Comparison of contaminant levels in oysters from Tauranga Harbour in 1990 and 2016

Bay of Plenty Regional Council
Environmental Publication 2016/09

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ISSN: 1175-9372 (Print)
ISSN: 1179-9471 (Online)

BAY OF PLENTY REGIONAL COUNCIL
TOI MOANA

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Cover Photo: Sentinel Oysters deployed in the port area of Tauranga Harbour in 2015.

Acknowledgements

The contribution of Rob Win in organising and undertaking sourcing, deployment and retrieval of oysters at sites throughout Tauranga Harbour is acknowledged and greatly appreciated.

Also thanks to the Bay of Plenty Regional Council laboratory staff for general help with logistics of sample handling and processing and to Rebecca Lawton for reviewing the draft document.

Executive summary

This report presents contaminant results (metals and organics) from sentinel oyster deployments and wild shellfish collections made in Tauranga Harbour between February and June 2016. The location of sites focused on assessing areas of the harbour most at risk from catchment derived contaminants and duplicated sites used in a comparable study conducted in 1990, so that assessment of changes since that time could be made.

Arsenic, chromium, lead and nickel concentrations in oysters showed low levels (e.g. maximum 2.7, 0.21, 0.4 mg/kg wet wt. respectively) across the whole harbour, while Zinc and Copper showed higher levels around the port and city area. Copper levels have increased markedly (by 200% to 400%) in the port area since the 1990 study and this is likely to be the result of increased Copper antifouling being used on commercial shipping. There were some species specific differences noted with mussels having lower Zinc and Copper concentrations than oysters, which is consistent with other studies comparing these species. Wild Oysters also displayed higher Zinc concentrations than Sentinel Oysters, which is consistent with the 1990 study.

Concentrations of Polycyclic Aromatic Hydrocarbons (PAHs) in shellfish showed similar geographical patterns across Tauranga Harbour to the heavy metals, with highest levels (5–23 μg/kg wet wt.) around the port and city areas. Levels were similar at most port sites between 1990 and 2016, while other sites around the city (Waikareao) show higher levels than previously recorded. One of the main contributors to the higher levels of PAHs measured in 2016, is likely to be increased traffic volumes around the city, although the Mobil oil spill which occurred in 2015 may have affected some sites. The levels of PAHs are similar to those recorded in the Manukau Harbour, when taking into account proximity to potential sources.

Analysis was also carried out on a range of commonly used and environmentally persistent organochlorine pesticides that have previously been used in New Zealand. All were below levels of detection except for DDT and its breakdown products. Concentrations of total DDT in 2016 (average 2.05 μg/kg wet wt.) are now lower than in 1990 (average 3.71 μg/kg wet wt.) indicating that environmental levels are trending down.

Tributyltin (TBT) concentrations measured in the 2016 oyster samples (0.0–8.0 μg/kg wet wt.) were much lower than in 1990 (0.3–31.6 μg/kg wet wt.). In 2016, all sites except for the Sulphur Point Marina had concentrations below detection limits. The marked decrease in TBT levels is due to the complete ban of its use as an antifouling compound in commercial shipping since 2008.

None of the metal or organic contaminant concentrations measured in this study were assessed to pose a health risk from consumption of these shellfish.

Contents

Appendices

Part 1: Introduction

1.1 Scope

This report presents the results of shellfish (mainly oyster) contamination surveys in Tauranga Harbour. The surveys were undertaken to provide:

- Assessment of the current (2016) level of contaminants around Tauranga Harbour.
- Assessment of changes in contamination levels since 1990.

The information can also be used to evaluate the effectiveness of the Regional Council's policy provisions which seek to maintain a healthy and sustainable coastal environment.

1.2 Background

Accumulation of contaminants in estuarine systems is a global problem. Rivers and streams carry a range of pollutants from developed catchments and, because of chemical and physical processes, these pollutants tend to accumulate in harbours and estuaries. Contaminants vary according to land use and other activities and come from both point and diffuse sources. Nutrients, pesticides and herbicides are common contaminants from agricultural use while urban areas often contribute contaminants such as Zinc, lead, Copper, and organic PAH's that are sourced from oil and combustion processes. When these compounds or metals accumulate to high levels they can have a wide range of effects on different species. The effects need not be lethal and if certain key species are affected, there may also be marked flow on effects to the ecosystem as a whole.

In Tauranga Harbour, the greatest potential for contamination, particularly for contaminants such as metals and organics associated with urbanisation and industrial areas, occurs in the southern area of the harbour. Tauranga city and the Port of Tauranga are located at the southern (Mount Maunganui) entrance to the harbour. Tauranga City is one of the fastest growing centres in New Zealand with a census population of 114,789 in 2013 and now estimated to be around 128,000. The Port of Tauranga is New Zealand's largest port by volume and has just completed a new capital dredging programme that will see New Zealand's largest container vessels (348 m length - 9500 containers) regularly scheduled to visit the country.

Previous surveys in Tauranga Harbour have identified that shellfish contamination reflects the degree of development in the catchments. A survey conducted in 1990 using Sentinel Oysters (shellfish deployed for the purpose of monitoring) (Power 1994) found the lowest level of contaminants in the northern basin and highest levels around the port and city. A similar trend has been shown for contaminants in sediments (McIntosh 1994, Park 2003).

Overall, the 1990 survey showed that levels of agricultural chemicals (pesticides and herbicides) and chemicals from industry and urban areas were below concentrations that are of concern for human consumption (Power 1994). However, levels of Tributyltin (TBT) were also shown to be high enough at the time of the 1990 survey to cause sub-lethal effects (imposex) in gastropod snails around the Port of Tauranga and potentially population impacts (Stewart et al. 1992). Stewart et al. (1992) also noted that the imposex gradient around Tauranga Harbour was much more pronounced than for Waitemata Harbour.

Since 1990 there have been significant changes, not only including the marked growth of Tauranga city and the port, but also national and international legislative changes on the use of persistent and toxic organic compounds. In the 1980's, some countries banned the use of TBT on vessels smaller than 25 m. In 2008, the International Maritime Organisation completely banned the use of organotin compounds (includes TBT) as biocides in anti-fouling paint under the International Convention on the Control of Harmful Anti-fouling Systems on Ships. Hence, the current shellfish survey in 2015/16 occurs 25 years after the 1990 survey and provides an up to date assessment of changes that have occurred over that period.

Part 2: Location and methods

2.1 Location

Tauranga Harbour lies within the western area of the Bay of Plenty region which is located on the northeast coast of the North Island, New Zealand. It has similar oceanographic characteristics to the coast extending further north and is strongly influenced by the East Auckland current.

2.1.1 Tauranga Harbour

Tauranga Harbour is the largest estuarine inlet in the region being impounded by a barrier island (Matakana Island) and two barrier tombolos, Mount Maunganui at the southern entrance and Bowentown to the north (Healy and Kirk 1981). The harbour is shallow and covers an area of 201 km^2 with 66% of its total area being intertidal.

The harbour catchment covers an area of approximately 1,300 km^2 and is well developed with extensive horticultural and agricultural use. At the southern end of the harbour, the city of Tauranga and surrounding area supports a large residential population (around 128,000). Near the southern entrance, the Mount Maunganui–Sulphur Point region of the harbour has been progressively developed for port facilities.

There are three main harbour basins with the northern basin having a total catchment area of 270 km^2 and a mean freshwater inflow of 4.1 m^3/s. The southern catchment has a total area of 1,030 km^2 and a mean freshwater inflow of 30.5 m^3/s. There are many small sub-estuaries around the harbour. At mean high water the northern basin has a volume of approximately 178 million m^3 and the southern basin a volume of 278 million m^3. In the northern harbour, the freshwater inflow represents only 0.1% of the harbour volume per tidal cycle while the southern input represents 0.48%.

A more detailed and harbour-wide breakdown of catchments and sub estuaries is presented in Park (2003).

