



TECHNICAL REPORT

Yarra and Maribyrnong estuaries: Investigation of contaminants in fish



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YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINATION IN FISH

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- EPA Victoria
- Department of Human Services
- Department of Primary Industries (Fisheries Victoria)
- Department of Sustainability and Environment
- Parks Victoria
- Melbourne Water*
- Port of Melbourne Corporation*

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ABBREVIATIONS

Aroclor	mixture/formulation of PCB congeners
Composites	samples consist of tissue from 4 to 10 individual fish from a single species at a single site blended together
DDT	dichlorodiphenyltrichloro ethane
DDE	dichlorodiphenyldichlor ethylene
DDD	dichlorodiphenyldichloro ethane
FSANZ	Food Standards Australia and New Zealand
MRL	Maximum residue levels
NH&MRC	National Health and Medical Research Council
NMI	National Measurement Institute
OC	organochlorine pesticides
OP	organophosphate pesticides
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCB Congener	a single, well defined chemical compound in the PCB category
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofuran
PBDE	polybrominated diphenyl ethers
QC	quality control
TBT	tributyl tin
TCDD	2,3,7,8 tetrachloro-p-dibenzo dioxin
TEQ	toxic equivalents - toxicity relative to TCDD, the most toxic member of the dioxin family
TPH	total petroleum hydrocarbons

UNITS OF MEASUREMENT

mg - milligram	10 ⁻³ gram (0.001 g)
µg - microgram	10 ⁻⁶ gram (0.000 001 g)
ng - nanogram	10 ⁻⁹ gram (0.000 000 001 g)
pg - picogram	10 ⁻¹² gram (0.000 000 000 001g)
kg - kilogram	10 ³ gram (1000 g)

EXECUTIVE SUMMARY

The Yarra and Maribyrnong estuaries have a long history of urban and industrial activity and it has only been in the last 30 years that industrial discharges have been redirected to sewer. Water quality in the rivers has improved to the extent that it is now the focus of considerable community activity, including fishing and boating.

Contamination of water, sediment and biota in the Yarra and Maribyrnong rivers consistent with the long history of urban and industrial activity in the catchment, has previously been reported. More recently the community has sought additional information about the suitability of fish from the lower reaches of these waterways for human consumption.

A Preliminary Investigation of Contaminants Within Fish (Melbourne Water and EPA Victoria, 2005) found that some eels caught in the estuary contained levels of polychlorinated biphenyls (PCBs) above the Food Standards Australia and New Zealand Maximum Residue Limit (MRL). The Chief Health Officer advised that eels from the Yarra and Maribyrnong estuary should not be eaten more than once a month and that further investigations should be conducted.

In 2006 a more detailed study focusing on fish, including eels, caught in the Yarra and Maribyrnong rivers estuary was undertaken. The aim of this study was to provide the community with better information about contaminant concentrations in recreationally caught fish. This report includes background and data, including all final analysis results for the investigation. This data report forms the basis for expert advice about consumption of fish from these rivers.

Fish were collected and analysed for a wide range of organic contaminants and heavy metals. Polychlorinated biphenyls (PCB) were detected in all fish samples, but no fish, including eels, taken in the 2006 survey had PCBs in excess of the MRL. Organochlorine pesticides (OC) and polycyclic aromatic hydrocarbons (PAH) were also detected in a small number of fish composites (mainly eels). Polychlorinated dibenzodioxins (dioxins), polychlorinated dibenzofurans (PCDF) and polybrominated diphenyl ethers (PBDE) were also detected in all tested composites. All other analytes tested, including metals and metalloids, such as mercury and arsenic, were generally below or similar to the screening values (SVs) published by the USEPA (or other relevant guideline values) used in assessing recreationally caught fish and were not of concern in relation to the consumption of fish.

The results of this study have been referred to an independent expert panel for further advice in relation to the safety of fish from the estuary for human consumption.

The Expert Panel has concluded that:

- levels of chemicals other than PCBs do not warrant further assessment or advice
- the eel consumption limit of one serve per month proposed in 2005 remains appropriate on public health grounds
- the information on PCB levels indicates it would be prudent to provide advice about limiting consumption of fish caught from the Yarra and Maribyrnong estuaries. This advice is only likely to affect those who regularly eat fish caught in these estuaries
- an advisory limit for the general population aged 16 years and over of one 150 g serve per month for eels and one 150 g serve per week for all other fish caught in the Maribyrnong and Yarra estuaries would be prudent.
- a fourfold reduction in the advisory limit would be appropriate for children and that this be extended to pregnant women in order to accommodate a need for greater protection for both these groups. The extension of the recommended consumption limit to pregnant women is not necessarily implied by the risk assessment, but it is not uncommon for a more conservative approach to be recommended for pregnant women when the developing foetus is likely to be particularly susceptible to a toxic agent, or where it may be transferred in breast milk. This approach would lead to advice that children up to the age of 15 years and pregnant women limit consumption of fish caught in the lower Maribyrnong and Yarra estuaries to one serve every month, and to avoid eating eels from these estuaries.

