upper µg/kg</b>	<b>8.21</b>	<b>5.90</b>	<b>0.96</b>	<b>2.56</b>	<b>1.43</b>

<b>FERA LIMS No.</b>	S18-000581	S18-001372	S18-003670	S18-000577	S18-000578
<b>Species</b>	Common Mussels	Pacific Oyster	Razors	Common Mussels	Common Mussels
<b>Production Area</b>	Loch Incharad	Fairlie	Stevenston Sands Razors	West of Langa	Swining Voe
<b>Sample Site Name</b>	Loch Incharad – Site 1 – D. Ross	Southannan Sands	Stevenston Sands Razors	Scalloway	North West of Cul Houb
<b>µg/kg whole weight</b>					
acenaphthylene	<0.16	<0.44	0.17	<0.11	<0.11
acenaphthene	<0.32	<0.32	<0.35	<0.29	<0.29
fluorene	<0.43	0.50	0.63	<0.6	<0.6
phenanthrene	1.33	2.39	2.25	<0.82	<0.82
anthracene	0.09	0.34	0.20i	0.08	0.08
fluoranthene	1.00	7.99	5.62	0.51	0.51
benzo[c]fluorene	0.05	0.42i	0.46	0.03	0.04
pyrene	0.77i	8.99i	4.50i	0.65	0.64i
benzo[ghi]fluoranthene	0.45	2.76	1.91	0.33	0.38
benz[a]anthracene	0.15	2.36	2.73	0.23	0.32
benzo[b]naphtho[2,1-d]thiophene	<0.05	0.43	0.54	0.05	0.07
cyclopenta[c,d]pyrene	<0.05	<0.05	0.08	0.02	0.03
chrysene	0.26	2.91	3.27	0.49	0.64
5-methylchrysene	<0.05	0.09	0.11	<0.01	0.01
benzo[b]fluoranthene	0.78	5.57	3.12	0.96	0.97
benzo[j]fluoranthene	0.28	1.51	1.41	0.39	0.43
benzo[k]fluoranthene	0.28	2.61	1.64	0.35	0.36
benzo[e]pyrene	1.21	7.67	4.57	1.05	1.02
benzo[a]pyrene	0.16	1.44	1.87	0.22	0.26
indeno[1,2,3-cd]pyrene	0.31	0.89	0.76	0.43	0.40
dibenz[a,h]anthracene	<0.06	0.29	0.17	0.07	0.06
benzo-[g,h,i]perylene	0.45	1.33	0.93	0.56	0.51
anthanthrene	<0.1	<0.1	<0.1	<0.1	<0.1
dibenzo[a,l]pyrene	<0.1	<0.1	<0.1	<0.1	<0.1
dibenzo[a,e]pyrene	<0.1	<0.11	<0.11	<0.1	<0.1
dibenzo[a,i]pyrene	<0.1	<0.1	<0.1	<0.1	<0.1
dibenzo[a,h]pyrene	<0.1	<0.1	<0.1	<0.1	<0.1
coronene	0.17	0.16	0.16	0.17	0.18
<b>PAH 4 Sum Lower µg/kg</b>	<b>1.35</b>	<b>12.28</b>	<b>10.99</b>	<b>1.90</b>	<b>2.19</b>
<b>PAH 4 Sum Upper µg/kg</b>	<b>1.35</b>	<b>12.28</b>	<b>10.99</b>	<b>1.90</b>	<b>2.19</b>