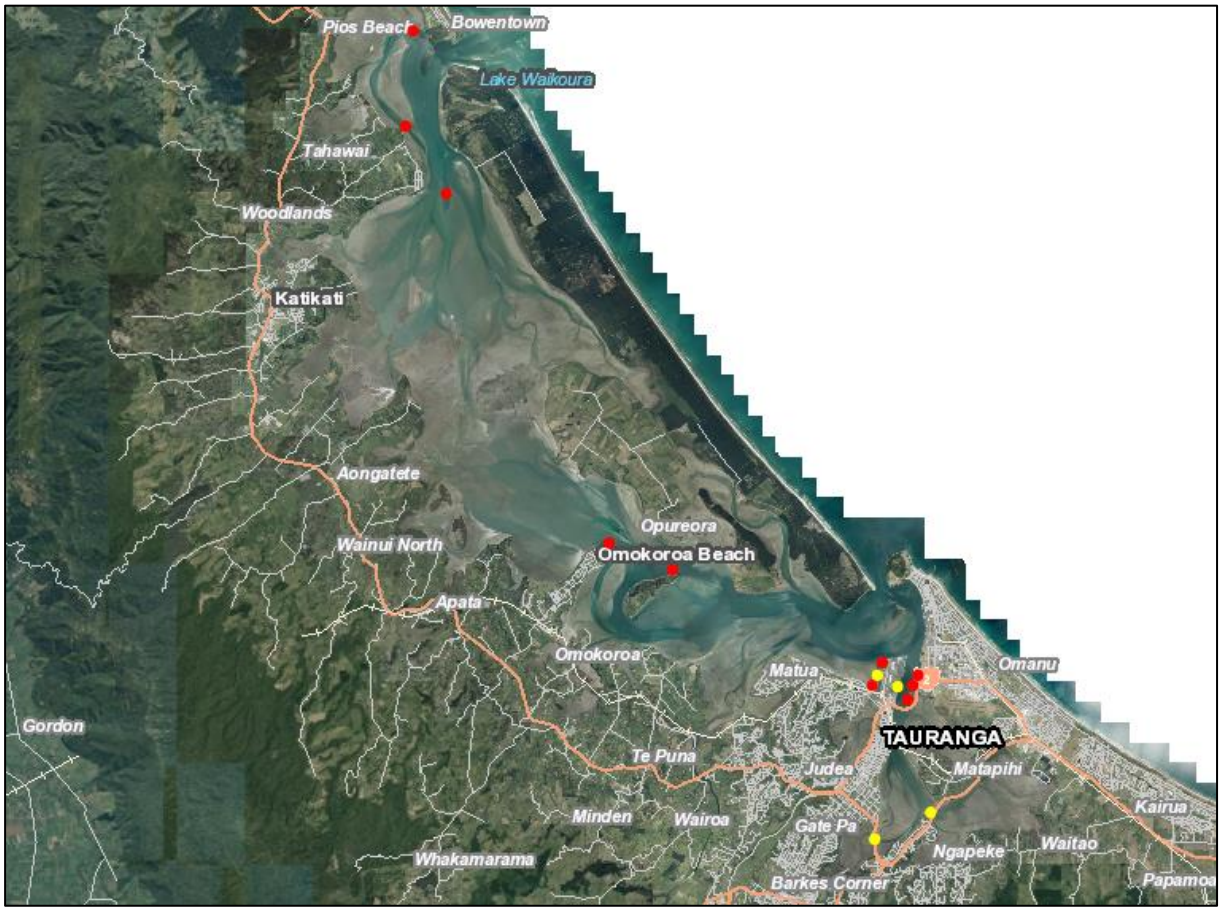

Figure 1 *Location of the sites in Tauranga Harbour for deployed oysters (red dots) and wild shellfish (yellow dots) analysed for a range of metal and organic contaminants in 2016.*

2.2 Methods

2.2.1 Shellfish sample collection

Sampling sites for this study were selected with consideration of historic information and sampling, with weighting of sites towards the southern area of the harbour which has been previously shown to have the highest contaminant levels. Many of the sites were matched up with the location of the 1990 sites to allow a direct comparison of any changes. Some additional sites were included around the city area to help show patterns of contamination.

Details of dates for deployment, retrieval and collection of wild shellfish at each site along with grid references for location are contained in Appendix 1. Figure 1 above also shows the shellfish sites. All deployments of Sentinel Oysters were made in December 2015 and retrieved between 9 February and 29 March 2016, except for the fuel berth site in the Port of Tauranga which was not retrieved until 22 June 2016. Wild shellfish samples were collected on 17 and 20 June 2016.

The study primarily focused on using oysters which were the species used in the 1990 study, although one Green Lipped Mussel sample was included where they occurred alongside oysters. Oysters (Pacific Rock Oysters - *Crassostrea gigas*) were obtained from the Ohiwa Harbour Oyster Farm and deployed in plastic mesh bags. They were placed in labelled plastic bags and stored in chilly bins with ice upon retrieval and sent to the laboratory for testing within 24 hours.

At the laboratory, shellfish were washed and shucked under clean conditions using stainless steel tools. The whole animal from inside the shell was used for analysis with a minimum of 10 blended up for each sample. The imported Sentinel Oysters were of average market size with most measuring between 80-120 mm shell length.

Wild Oysters (Rock Oysters - *Saccostrea glomerata*) were opened upon collection on the rocks using clean stainless steel tools and the flesh carefully removed and placed directly into a prepared clean glass container. These were stored in a chilly bin with ice upon completion of sample collection and sent to the laboratory for testing with 24 hours. The Wild Oysters tended to be smaller (60–80 mm shell length) than the Sentinel Oysters, consequently a minimum of 30 animals were combined into each sample.

Wild Mussel (Green Lipped Mussel – *Perna canaliculus*) collection and processing was the same as that for the Wild Oysters. The average size was around 100 mm shell length with 10 animals in the sample.

2.2.2 Contaminant analysis

Methods for contaminant and lipid analysis follows standard methods conducted by International Accreditation New Zealand (IANZ) accredited laboratories. In this study, all shellfish flesh samples were analysed on a wet weight basis at Hill Laboratories, Hamilton, New Zealand. The full set of analytical results and the methods used for each class of chemical analysis are provided in Appendix 2, in the form of the laboratory results sheets.

The lowest possible detection limits provided by the laboratory were utilised for all classes of contaminants sent for testing. Contaminant classes included heavy metals, PAHs, Polychlorinated Biphenyls (PBs), TBTs and Triphenyltin and Organochlorine Pesticides. These classes of compounds were also tested to very low levels in 1990.

2.2.3 Comparison of 1990/2016 Polycyclic Acromatic Hydrocarbons data

Analysis of the 1990 PAH compounds only covers eight of the sixteen compounds tested in 2016. To enable comparison of total PAHs, the 1990 results have been adjusted up by a factor of 1.429, which is derived by using the average proportion of each PAH, as a percentage of the PAH profile of all 16 PAH compounds found in similar biota in Tauranga Harbour. For example, Phenanthrene was not measured in 1990 and usually makes up around 15% of the total PAHs. It is the total of the missing expected PAH proportions (30%) that is then corrected for, to give an estimated equivalent to the 2016 total PAH results. The compounds not measured in 1990 and the estimated percentage of total PAH profile were Acenaphthene (0), Acenaphthylene (1), Benzo[a]anthracene (6), Benzo[g,h,i]perylene (3), Fluorene (3), Indo[1,2,3-c,d]pyrene (2), Naphthalene (0) and Phenenthrene (15).

Part 3: Results for Shellfish contaminants

Results for analysis of contaminants are provided in the following sections, but some presentation of results is based on selected or summarised data. The full set of analytical results is provided in Appendix 2. Appendix 1 contains the sample identification number used on the laboratory results sheets in Appendix 2.

3.1 Metals

Concentration of heavy metals analysed in the shellfish from Tauranga Harbour are set out below in Table 1. Arsenic (0.96-4.3 mg/kg ww), chromium (0.04-0.21 mg/kg ww), lead (0.041-0.123 mg/kg ww) and nickel (<0.1-0.4 mg/kg ww) concentrations in the shellfish, show minor variation between sites but no consistent trends over the whole harbour. Cadmium levels (0.065-1.06 mg/kg ww) also show no consistent trend over the whole harbour for Sentinel Oysters, but levels appear to be higher in the Wild Oysters. The Wild Mussel sample from the same general location as the Waikareao Sentinel and Wild Oysters shows lower levels of Cadmium. Levels of Zinc measured in the mussel sample were also markedly lower than the levels measured in all oysters.

Concentrations of Zinc in oysters tended to be higher in the city and port area. There is also a distinct difference in levels of Zinc recorded with the Wild Oysters being consistently higher.

Table 1 Concentration of metals (mg/kg wet weight) in shellfish collected from sites in Tauranga Harbour in 2016.

Site	Shellfish	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Ongare Pt	Sentinel Oyster	1.09	0.173	0.12	17.9	0.059	0.017	0.11	112
Bowentown	Sentinel Oyster	1.52	0.165	0.13	11.6	0.041	0.014	<0.1	89
Kauri Pt	Sentinel Oyster	2.2	0.146	0.14	13.7	0.057	0.019	< 0.10	93
Ōmokoroa D mark	Sentinel Oyster	1.63	0.099	0.16	18.2	0.075	0.012	< 0.10	110
Motuhoa Island	Sentinel Oyster	1.76	0.11	0.06	16.9	0.049	0.013	< 0.10	96
Port Fuel Berth	Sentinel Oyster	1.93	0.25	0.11	37	0.065		< 0.10	250
Port Butters Wharf	Sentinel Oyster	1.46	0.24	0.14	50	0.102	0.014	<0.1	340
Port Bridge Marina	Sentinel Oyster	1.14	0.103	0.1	45	0.087	0.01	<0.1	220
Port Cross Road	Wild Oyster	4.3	0.93	0.1	92	0.07		0.15	1250
Sulphur Point Marina	Sentinel Oyster	1.66	0.065	0.04	77	0.065	0.014	<0.1	186

Site	Shellfish	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Waikareao Rail Bridge	Sentinel Oyster	0.96	0.152	0.09	26	0.118	0.017	<0.1	177
Waikareao Rail Bridge	Wild Oyster	2.7	1.06	0.21	49	0.051		0.4	940
Maungatapu Bridge	Wild Oyster	2.2	0.42	0.06	54	0.054		0.14	800
Waimapu Bridge	Wild Oyster	1.8	0.25	0.07	44	0.069		0.12	830
Waikareao Ramp	Wild Mussel	1.88	0.14	0.09	1.09	0.123		0.16	14.2

Concentrations of Copper in oysters were lowest in the northern and main southern basin of Tauranga Harbour with the highest levels occurring around the sites in the city and port area (Figure 2). The Wild Mussel sample shows a much lower level of Copper compared to the oysters from the same location. Copper levels were also higher around the port area compared to those recorded in 1990. Figure 2 below shows the trend in Copper concentrations across harbour sites in 1990 and 2016.