<b>FERA LIMS No.</b>	<b>S18-000579</b>	<b>S18-000580</b>	<b>S18-001827</b>	<b>S18-001829</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm
<b>µg/kg whole weight</b>				
acenaphthylene	0.16	<0.09	<0.08	<0.09
acenaphthene	<0.29	<0.32	<0.3	<0.32
fluorene	<0.6	<0.43	<0.41	<0.44
phenanthrene	0.91	<0.55	<0.52	0.58
anthracene	<0.08	<0.05	<0.05	<0.05
fluoranthene	1.05	<0.32	0.40	0.45
benzo[c]fluorene	0.06	<0.03	<0.02	<0.03
pyrene	0.99	0.29i	0.46i	0.49i
benzo[ghi]fluoranthene	0.53	0.18	0.18	0.17
benz[a]anthracene	0.40	0.13	0.11	0.09
benzo[b]naphtho[2,1-d]thiophene	0.07	<0.05	<0.05	<0.05
cyclopenta[c,d]pyrene	0.03	<0.05	<0.05	<0.05
chrysene	0.75	0.28	0.30	0.30
5-methylchrysene	0.01	<0.05	<0.05	<0.05
benzo[b]fluoranthene	1.20	0.58	0.55	0.49
benzo[j]fluoranthene	0.49	0.21	0.19	0.19
benzo[k]fluoranthene	0.44	0.24	0.21	0.19
benzo[e]pyrene	1.18	0.55	0.55	0.42
benzo[a]pyrene	0.29	0.18	0.15	<0.14
indeno[1,2,3-cd]pyrene	0.50	0.30	0.25	0.19
dibenz[ah]anthracene	0.07	<0.06	0.07	<0.06
benzo-[g,h,i]perylene	0.62	0.34	0.30	0.25
anthanthrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,l]pyrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,e]pyrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,i]pyrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,h]pyrene	<0.1	<0.1	<0.1	<0.1
coronene	0.20	0.12	<0.1	<0.1
<b>PAH 4 Sum Lower µg/kg</b>	<b>2.64</b>	<b>1.17</b>	<b>1.11</b>	<b>0.88</b>
<b>PAH 4 Sum Upper µg/kg</b>	<b>2.64</b>	<b>1.17</b>	<b>1.11</b>	<b>1.02</b>

<b>FERA LIMS No.</b>	<b>S18-001830</b>	<b>S18-001831</b>	<b>S18-014966</b>	<b>S18-003671</b>
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Razors
<b>Production Area</b>	Laxfirth	Catfirth Mussels 2	Aith Voe Sletta	North Bay
<b>Sample Site Name</b>	North West of Skerby Ayre	East of Brunt Hamarsland	Slyde	Barassie
<b>µg/kg whole weight</b>				
acenaphthylene	<0.06	<0.06	<0.13	0.13
acenaphthene	<0.36	<0.36	<0.36	<0.35
fluorene	<0.46	<0.47	<0.44	0.64
phenanthrene	<0.62	<0.62	<0.55	2.41
anthracene	<0.05	<0.05	<0.05	0.26i
fluoranthene	0.61	<0.37	0.54	6.38
benzo[c]fluorene	0.03	0.02	0.02	0.45
pyrene	2.04i	0.37i	0.38i	5.30i
benzo[ghi]fluoranthene	0.38	0.17	0.30	1.87
benz[a]anthracene	0.15	0.13	0.14	2.79
benzo[b]naphtho[2,1-d]thiophene	<0.04	<0.04	<0.04	0.53
cyclopenta[c,d]pyrene	<0.05	<0.05	<0.03	0.08
chrysene	0.32	0.28	0.42	3.11
5-methylchrysene	<0.05	<0.05	<0.05	0.10
benzo[b]fluoranthene	0.41	0.41	0.81	2.99
benzo[j]fluoranthene	0.17	0.18	0.29	1.40
benzo[k]fluoranthene	0.14	0.16	0.32	1.58
benzo[e]pyrene	0.35	0.29	0.78	4.16
benzo[a]pyrene	0.07	0.07	<0.18	1.88
indeno[1,2,3-cd]pyrene	0.21	0.20	0.33	0.71
dibenz[ah]anthracene	<0.05	<0.05	<0.06	0.16
benzo-[g,h,i]perylene	0.41	0.21	0.39	0.87
anthanthrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,l]pyrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,e]pyrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,i]pyrene	<0.1	<0.1	<0.1	<0.1
dibenzo[a,h]pyrene	<0.1	<0.1	<0.1	<0.1
coronene	0.11	<0.1	0.15	0.12
<b>PAH 4 Sum Lower µg/kg</b>	<b>0.95</b>	<b>0.89</b>	<b>1.37</b>	<b>10.77</b>
<b>PAH 4 Sum Upper µg/kg</b>	<b>0.95</b>	<b>0.89</b>	<b>1.55</b>	<b>10.77</b>