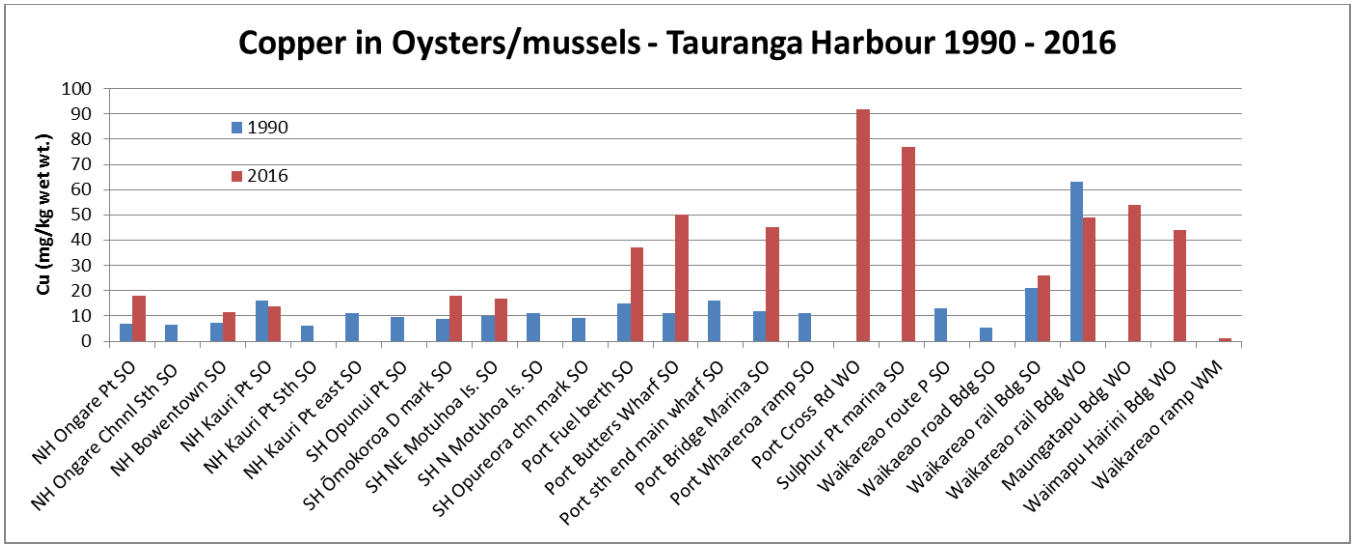

Figure 2 *Total Copper concentration (mg/kg wet weight) in oysters/mussels from sites around Tauranga Harbour in 1990 and 2016 (NH = Northern Harbour, SH = Southern Harbour, SO = Sentinel Oyster, WO = Wild Oyster, WM = Wild Mussel).*

3.2 Polycyclic Aromatic Hydrocarbons (PAHs)

Summary data on the concentration of PAHs is provided in Table 2. This is based on adding up only the detected concentrations of analysed PAH compounds. The full results for individual compounds measured in each sample are provided in Appendix 2. Care needs to be taken in comparing the 2016 results due to technical difficulties that caused higher detection limits (less sensitive) for the Sentinel Oysters, except for the Fuel Berth sample from the port area.

Levels of PAHs are lowest in the northern and main Southern Harbour basins and are highest around the city and port areas. The highest concentration of Benzo(b)fluoranthene + Benzo(j)fluoranthene and Pyrene were measured in the Sulphur Point Marina Sentinel Oysters. Only one other compound was above the detection limits (Fluoranthene) for the Sulphur Point Oysters, which are one of the sites to have higher detection limits. Taking into account that all sites showed similar PAH profiles in terms of the relative concentration of the various PAH compounds, it is likely the Sulphur Point Sentinel Oysters have the highest total PAHs of all sites.

The geographical variation in total PAH concentration in shellfish across Tauranga Harbour is similar to results found in 1990 (Figure 3). Also apparent from the comparison of the 1990 and 2016 data, is that levels around the city are higher in 2016. The level of total PAHs measured in the 2016 sample from the Hairini Bridge site at Waimapu Estuary, is around twice the levels recorded around the port in 1990. However, the Fuel Berth and Cross Road samples from the port area in 2016, had similar total PAH concentrations to those measured in 1990.

Table 2 Concentrations of Low Molecular Weight (LMW), High Molecular Weight (HMW) and total PAH's, plus the total B[a]P toxicity equivalency (μg/kg wet weight) measured in shellfish flesh samples from Tauranga Harbour in 2016.

Site	Species	Lipid%	Sum LMW PAHs	Sum HMW PAHs	Total PAHs	B[a]P toxicity equivalence
Ongare Pt*	Sentinel Oyster	1.4	0	0	0	0
Bowentown*	Sentinel Oyster	3.6	0	0	0	0
Kauri Pt*	Sentinel Oyster	2.9	0	0	0	0
Ōmokoroa D mark*	Sentinel Oyster	1.6	2	0	2	0
NE Motuhoa Is.*	Sentinel Oyster	2.1	0	0	0	0
Butters Wharf*	Sentinel Oyster	0.7	0	0	0	0
Bridge Marina*	Sentinel Oyster	1.2	0	0	0	0
Sulphur Pt Marina*	Sentinel Oyster	2.8	0	10	10	0.2
Waikareao Rail Bridge*	Sentinel Oyster	1.1	3	2	5	0
Cross Road	Wild Oyster	1.7	3.0	7.7	10.7	0.586
Fuel Berth	Sentinel Oyster	1.3	2.8	5.1	7.9	0.301
Maungatapu Bridge	Wild Oyster	1.4	5.4	11.1	16.5	0.647
Waimapu Hairini Bridge	Wild Oyster	1.7	8.1	14.9	23.0	0.697
Waikareao Rail Bridge*	Wild Oyster	2.4	4.4	12	16.4	1.03
Waikareao Ramp	Wild Mussel	1.7	6.2	8.7	14.9	0.605

* Samples that have a higher (less sensitive) detection limit on most analyses.

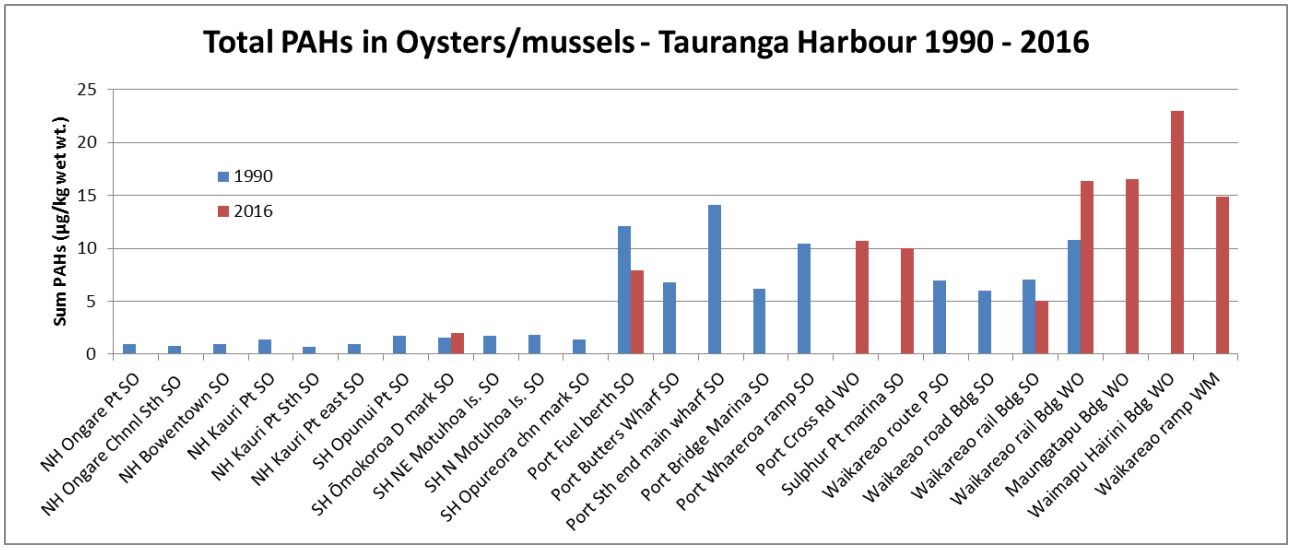

Figure 3 *Total PAHs (µg/kg wet weight) in oysters/mussels from sites around Tauranga Harbour in 1990 and 2016 (NH = Northern Harbour, SH = Southern Harbour, SO = Sentinel Oyster, WO = Wild Oyster, WM = Wild Mussel).*

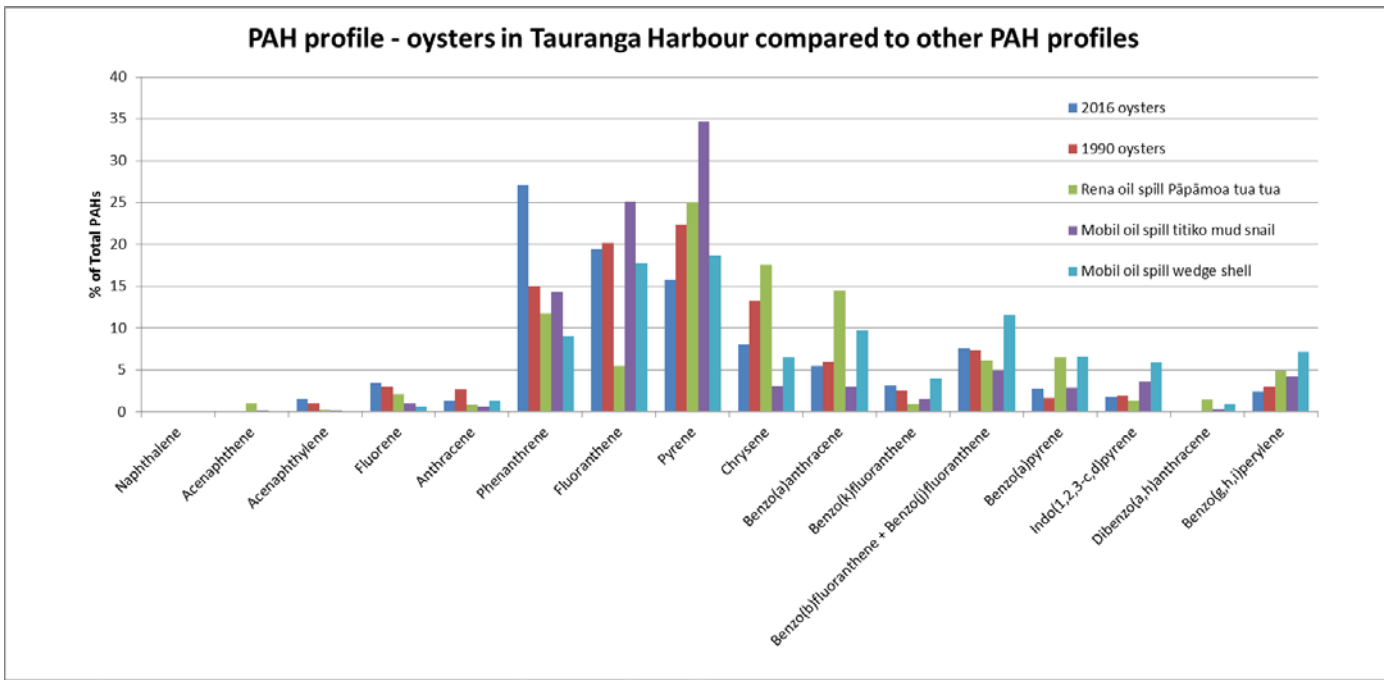

Figure 4 *Profile of relative PAH compound concentration (% Total PAHs) in oysters from sites around the port and southern most sites in Tauranga Harbour in 2016, with comparison to Tuatua at Ōmanu/Papamoa after the Rena oil spill, Rena contaminated sediment at Astrolabe Reef, Titiko (mud snail) and Wedge Shells after the Mobil oil spill.*

Figure 4 above compares the relative concentration profile of all the individual PAH compounds tested for in 2016 (using samples with low detection levels and high incidence of detects) with the PAH profiles from:

- Tuatua sampled from Omanu Beach.
- Sediment from Astrolabe Reef in the four months following the Rena heavy fuel oil spill in October 2011.
- Titiko (mud snails) and Hanikura (wedge shells) sampled in Maungatapu Bay following the April 2015 Mobil heavy fuel oil spill in Tauranga Harbour.

Despite the different species and feeding modes, all profiles have a high degree of similarity in the relative concentration of PAH compounds measured. One of the biggest differences between the 2016 shellfish results and the other sample sets is the high level of Phenanthrene. For all other PAH compounds, the 2016 profile is very similar to the other profiles.

3.3 Pesticides

Analysis of pesticide contaminants in shellfish samples was made for the organochlorine class of pesticides, as these include many of the historically used and highly toxic and persistent chemicals. Those analysed included Aldrin, Lindane, Chlordane, Dieldrin, Endrin, Heptachlor, Methoxychlor and DDT (and its breakdown products). The full list of compounds analysed and results of these analyses are provided in Appendix 2. The results showed that at the level of detection used, the only pesticides detected were 4,4-DDE at low levels (0.7–2.4 µg/kg wet wt.) in the city/port sites oyster samples in 2016 and 4,4-DDD was detected (6 µg/kg wet wt.) in the mussel sample from the boat ramp at Waikareao Estuary. Figure 5 below compares the results for DDT in this study against the 1990 survey results. The level of detection in this study was 0.5 µg/kg wet weight of flesh and all the 1990 results are above this level, hence, the 2016 results are lower.

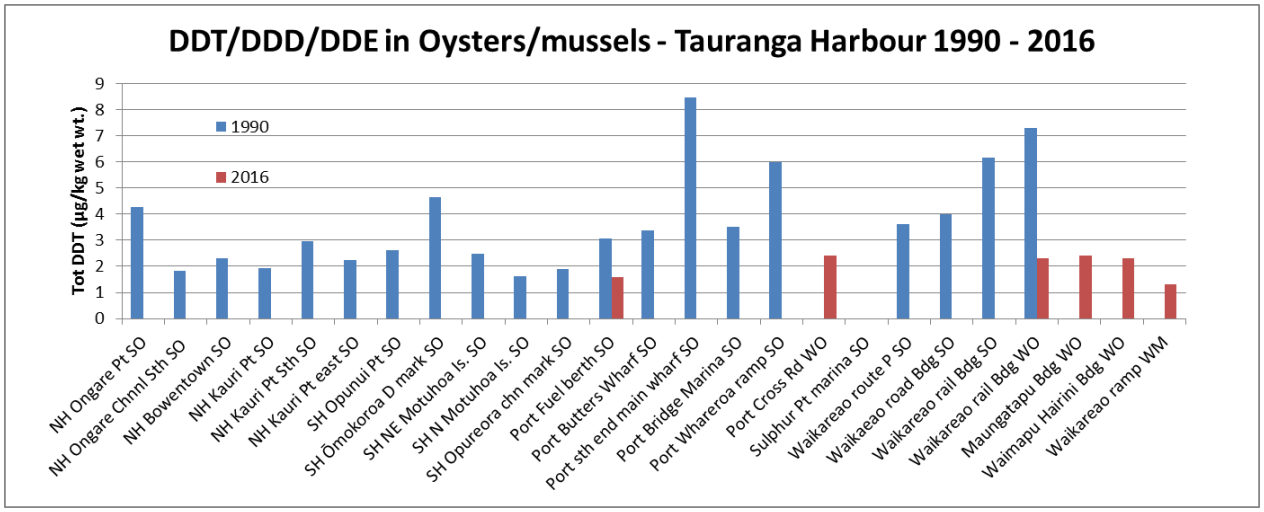

Figure 5 *Total DDT/DDD/DDE (µg/kg wet weight) in oysters/mussels from sites around Tauranga Harbour in 1990 and 2016 (NH = Northern Harbour, SH = Southern Harbour, SO = Sentinel Oyster, WO = Wild Oyster, WM = Wild Mussel).*

3.4 Tributyltin

Both Tributyltin and Triphenyltin were tested for in the shellfish samples. Results showed that all samples had no detects for Triphenyltin and only the Sulphur Point Sentinel Oyster sample had a detect for Tributyltin, with a concentration of 8 µg/kg wet weight of flesh. Figure 6 provides a comparison of total Tri, Di and Mono-butyltin results for the 2016 and 1990 surveys. The 2016 survey results are markedly lower than 1990 survey. In 1990, the highest levels were all recorded around the port area (ships being the source).

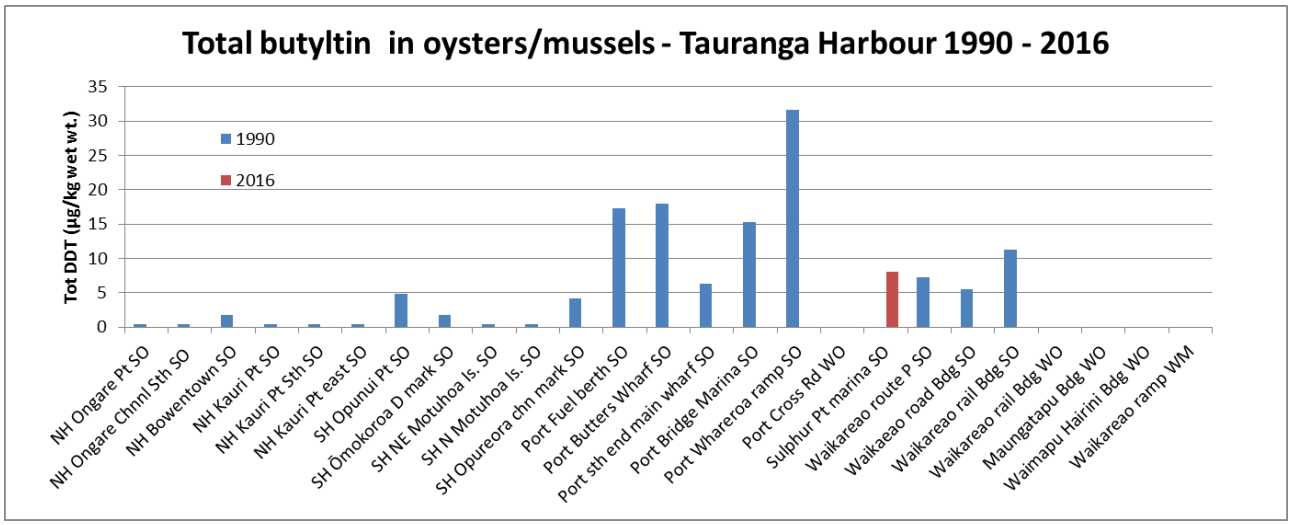

Figure 6 *Tributyltin (total TBT/DBT/MBT as Sn, µg/kg wet weight) in oysters/mussels from sites around Tauranga Harbour in 1990 and 2016 (NH = Northern Harbour, SH = Southern Harbour, SO = Sentinel Oyster, WO = Wild Oyster, WM = Wild Mussel).*

3.5 Polychlorinated Biphenyls (PCBs)

Only the February and March shellfish samples (all imported Sentinel Oysters) were tested for Polychlorinated Biphenyls (PCBs). Results showed that all samples were below the detection limit of 10 µg/kg wet weight of flesh for the individual PCB congeners. The highest level of total PCBs detected in 1990 was 9.7 µg/kg wet weight in the Wild Oyster sample from Waikareao Estuary and this concentration is the same as the detection limit achieved for this study.

Part 4: Discussion

4.1 Metals

4.1.1 Assessment of metal changes 1990-2016

The concentration of Cadmium, Chromium, Mercury and Zinc in oysters has not changed between 1990 and 2016, indicating that background levels of these metals do not appear to be increasing around any part of the harbour. This may indicate that potential sources of these particular metal contaminants are being adequately managed around the port and Tauranga city areas of the harbour.

Lead levels appear to have dropped in shellfish since 1990. Results from the port and Waikareao Estuary areas show the average level to be 164 μg/kg wet wt. in 1990 and 80 μg/kg wet wt. in 2016. This halving of the lead levels may be related to removal of lead from petrol in 1996 as vehicle emission had been shown to be a major contributor to the environment in the past (Kennedy & Southerland, 2008). The Auckland Council shellfish contaminant monitoring programme using oysters in the Manukau Harbour also indicates a downward trend for lead between 2002 and 2011 (Stewart *et al*. 2013). Results from Manukau Harbour (2009-2011) show a similar range of lead concentrations and spatial pattern to the Tauranga Harbour results. That is highest concentrations being measured nearest developed areas, particularly commercial/industrial zones.