## Table 11: Samples selected for Trace Element contaminant testing (20)

Local Authority	Production Area	Sample Site Name	Site Identification No	Grid Reference	Species	Date Sample Taken	Date Sample Received at Fera	FERA LIMS No.
Argyll & Bute	Lynn of Lorn: Sgear Liath	Sgear Liath	AB-318-068-13	NM 87161 38891	Pacific Oysters	13/03/2018	14/03/2018	S18-014598
Argyll & Bute	Loch Craignish Cockles	Ardfern	AB-786-2028-04	NM 82050 05266	Common Cockles	21/03/2018	22/03/2018	S18-015405
Argyll & Bute	Peninver Razors	Peninver Razors	AB-766-1962-16	NR 74304 25007	Razors	26/03/2018	29/03/2018	S18-016444
Dumfries & Galloway	Loch Ryan	Leffnoll Point	DG-191-174-12	NX 0660 2066	Native Oysters	19/03/2018	20/03/2018	S18-014965
Fife	Firth of Forth: North	Anstruther	FF-068-184-19	NO 5944 0475	Surf Clams	05/02/2018	07/02/2018	S18-001714
Highlands - Lochaber	Loch Sunart	Liddisdale	HL-206-1237-08	NM7830 6012	Common Mussels	30/01/2018	31/01/2018	S18-001371
Highlands - Lochaber	Loch Eil: Fassfern	Fassfern	HL-136-219-08	NN02957815	Common Mussels	30/01/2018	31/01/2018	S18-001373
Highlands - Lochaber	Loch Eil	Duisky	HL-134-216-08	Not Supplied	Common Mussels	27/03/2018	28/03/2018	S18-016326
Highlands - Ross & Cromarty	Loch Kanaird	Ardmair	RC-625-1233-13	NH 11815 99204	Pacific Oysters	19/03/2018	20/03/2018	S18-014967
Highlands - Ross & Cromarty	Inner Loch Torridon	Dubh Aird	RC-090-1616-08	NG 8747 5496	Common Mussels	27/03/2018	28/03/2018	S18-016325
Highlands - Sutherland	Loch Laxford	Weavers Bay	HS-167-320-08	NC2134 4858	Common Mussels	13/03/2018	14/03/2018	S18-014597
North Ayrshire	Stevenston Sands Razors	Stevenston Sands Razors	NA-825-2169-16	NS 2629 4038	Razors	20/02/2018	22/02/2018	S18-003670
Shetland	West of Langa	Scalloway	SI-822-2160-08	HU 3714 3951	Common Mussels	17/01/2018	18/01/2018	S18-000577
Shetland	Swining Voe	North West of Cul Houb	SI-820-2156-08	HU 4645 6842	Common Mussels	17/01/2018	18/01/2018	S18-000578
Shetland	Seli Voe	Garderhouse	SI-815-2143-08	HU 3336 4692	Common Mussels	17/01/2018	18/01/2018	S18-000579
Shetland	Colla Firth	Colla Firth	SI-040-417-08	HU 4742 6925	Common Mussels	17/01/2018	18/01/2018	S18-000580

Shetland	Dales Voe: Muckle Ayre	Muckle Ayre	S1-049-419 -08	HU4430 4433	Common Mussels	07/02/2018	08/02/2018	S18-001827
Shetland	Catfirth Mussels 1	East of Little Holm	SI-816-2144-08	HU 4557 5281	Common Mussels	07/02/2018	08/02/2018	S18-001829
Shetland	Laxfirth	North West of Skerby Ayre	SI-814-2142-08	HU 4445 4768	Common Mussels	07/02/2018	08/02/2018	S18-001830
Shetland	Catfirth Mussels 2	East of Brunt Hamarsland	SI-817-2147-08	HU 4471 5234	Common Mussels	07/02/2018	08/02/2018	S18-001831