Copper showed marked changes between 1990 and 2016, particularly in the port area with increases from an average value of 13 mg/kg wet weight for oysters in 1990 to 60 mg/kg in 2016. The increases are possibly linked to the switch from TBT antifouling on ships in 2008 back to Copper based antifouling paint systems as other areas around the city did not show the same degree of increase. Also the Bay of Plenty Regional Council's sediment contaminants monitoring programme does not show any significant upward trends in Copper concentrations. The range of Copper concentrations in shellfish in Tauranga Harbour for 2016, is similar to the range and pattern shown for the Auckland Council monitoring programme for oysters in Manukau Harbour (Stewart *et al*., 2013).

In the 2016, collection of shellfish for this study, a wild mussel sample was obtained at the Waikareao ramp/rail bridge site where they occurred alongside oysters. As noted in the results, there is some variance in metals uptake between oysters and mussels. This differential between species is well documented and the key differences observed in this study (lower levels of Copper and Zinc in mussels) are the same as found in the Auckland Council shellfish contaminants monitoring programme (Stewart *et al*., 2013).

4.1.2 Health risk assessment of metal contaminants in oysters

A health risk assessment of the 2016 levels of metal contaminants in the oysters can be made against relevant guidelines for human consumption. These are set out in Table 3 along with the upper and lower values from the oysters throughout the whole harbour. For arsenic, the 1 mg/kg upper limit for the concentration in shellfish is taken as an inorganic metal, which is usually around a tenth of the total present. This means that even the highest value obtained for oyster from the Waikareao Estuary is less than half the acceptable limit. Cadmium, mercury and lead are also set as maximum acceptable levels (ANZFS 2016) with highest recorded levels all below the limits.

The guidelines for Copper and Zinc are upper limits for daily intake for adults. On average adult females are estimated to consume 2 g of oysters per day and adult males 4 g per day (Kelly 2014). Hence, using the highest concentrations measured in the oysters, both Copper and Zinc levels are below the guidelines at 3.7% and 12.5% of the upper limits for daily intake for adult males. These percentages are also low enough to allow for other dietary intake sources of Copper and Zinc.

The chromium guideline in Table 3 is based on chromium III and there is no data to ascertain the proportion of the total chromium concentration in the oysters that will be in a chromium III oxidation state. However, even if the total levels measured were all chromium III then the highest recorded levels for an adult male would be around 0.0001% of the tolerable daily intake, even after adjusting for higher than average consumption rate.

Table 3 Concentration of metals (mg/kg wet weight) in all oysters collected from Tauranga Harbour in 2016 compared against relevant health guidelines.

Trace element	Food	Maximum level	Results range	Source
Arsenic	Shellfish	1 mg/kg	0.96-2.70	ANZFS[1]
Cadmium	Shellfish	2 mg/kg	0.07–1.10	ANZFS[1]
Chromium	All food	0.3mg/kg bw/day Cr III	0.04–0.21	EFSA (2014)
Copper	Fish/shellfish	10 mg/day	12-92	NHMRC[2]
Mercury	Shellfish	1 mg/kg	0.01–0.019	ANZFS[1]
Lead	Shellfish	2 mg/kg	0.041–0.118	ANZFS[1]
Zinc	All food	40 mg/day	89-1250	NHMRC[2]

1 - Australia New Zealand Food Standards Code – March 2016. 2 – National Health & Medical Research Council (2006).

4.2 Polycyclic Aromatic Hydrocarbons (PAHs)

4.2.1 Assessment of Polycyclic Aromatic Hydrocarbons changes 1990-2016

The PAH levels appear to now be around twice the level recorded in similar locations around the city areas compared to 1990. Within the last five years there have been two major oils spills. The largest of these was the Rena oil spill on 5 October 2011 (up to 400,000 L heavy fuel oil) which mainly affected open coastal areas. However, monitoring of shellfish in Tauranga Harbour shortly after the Rena oil spill showed no signs of elevated PAH levels as a result of this disaster. The Mobil oil spill on 27 April 2015 (up to 6,000 L heavy fuel oil) was located in the port but most severely affected areas up the harbour, particularly towards Waimapu Estuary in Maungatapu Bay. Monitoring of this spill showed that there was only a low degree of impact on the PAH levels in shellfish close to areas of accumulated oil (Win *et. al*. 2015).

The Hairini Bridge site sampled in this study was immediately adjacent to and just north of the area referred to as Maungatapu Bay which received extensive oiling of the upper shoreline. It recorded the highest level of PAHs in this study with levels 50% higher than other similar Wild Oyster sites around the city. Hence, it is possible that levels have been slightly elevated by the Mobil oil spill as found in nearby shellfish by Win *et al*. (2015).

Other Wild Oyster sites similar to the Hairini Bridge/Waimapu Estuary site, such as Waikareao Estuary, which should have received minimal, if any impact from the Mobil oil spill have PAH levels around 50% higher than measured in 1990. Hence, it is likely that another key factor contributing to the higher levels of PAHs around the city area seen in this study, is increased urban development and traffic volumes.

The standardised PAH profiles shown in Figure 4 which displays results for shellfish with different feeding modes, has the PAH compounds ordered from low weight and higher solubility (which is still low) to those compounds of highest weight and virtually no solubility. Analysis of the Rena oil spill showed that heavy fuel oil has very high proportions of light two-ring PAHs such as Napthalene, but these are quickly lost once released to the environment and the proportions of PAHs remaining after even days in the water/sediment is very similar to the PAH profile of all the species shown in Figure 4. Hence, the shellfish results closely indicate what is generally present in the estuarine sediments and points to petroleum derived PAHs (vehicles and spills), being a key source of observed shellfish contamination.

One of the biggest differences in the PAH profiles is between the 2016 oysters (and mussels) which have a far higher proportion of Phenanthrene compared to all other shellfish. This may be due to differences in feeding/environment factors. However, the change between the 1990 and 2016 levels of Phenanthrene in oysters indicate an increase in relative proportions since 1990. The proportion of Phenanthrene is also higher than found in the 2007 data in the Auckland Sentinel Shellfish monitoring programme (Olsen & Stewart 2009). The 2016 oysters Phenanthrene proportions, do, however, match reasonably closely to those observed for less weathered, oil contaminated sediments.

The total PAH concentrations recorded around the Tauranga city/port areas in 2016 are higher than those measured in the Manukau Harbour for the Auckland City monitoring programme in 2011 (Smith *et al*. 2013). Results from the Auckland programme are presented as dry weights and range up around 40-50 μg/kg near upper harbour port/industrial areas. Results from this study when calculated on the same basis range up around 50-230 μg/kg for total PAHs. This is higher, but then the proximity to sources may be greater in this study. More open harbour sites in this study near less intensely developed areas, such as the Omokoroa site, are very similar to the Manukau results for less impacted locations.

4.2.2 Health risk assessment of Polycyclic Aromatic Hydrocarbons contaminants in oysters

Polycyclic Aromatic Hydrocarbons are both carcinogenic and genotoxic. The PAH results as analysed in this study are for parent compounds and results do not include alkylated variants of each PAH compound. Alkylated PAHs are also toxic to varying degrees but there is little to no information on toxicity of specific compounds because of the huge possible number of Alkyl-PAHs. Hence, assessment here is just for base PAHs. There are a number of health risk assessment guidelines for assessing potential human health risk and one method is to calculate the total BaP (Benzo(a)pyrene) toxicity equivalency which has a guideline of 10 μg/kg wet weight of shellfish set by the EU in 2005 (EU 2005). Based on this guideline, the highest result in the current study is one tenth of the guideline.

Other guidelines for PAHs are based on tolerable daily limits with an upper guideline limit of 6.5 ng/kg/day for Bap and 34.5 ng/kg/day for PAH4 compounds (Bap, Chrysene, Benzo(a)anthracene and Benzo(b)fluoranthene) (in Kelly 2014). Using the example of an adult male (average weight 82 kg, average consumption 4 g/day) then the highest concentration of Bap (Waikareao Estuary) will result in an exposure of 0.137 ng/kg/day (adjusted for higher than average consumption rates). Polycyclic Aromatic Hydrocarbons (PAH4) exposure using an adult male (higher than average consumption) will result in exposure of 0.956 ng/kg/day. These exposures are 2.1% and 2.8% of the respective tolerable daily intake.

4.3 Pesticides

Pesticide analysis in this study focused on the more environmentally persistent and toxic organochlorine group of compounds that have now been banned from use in New Zealand. For all compounds except DDT, the concentrations in shellfish were lower than the detection limits, which were not as low as the limits achieved in the 1990 study. Hence, it is only possible to state that levels in 2016 are no higher than in 1990. The detection level achieved for this study (0.5 ng/kg) is, however, low enough to confidently state that there does not appear to be any environmental contamination issue or any health risks associated with consumption.

Levels of DDT show a decline since 1990 and it is likely that all other banned organochlorine pesticides will follow a similar trend in Tauranga Harbour. Even the highest DDT concentrations measured in 2016 (0.0024 mg/kg wet wt.) are well below permissible levels for consumption (1.0 mg/kg - FSANZ). The levels of DDT detected in this study are similar to those recorded for the Auckland Council monitoring programme in the Manukau Harbour (Smith *et al*., 2013). Given that the organochlorine pesticides are no longer in use and are not showing longer term contamination issues in Tauranga Harbour shellfish, there is no need to continue monitoring for these compounds in the future.

4.4 Tributyltin

Organotin Compound (OTC) concentrations in shellfish for the 2016 survey, are overall much lower than measured in 1990 with most results below the limits of detection. This is in line with phasing out of TBT and TPT use as an antifouling compound on commercial shipping between 1990 and 2008. The move to ban organotin compounds was made due to studies showing a range of widespread environmental toxicity impacts to aquatic organisms and bioaccumulation up through the food chains. Organotin compounds are highly toxic and cause effects in gastropods and fish at levels as low as 1 ng/L in water (Bryan *et al*. 1986).

Overall TBT levels in suspension feeding shellfish such as oysters and mussels closely reflect what is available in the water column. This will include release of TBT that has previously contaminated sediments in the harbour. Although TBT has a half-life of two years it can persist for up to 30 years in marine sediments, hence, remain a possible on-going source in Tauranga Harbour. The 2016 shellfish results indicate that sediment derived TBT is not providing a significant source of contamination. One exception to that may be the Sulphur Point Marina site as the only other plausible explanation for the high levels of TBT measured in shellfish sampled at this location, would be a boat illegally painted with TBT antifouling.

In respect of human health risks for consumption, the European Food Safety Authority (EFSA, 2004) set a guideline for OTC (all TBT/TPT compounds) in food stuffs as a daily tolerable intake of 0.1 μg/kg/day when measured as tin (Sn) levels. Kelly (2014) presents data on typical consumption levels of oysters and for an adult male (82 kg) at an average of 4 g per day. This equates to an average daily intake of 0.00039 μg/kg/day for adult males, which represent only 0.4% of the tolerable daily intake guideline. Even if adjusted for very high consumption rates, (i.e. 10 x higher) it is clear that the current levels of TBT contamination recorded in Tauranga Harbour shellfish are not a human health issue.

4.5 Polychlorinated Biphenyls

Polychlorinated Biphenyls (PCBs) include 209 possible congeners with one to ten chlorine atoms. Toxicity varies markedly across the range of congeners with PCB 126 (3,3',4,4',5-pentachlorobiphenyl) being one of the most toxic with an equivalency of 0.1 (or 10%) of the most toxic dioxin compound. Polychlorinated Biphenyls are also hydrophobic and hence, tend to bioaccumulate quite strongly. For those sites tested, the results were below the level of detection at 0.01 mg/kg wet weight for the individual congeners. In terms of human health risk from consumption, ANZFS set a maximum acceptable level for PCBs-total of 0.5 mg/kg wet weight for fish. Other guidelines such as the EFSA guideline for fish based on dioxin toxicity equivalency (PCB-TEQ) has a guideline of 6.5 pg/g wet weight. In general terms, the lack of any detects for individual congeners at 0.01 mg/kg equates to none of the oyster samples exceeding guidelines for consumption.

Part 5: References

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Appendices

Appendix 1 – Shellfish sampling sites

Location	Retrieval	Deployed	Sample ID	Shellfish	East	North
1990 Site details						
Waikareao Ramp	17/12/1990	24/10/1990	1	Native Oyster	1879130	5826030
Waikareao Rail	17/12/1990	24/10/1990	2	Import Oyster	1879015	5826011
Waikareao Rail	17/12/1990	24/10/1990	3	Import Oyster	1878860	5825740
Waikareao Route P	17/12/1990	24/10/1990	5	Import Oyster	1879110	5825380
Port Fuel Berth-16	17/12/1990	24/10/1990	1	Import Oyster	1880535	5826700
Port Butters Wharf	17/12/1990	24/10/1990	2	Import Oyster	1880484	5826420
Port South Main	17/12/1990	24/10/1990	3	Import Oyster	1880644	5827707
Port Bridge Marina	17/12/1990	24/10/1990	4	Import Oyster	1880270	5825830
Port Whareroa	17/12/1990	24/10/1990	5	Import Oyster	1880540	5826108
Oposite Opunui Pt	17/12/1990	24/10/1990	1	Import Oyster	1873638	5829850
NE Motuhoa Island	17/12/1990	24/10/1990	2	Import Oyster	1872197	5830270
N Motuhoa Island	17/12/1990	24/10/1990	3	Import Oyster	1871358	5830188
Opureora chn mark	17/12/1990	24/10/1990	4	Import Oyster	1872460	5830646
Ōmokoroa D mark	17/12/1990	24/10/1990	5	Import Oyster	1869734	5831396
Ongare Pt	17/12/1990	24/10/1990	1	Import Oyster	1862755	5846005
Ongare Channel	17/12/1990	24/10/1990	2	Import Oyster	1862788	5845732
Ongare Chn south	17/12/1990	24/10/1990	3	Import Oyster	1863223	5844958
Kauri Pt	17/12/1990	24/10/1990	4	Import Oyster	1863000	5843573
Kauri Pt south	17/12/1990	24/10/1990	5	Import Oyster	1863475	5842989
Kauri Pt east	17/12/1990	24/10/1990	6	Import Oyster	1864398	5843558
2015/16 Site details						
Berth 16 Fuel Berth	22/06/2016	4/12/2015	16/1047-6	Import Oyster	1880521	5826634
Butters Wharf	29/03/2016	4/12/2015	THS15-0300	Import Oyster	1880460	5826310
Bridge Marina	17/03/2016	4/12/2015	THS15-0310	Import Oyster	1880215	5825789
Sulphur Pt Marina	17/03/2016	4/12/2015	THS15-0311	Import Oyster	1879299	5827235
Ōmokoroa D marker	9/02/2016	10/12/2015	THS15-0312	Import Oyster	1869614	5831380
Waikareao Rail	9/02/2016	4/12/2015	THS15-0313	Import Oyster	1879126	5826074
NE Motuhoa Island	9/02/2016	10/12/2015	THS15-0314	Import Oyster	1871863	5830409
Ongare Pt	9/02/2016	17/12/2015	THS15-0315	Import Oyster	1862453	5846064
Bowentown	9/02/2016	17/12/2015	THS15-0316	Import Oyster	1862740	5849458
Kauri Pt	9/02/2016	17/12/2015	THS15-0317	Import Oyster	1863999	5843697
Waikareao Rail	20/06/2016	NA	16/1047-1	Wild Oyster	1879070	5825960
Waikareao Ramp	20/06/2016	NA	16/1047-2	Wild Mussel	1879130	5826015
Cross Rd Sulphur Pt	20/06/2016	NA	16/1047-3	Wild Oyster	1879755	5825850
Maungatapu Bridge	20/06/2016	NA	16/1047-4	Wild Oyster	1881050	5821680
Waimapu Hairini Bridge	17/06/2016	NA	16/1047-5	Wild Oyster	1879015	5820790

Appendix 2 – Shellfish laboratory results for metals and organics

Hill Laboratories
BETTER TESTING BETTER RESULTS

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Bay of Plenty Regional Council	Lab No:	1605333	SPv1
Contact:	Scott Mitchell	Date Registered:	27-Jun-2016	
	C/- Bay of Plenty Regional Council	Date Reported:	14-Jul-2016	
	PO Box 364	Quote No:	78383	
	Whakatane 3158	Order No:	84886	
		Client Reference:	16/1047 Shellfish	
		Submitted By:	Scott Mitchell	

Sample Type: Shellfish Tissue						
Sample Name:		16/1047 - 1 20-Jun-2016	16/1047 - 2 20-Jun-2016	16/1047 - 3 20-Jun-2016	16/1047 - 4 20-Jun-2016	16/1047 - 5 17-Jun-2016
Lab Number:		1605333.1	1605333.2	1605333.3	1605333.4	1605333.5
Individual Tests						
Lipid Content*	g/100g	2.4	1.7	1.7	1.4	1.7
Arsenic	mg/kg as rcvd	2.7	1.88	4.3	2.2	1.80
Cadmium	mg/kg as rcvd	1.06	0.140	0.93	0.42	0.25
Chromium	mg/kg as rcvd	0.21	0.09	0.10	0.06	0.07
Copper	mg/kg as rcvd	49	1.09	92	54	44
Lead	mg/kg as rcvd	0.051	0.123	0.070	0.054	0.069
Nickel	mg/kg as rcvd	0.40	0.16	0.15	0.14	0.12
Zinc	mg/kg as rcvd	940	14.2	1,250	800	830
Organochlorine Pesticides in Biomatter						
Aldrin*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
alpha-BHC*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
beta-BHC*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
delta-BHC*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
gamma-BHC (Lindane)*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
cis-Chlordane*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
trans-Chlordane*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
2,4'-DDD*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4,4'-DDD*	mg/kg	< 0.0005	0.0006	< 0.0005	< 0.0005	< 0.0005
2,4'-DDE*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4,4'-DDE*	mg/kg	0.0023	0.0007	0.0024	0.0023	0.0024
2,4'-DDT*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
4,4'-DDT*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Dieldrin*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endosulfan I*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endosulfan II*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endosulfan sulfate*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endrin*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endrin aldehyde*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Endrin ketone*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Heptachlor*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Heptachlor epoxide*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Hexachlorobenzene*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Methoxychlor*	mg/kg	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Total Chlordane [(cis+trans)*100/42]*	mg/kg	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002