**Table 12: Trace Element Concentrations (mg/kg whole weight)**

<b>FERA LIMS No.</b>	S18-014598	S18-015405	S18-016444	S18-014965	S18-001714	S18-001371	S18-001373
<b>Species</b>	Pacific Oysters	Common Cockles	Razors	Native Oysters	Surf Clams	Common Mussels	Common Mussels
<b>Production Area</b>	Lynn of Lorn: Sgear Liath	Loch Craignish Cockles	Peninver Razors	Loch Ryan	Firth of Forth: North	Loch Sunart	Loch Eil: Fassfern
<b>Sample Site Name</b>	Sgear Liath	Ardfern	Peninver Razors	Leffnoll Point	Anstruther	Liddisdale	Fassfern
<b>Result mg/kg whole weight</b>							
Chromium	<0.03	0.24	0.15	0.19	0.21	0.10	~0.09
Manganese	1.61	2.93	2.77	4.35	3.00	2.91	2.58
Cobalt	0.014	0.148	0.086	0.046	0.144	0.027	0.029
Nickel	~0.03	1.36	0.11	0.13	0.27	~0.09	~0.07
Copper	5.0	0.40	1.34	27.1	1.52	0.66	0.74
Zinc	102.0	4.59	16.2	303.0	8.19	9.95	8.98
Arsenic	1.11	0.99	1.52	1.62	1.73	1.33	1.48
Selenium	0.136	0.151	0.257	0.463	0.397	0.310	0.280
Silver	0.307	<0.003	0.121	1.750	0.304	0.015	0.010
Cadmium	0.098	0.027	0.023	0.35	0.066	0.068	0.068
Mercury	0.009	0.007	0.011	0.017	0.014	0.012	0.015
Lead	0.029	0.047	0.083	0.080	0.138	1.180	0.050

' ~ ' indicates the measured value was above LoD but below LoQ

<b>FERA LIMS No.</b>	S18-016326	S18-014967	S18-016325	S18-014597	S18-003670	S18-000577	S18-000578
<b>Species</b>	Common Mussels	Pacific Oysters	Common Mussels	Common Mussels	Razors	Common Mussels	Common Mussels
<b>Production Area</b>	Loch Eil	Loch Kanaird	Inner Loch Torridon	Loch Laxford	Stevenston Sands Razors	West of Langa	Swining Voe
<b>Sample Site Name</b>	Duisky	Ardmair	Dubh Aird	Weavers Bay	Stevenston Sands Razors	Scalloway	North West of Cul Houb
<b>Result mg/kg whole weight</b>							
Chromium	~0.08	~0.04	~0.09	0.11	0.19	0.12	0.11
Manganese	3.22	1.56	0.89	0.89	0.80	0.66	0.50
Cobalt	0.037	0.017	0.020	0.025	0.094	0.029	0.028
Nickel	~0.09	~0.04	~0.08	0.10	~0.09	0.11	0.12
Copper	0.62	3.02	0.36	0.77	1.19	0.97	0.80
Zinc	8.31	93.8	4.73	7.05	14.2	19.7	25.3
Arsenic	1.73	1.63	1.76	1.58	1.65	2.13	2.17
Selenium	0.336	0.272	0.228	0.470	0.244	0.369	0.355
Silver	0.012	0.213	~0.006	~0.006	0.470	~0.004	~0.006
Cadmium	0.062	0.174	0.093	0.046	0.024	0.222	0.157
Mercury	0.016	0.011	0.011	0.008	0.018	~0.005	0.007
Lead	0.044	0.024	0.070	0.067	0.086	0.138	0.165

<b>FERA LIMS No.</b>	S18-000579	S18-000580	S18-001827	S18-001829	S18-001830	S18-001831
<b>Species</b>	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels	Common Mussels
<b>Production Area</b>	Seli Voe	Colla Firth	Dales Voe: Muckle Ayre	Catfirth Mussels 1	Laxfirth	Catfirth Mussels 2
<b>Sample Site Name</b>	Garderhouse	Colla Firth	Muckle Ayre	East of Little Holm	North West of Skerby Ayre	East of Brunt Hamarland
Result mg/kg whole weight						
Chromium	0.14	~0.08	0.10	~0.06	~0.06	~0.07
Manganese	0.75	0.29	0.49	0.39	0.65	0.38
Cobalt	0.031	0.017	0.022	0.014	0.015	0.015
Nickel	0.14	~0.08	0.11	~0.08	~0.08	~0.09
Copper	1.03	0.44	0.70	0.45	0.43	0.45
Zinc	23.1	15.9	17.0	16.6	14.3	16.0
Arsenic	2.27	1.22	1.38	1.26	1.21	1.15
Selenium	0.299	0.206	0.223	0.184	0.182	0.191
Silver	~0.005	<0.003	~0.003	<0.003	<0.003	<0.003
Cadmium	0.124	0.111	0.085	0.096	0.078	0.10
Mercury	~0.006	~0.005	~0.006	~0.005	~0.005	~0.005
Lead	0.162	0.099	0.179	0.103	0.099	0.110

' ~ ' indicates the measured value was above LoD but below LoQ

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