Sample Type: Shellfish Tissue						
Sample Name:		16/1047 - 1 20-Jun-2016	16/1047 - 2 20-Jun-2016	16/1047 - 3 20-Jun-2016	16/1047 - 4 20-Jun-2016	16/1047 - 5 17-Jun-2016
Lab Number:		1605333.1	1605333.2	1605333.3	1605333.4	1605333.5
Polycyclic Aromatic Hydrocarbons in Biomatter						
Acenaphthene*	mg/kg as rcvd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Acenaphthylene*	mg/kg as rcvd	< 0.0005	0.0007	< 0.0005	< 0.0005	0.0007
Anthracene*	mg/kg as rcvd	0.0004	0.0004	< 0.0002	< 0.0002	0.0004
Benzo[a]anthracene*	mg/kg as rcvd	0.0009	0.0008	0.0005	0.0009	0.0013
Benzo[a]pyrene (BAP)*	mg/kg as rcvd	0.0007	0.0004	0.0004	0.0004	0.0004
Benzo[b]fluoranthene + Benzo[j] fluoranthene*	mg/kg as rcvd	0.0018	0.0009	0.0011	0.0012	0.0013
Benzo[g,h,i]perylene*	mg/kg as rcvd	0.0007	0.0006	0.0003	0.0003	0.0003
Benzo[k]fluoranthene*	mg/kg as rcvd	0.0008	0.0004	0.0005	0.0006	0.0005
Chrysene*	mg/kg as rcvd	0.0015	0.0010	0.0009	0.0014	0.0017
Dibenzo[a,h]anthracene*	mg/kg as rcvd	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0003
Fluoranthene*	mg/kg as rcvd	0.0029	0.0019	0.0021	0.0036	0.0052
Fluorene*	mg/kg as rcvd	0.0005	0.0008	0.0004	0.0007	0.0007
Indeno(1,2,3-c,d)pyrene*	mg/kg as rcvd	0.0005	0.0003	0.0002	0.0003	0.0003
Naphthalene*	mg/kg as rcvd	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Phenanthrene*	mg/kg as rcvd	0.0035	0.0043	0.0026	0.0047	0.0063
Pyrene*	mg/kg as rcvd	0.0022	0.0024	0.0017	0.0024	0.0039
Tributyl Tin in Biota samples by GCMS						
Dibutyltin (as Sn)	mg/kg as rcvd	< 0.006	< 0.005	< 0.006	< 0.006	< 0.005
Monobutyltin (as Sn)	mg/kg as rcvd	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Tributyltin (as Sn)	mg/kg as rcvd	< 0.005	< 0.004	< 0.005	< 0.005	< 0.004
Triphenyltin (as Sn)	mg/kg as rcvd	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004

Sample Name:		16/1047 - 6 22-Jun-2016				
Lab Number:		1605333.6				
Individual Tests						
Lipid Content*	g/100g	1.3	-	-	-	-
Arsenic	mg/kg as rcvd	1.93	-	-	-	-
Cadmium	mg/kg as rcvd	0.25	-	-	-	-
Chromium	mg/kg as rcvd	0.11	-	-	-	-
Copper	mg/kg as rcvd	37	-	-	-	-
Lead	mg/kg as rcvd	0.065	-	-	-	-
Nickel	mg/kg as rcvd	< 0.10	-	-	-	-
Zinc	mg/kg as rcvd	250	-	-	-	-
Organochlorine Pesticides in Biomatter						
Aldrin*	mg/kg	< 0.0005	-	-	-	-
alpha-BHC*	mg/kg	< 0.0005	-	-	-	-
beta-BHC*	mg/kg	< 0.0005	-	-	-	-
delta-BHC*	mg/kg	< 0.0005	-	-	-	-
gamma-BHC (Lindane)*	mg/kg	< 0.0005	-	-	-	-
cis-Chlordane*	mg/kg	< 0.0005	-	-	-	-
trans-Chlordane*	mg/kg	< 0.0005	-	-	-	-
2,4'-DDD*	mg/kg	< 0.0005	-	-	-	-
4,4'-DDD*	mg/kg	< 0.0005	-	-	-	-
2,4'-DDE*	mg/kg	< 0.0005	-	-	-	-
4,4'-DDE*	mg/kg	0.0016	-	-	-	-
2,4'-DDT*	mg/kg	< 0.0005	-	-	-	-
4,4'-DDT*	mg/kg	< 0.0005	-	-	-	-
Dieldrin*	mg/kg	< 0.0005	-	-	-	-
Endosulfan I*	mg/kg	< 0.0005	-	-	-	-
Endosulfan II*	mg/kg	< 0.0005	-	-	-	-
Endosulfan sulfate*	mg/kg	< 0.0005	-	-	-	-
Endrin*	mg/kg	< 0.0005	-	-	-	-
Endrin aldehyde*	mg/kg	< 0.0005	-	-	-	-
Endrin ketone*	mg/kg	< 0.0005	-	-	-	-

Sample Type: Shellfish Tissue						
Sample Name:		16/1047 - 6 22-Jun-2016				
Lab Number:		1605333.6				
Organochlorine Pesticides in Biomatter						
Heptachlor*	mg/kg	< 0.0005	-	-	-	-
Heptachlor epoxide*	mg/kg	< 0.0005	-	-	-	-
Hexachlorobenzene*	mg/kg	< 0.0005	-	-	-	-
Methoxychlor*	mg/kg	< 0.0005	-	-	-	-
Total Chlordane [(cis+trans)*100/42]*	mg/kg	< 0.002	-	-	-	-
Polycyclic Aromatic Hydrocarbons in Biomatter						
Acenaphthene*	mg/kg as rcvd	< 0.0005	-	-	-	-
Acenaphthylene*	mg/kg as rcvd	< 0.0005	-	-	-	-
Anthracene*	mg/kg as rcvd	< 0.0003	-	-	-	-
Benzo[a]anthracene*	mg/kg as rcvd	0.0005	-	-	-	-
Benzo[a]pyrene (BAP)*	mg/kg as rcvd	0.0002	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene*	mg/kg as rcvd	0.0005	-	-	-	-
Benzo[g,h,i]perylene*	mg/kg as rcvd	< 0.0003	-	-	-	-
Benzo[k]fluoranthene*	mg/kg as rcvd	< 0.0002	-	-	-	-
Chrysene*	mg/kg as rcvd	0.0007	-	-	-	-
Dibenzo[a,h]anthracene*	mg/kg as rcvd	< 0.0003	-	-	-	-
Fluoranthene*	mg/kg as rcvd	0.0017	-	-	-	-
Fluorene*	mg/kg as rcvd	< 0.0003	-	-	-	-
Indeno(1,2,3-c,d)pyrene*	mg/kg as rcvd	< 0.0002	-	-	-	-
Naphthalene*	mg/kg as rcvd	< 0.005	-	-	-	-
Phenanthrene*	mg/kg as rcvd	0.0028	-	-	-	-
Pyrene*	mg/kg as rcvd	0.0015	-	-	-	-
Tributyl Tin in Biota samples by GCMS						
Dibutyltin (as Sn)	mg/kg as rcvd	< 0.006	-	-	-	-
Monobutyltin (as Sn)	mg/kg as rcvd	< 0.007	-	-	-	-
Tributyltin (as Sn)	mg/kg as rcvd	< 0.005	-	-	-	-
Triphenyltin (as Sn)	mg/kg as rcvd	< 0.004	-	-	-	-

Analyst's Comments

It has been noted that the spikes for DBT on sample 1605333.1 was run as part of our in-house QC procedure, had lower than expected recoveries at 19% & 17% for Dibutyltin (as Sn). Therefore the results may be underestimated.

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Shellfish Tissue			
Test	Method Description	Default Detection Limit	Sample No
Lipid Content*	Gravimetric.	0.2 g/100g	1-6
Homogenisation of Biological samples for Organics Tests*	Mincing, chopping, or blending of sample to form homogenous sample fraction.	-	1-6
Homogenise*	Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1-6
Biological Materials Digestion	Nitric and hydrochloric acid micro digestion, filtration. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1-6
Organochlorine Pesticides in Biomatter*	Sonication extraction, alumina cleanup, GPC cleanup, dual column GC-ECD analysis	0.0005 - 0.002 mg/kg	1-6
Polycyclic Aromatic Hydrocarbons in Biomatter*		0.0002 - 0.005 mg/kg as rcvd	1-6
Tributyl Tin in Biota samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis	0.0010 mg/kg as rcvd	1-6
Arsenic	Biological materials digestion, ICP-MS.	0.02 mg/kg as rcvd	1-6
Cadmium	Biological materials digestion, ICP-MS.	0.0004 mg/kg as rcvd	1-6
Chromium	Biological materials digestion, ICP-MS with dynamic reaction cell.	0.006 mg/kg as rcvd	1-6

Sample Type: Shellfish Tissue			
Test	Method Description	Default Detection Limit	Sample No
Copper	Biological materials digestion, ICP-MS.	0.010 mg/kg as rcvd	1-6
Lead	Biological materials digestion, ICP-MS.	0.002 mg/kg as rcvd	1-6
Nickel	Biological materials digestion, ICP-MS.	0.02 mg/kg as rcvd	1-6
Zinc	Biological materials digestion, ICP-MS.	0.2 mg/kg as rcvd	1-6

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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ANALYSIS REPORT

Client:	Bay of Plenty Regional Council	**Lab No:**	1559123 SPv2
Contact:	R Win	**Date Registered:**	30-Mar-2016
	C/- Bay of Plenty Regional Council	**Date Reported:**	01-Jun-2016
	PO Box 364	**Quote No:**	70501
	Whakatane 3158	**Order No:**	82374
		Client Reference:	Oyster Samples
		Submitted By:	R Win

Amended Report

This report replaces an earlier report issued on the 21 Apr 2016 at 3:34 pm
At the client's request, TBT, OCP, PCB and lipid analyses have been added to all the samples and metal analyses to four samples.

Sample Type: Oysters

Sample Name:		TH515-0300 29-Mar-2016	TH515-0310 17-Mar-2016	TH515-0311 17-Mar-2016	TH515-0312 09-Feb-2016	TH515-0313 09-Feb-2016
Lab Number:		1559123.1	1559123.2	1559123.3	1559123.4	1559123.5
Individual Tests						
Lipid Content*	g/100g	0.7	1.2	2.8	1.6	1.1
Arsenic	mg/kg as rcvd	1.46	1.14	1.66	1.63	0.96
Cadmium	mg/kg as rcvd	0.24	0.103	0.065	0.099	0.152
Chromium	mg/kg as rcvd	0.14	0.10	0.04	0.16	0.09
Copper	mg/kg as rcvd	50	45	77	18.2	26
Lead	mg/kg as rcvd	0.102	0.087	0.065	0.075	0.118
Mercury	mg/kg as rcvd	0.014	0.010	0.014	0.012	0.017
Nickel	mg/kg as rcvd	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Zinc	mg/kg as rcvd	340	220	186	110	177
Organochlorine Pesticides in Biomatter						
Aldrin*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
alpha-BHC*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
beta-BHC*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
delta-BHC*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
gamma-BHC (Lindane)*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
cis-Chlordane*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
trans-Chlordane*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
2,4'-DDD*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
4,4'-DDD*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
2,4'-DDE*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
4,4'-DDE*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
2,4'-DDT*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
4,4'-DDT*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Dieldrin*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endosulfan I*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endosulfan II*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endosulfan sulfate*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endrin*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endrin aldehyde*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Endrin ketone*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Heptachlor*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Heptachlor epoxide*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Hexachlorobenzene*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Methoxychlor*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Chlordane [(cis+trans)*100/42]*	mg/kg	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002

Sample Type: Oysters						
Sample Name:		TH515-0300 29-Mar-2016	TH515-0310 17-Mar-2016	TH515-0311 17-Mar-2016	TH515-0312 09-Feb-2016	TH515-0313 09-Feb-2016
Lab Number:		1559123.1	1559123.2	1559123.3	1559123.4	1559123.5
Polycyclic Aromatic Hydrocarbons in Biomatter						
Acenaphthene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Acenaphthylene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Anthracene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Benzo[a]anthracene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Benzo[a]pyrene (BAP)*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Benzo[b]fluoranthene + Benzo[j] fluoranthene*	mg/kg as rcvd	< 0.002	< 0.002	0.002	< 0.002	< 0.003
Benzo[g,h,i]perylene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Benzo[k]fluoranthene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Chrysene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Dibenzo[a,h]anthracene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Fluoranthene*	mg/kg as rcvd	< 0.002	< 0.002	0.003	< 0.002	0.002
Fluorene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Indeno(1,2,3-c,d)pyrene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	< 0.002	< 0.003
Naphthalene*	mg/kg as rcvd	< 0.010	< 0.010	< 0.011	< 0.010	< 0.011
Phenanthrene*	mg/kg as rcvd	< 0.002	< 0.002	< 0.003	0.002	0.003
Pyrene*	mg/kg as rcvd	< 0.002	< 0.002	0.005	< 0.002	< 0.003
Polychlorinated biphenyls in Biomatter						
PCB-18*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-28*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-31*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-44*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-49*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-52*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-60*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-77*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-81*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-86*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-101*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-105*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-110*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-114*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-118*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-121*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-123*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-126*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-128*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-138*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-141*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-149*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-151*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-153*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-156*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-157*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-159*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-167*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-169*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-170*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-180*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-189*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-194*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-206*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB-209*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total PCB (Sum of 35 congeners)*	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4

Sample Type: Oysters						
Sample Name:		TH515-0300 29-Mar-2016	TH515-0310 17-Mar-2016	TH515-0311 17-Mar-2016	TH515-0312 09-Feb-2016	TH515-0313 09-Feb-2016
Lab Number:		1559123.1	1559123.2	1559123.3	1559123.4	1559123.5
Tributyl Tin in Biota samples by GCMS						
Dibutyltin (as Sn)	mg/kg as rcvd	< 0.006	< 0.006	< 0.006	< 0.006	< 0.006
Monobutyltin (as Sn)	mg/kg as rcvd	< 0.007	< 0.007	< 0.007	< 0.007	< 0.007
Tributyltin (as Sn)	mg/kg as rcvd	< 0.005	< 0.005	0.008	< 0.005	< 0.005
Triphenyltin (as Sn)	mg/kg as rcvd	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004

Sample Name:		TH515-0314 09-Feb-2016	TH515-0315 09-Feb-2016	TH515-0316 09-Feb-2016	TH515-0317 09-Feb-2016	
Lab Number:		1559123.6	1559123.7	1559123.8	1559123.9	
Individual Tests						
Lipid Content*	g/100g	2.1	1.4	3.6	2.9	-
Arsenic	mg/kg as rcvd	1.76	1.09	1.52	2.2	-
Cadmium	mg/kg as rcvd	0.110	0.173	0.165	0.146	-
Chromium	mg/kg as rcvd	0.06	0.12	0.13	0.14	-
Copper	mg/kg as rcvd	16.9	17.9	11.6	13.7	-
Lead	mg/kg as rcvd	0.049	0.059	0.041	0.057	-
Mercury	mg/kg as rcvd	0.013	0.017	0.014	0.019	-
Nickel	mg/kg as rcvd	< 0.10	0.11	< 0.10	< 0.10	-
Zinc	mg/kg as rcvd	96	112	89	93	-
Organochlorine Pesticides in Biomatter						
Aldrin*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
alpha-BHC*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
beta-BHC*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
delta-BHC*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
gamma-BHC (Lindane)*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
cis-Chlordane*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
trans-Chlordane*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
2,4'-DDD*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
4,4'-DDD*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
2,4'-DDE*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
4,4'-DDE*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
2,4'-DDT*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
4,4'-DDT*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Dieldrin*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Endosulfan I*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Endosulfan II*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Endosulfan sulfate*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Endrin*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Endrin aldehyde*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Endrin ketone*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Heptachlor*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Heptachlor epoxide*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Hexachlorobenzene*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Methoxychlor*	mg/kg	< 0.0010	< 0.0010	< 0.0010	< 0.0010	-
Total Chlordane [(cis+trans)*100/42]*	mg/kg	< 0.002	< 0.002	< 0.002	< 0.002	-
Polycyclic Aromatic Hydrocarbons in Biomatter						
Acenaphthene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Acenaphthylene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Anthracene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Benzo[a]anthracene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Benzo[a]pyrene (BAP)*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Benzo[g,h,i]perylene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Benzo[k]fluoranthene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Chrysene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Dibenzo[a,h]anthracene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-

Sample Type: Oysters						
Sample Name:		TH515-0314 09-Feb-2016	TH515-0315 09-Feb-2016	TH515-0316 09-Feb-2016	TH515-0317 09-Feb-2016	
Lab Number:		1559123.6	1559123.7	1559123.8	1559123.9	
Polycyclic Aromatic Hydrocarbons in Biomatter						
Fluoranthene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Fluorene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Indeno(1,2,3-c,d)pyrene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Naphthalene*	mg/kg as rcvd	< 0.010	< 0.011	< 0.011	< 0.011	-
Phenanthrene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Pyrene*	mg/kg as rcvd	< 0.002	< 0.003	< 0.003	< 0.003	-
Polychlorinated biphenyls in Biomatter						
PCB-18*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-28*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-31*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-44*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-49*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-52*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-60*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-77*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-81*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-86*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-101*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-105*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-110*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-114*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-118*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-121*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-123*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-126*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-128*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-138*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-141*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-149*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-151*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-153*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-156*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-157*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-159*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-167*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-169*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-170*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-180*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-189*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-194*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-206*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
PCB-209*	mg/kg	< 0.010	< 0.010	< 0.010	< 0.010	-
Total PCB (Sum of 35 congeners)*	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4	-
Tributyl Tin in Biota samples by GCMS						
Dibutyltin (as Sn)	mg/kg as rcvd	< 0.006	< 0.006	< 0.005	< 0.006	-
Monobutyltin (as Sn)	mg/kg as rcvd	< 0.007	< 0.007	< 0.007	< 0.007	-
Tributyltin (as Sn)	mg/kg as rcvd	< 0.005	< 0.005	< 0.004	< 0.005	-
Triphenyltin (as Sn)	mg/kg as rcvd	< 0.004	< 0.004	< 0.004	< 0.004	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Oysters			
Test	Method Description	Default Detection Limit	Sample No
Lipid Content*	Gravimetric.	0.2 g/100g	1-9

Sample Type: Oysters			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
PCB And OCP in Biomatter	Sonication extraction, SPE cleanup, GPC cleanup, GC-ECD/GC-MS analysis	0.0005 - 0.02 mg/kg	1-9
Homogenisation of Biological samples for Organics Tests*	Mincing, chopping, or blending of sample to form homogenous sample fraction.	-	1-9
Shucking of Shellfish*	Removal of tissue from shell. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1-9
Homogenise*	Mincing, chopping, or blending of sample to form homogenous sample fraction. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1-9
Biological Materials Digestion	Nitric and hydrochloric acid micro digestion, filtration. Analysis performed at Hill Laboratories - Food & Bioanalytical Division, Waikato Innovation Park, Ruakura Lane, Hamilton.	-	1-9
Polycyclic Aromatic Hydrocarbons in Biomatter*		0.0002 - 0.005 mg/kg as rcvd	1-9
Tributyl Tin in Biota samples by GCMS	Solvent extraction, ethylation, SPE cleanup, GC-MS SIM analysis	0.0010 mg/kg as rcvd	1-9
Arsenic	Biological materials digestion, ICP-MS.	0.02 mg/kg as rcvd	1-9
Cadmium	Biological materials digestion, ICP-MS.	0.0004 mg/kg as rcvd	1-9
Chromium	Biological materials digestion, ICP-MS with dynamic reaction cell.	0.006 mg/kg as rcvd	1-9
Copper	Biological materials digestion, ICP-MS.	0.010 mg/kg as rcvd	1-9
Lead	Biological materials digestion, ICP-MS.	0.002 mg/kg as rcvd	1-9
Mercury	Biological materials digestion, ICP-MS.	0.002 mg/kg as rcvd	1-9
Nickel	Biological materials digestion, ICP-MS.	0.02 mg/kg as rcvd	1-9
Zinc	Biological materials digestion, ICP-MS.	0.2 mg/kg as rcvd	1-9

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

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