TABLE OF CONTENTS

ABBREVIATIONS..... 3

UNITS OF MEASUREMENT..... 3

EXECUTIVE SUMMARY..... 4

TABLE OF CONTENTS..... 5

1. INTRODUCTION..... 6

2. METHODS..... 7

 2.1 Study design..... 7

 2.2 Identification of study sites..... 7

 2.3 Species selection..... 7

 2.4 Fish sampling..... 8

 2.5 Fish processing..... 8

 2.6 Target analytes..... 8

 2.7 Laboratories..... 9

 2.8 Assessment criteria..... 9

3. RESULTS AND DISCUSSION..... 10

 3.1 Sampling results..... 10

 3.2 Analytical results – persistent organic pollutants..... 11

 3.2.1 Polychlorinated biphenyls (Appendix 4 Tables A4.1 and A4.4)..... 11

 3.2.2 Dioxins and dioxin-like PCBs (Appendix 4, tables A4.2 and A4.3)..... 14

 3.3 Organochlorine pesticides (OC) (Appendix 4, Table A4.5)..... 15

 3.3.1 DDT, DDD and DDE..... 15

 3.3.2 Aldrin and dieldrin..... 15

 3.3.3 Heptachlor epoxide..... 15

 3.4 Organophosphate pesticides and phenoxy acid herbicides (Appendix 4 Tables A4.6 and A4.7)..... 16

 3.5 Polycyclic aromatic hydrocarbons (PAHS) (Appendix 4, Table A4.8)..... 16

 3.6 Petroleum hydrocarbons (TPH) (Appendix 4, Table A4.9)..... 16

 3.7 Metals (Appendix 4, Table A4.10)..... 16

 3.8 Tributyl tin antifoulant (Appendix 4 Table A4.11)..... 16

 3.9 Polybrominated diphenyl ethers – PBDE (Appendix 4 Table A4.12)..... 16

4. CONCLUSION..... 17

5. REFERENCES..... 18

APPENDIX 1 SAMPLING SITES..... 19

APPENDIX 2 SCREENING VALUES AND ACTION LEVELS..... 20

APPENDIX 3: TISSUE COMPOSITES AND ANALYSIS DETAILS..... 21

APPENDIX 4 ANALYTICAL RESULTS TABLES..... 28

1. INTRODUCTION

The Yarra and Maribyrnong estuaries are waterways with a long history of urban and industrial activities. In recent years water quality has improved to the extent that it is now the focus of considerable community activity, such as fishing and boating.

Contamination of water, sediment and biota in the Yarra and Maribyrnong Rivers is consistent with the long history of urban and industrial activity in the catchment and has been reported previously (*Melbourne Water and EPA Victoria Preliminary Investigation of Contaminants Within Fish 2005*; Knuckey et al., 1997; Walker et al., 1998; Mueller et al., 2002). Contaminant levels in the water are below trigger levels specified for estuaries in the *ANZECC Guidelines for Fresh and Marine Waters 2000*. Sediment contaminant levels are generally low and for the contaminants listed as of potential concern for consumers of fish, such as polychlorinated biphenyls results are low with the majority below the level of detection.

While contaminant levels in water and sediment are low, in 2005, a *Preliminary Investigation of Contaminants Within Fish (Melbourne Water and EPA Victoria, 2005)* found that some eels caught in the Estuary contained levels of the polychlorinated biphenyls (PCBs), above the Food Standards Australia and New Zealand Maximum Residue Limit (MRL) and contaminants were present in fish, such as bream, at levels below the MRL. The Chief Health Officer advised that eels from the Estuary should not be eaten more than once a month and that further investigations should be conducted.

A more detailed study focusing on fish caught in the Yarra and Maribyrnong Rivers estuary has been undertaken in order to provide the community with better information about contaminant concentrations in recreationally caught fish and their safety for human consumption.

2. METHODS

2.1 Study design

The approach used was based on the United States EPA guidelines for the assessment of the risk to human health from eating contaminated fish, which recognises that for human health risks, eating the fish is the primary exposure route.¹ The study included fish samples obtained at five locations in the estuary.

Recreationally popular fish species were identified using a range of information sources. Studies showed black bream to be popular across the entire estuary, however the second species varied with location in the estuary. The study proposal recommended yellow-eyed mullet as the second species and tailor at the 'Warmies'. Reports indicated that catches of many species were seasonal and numbers caught were low. The study proposal was therefore adapted so that where the recommended species were not caught in the required numbers the entire catch was investigated and the dominant, recreationally popular species present in the 'by-catch' was substituted. This approach recognised that these species would be represented in the recreational fishers catch.

This study builds on the results of a previous study (EPA/MW 2005) and involved screening of the waterway by collecting and composite samples of target species to determine concentrations of a broad suite of potential contaminants.

This study provides an assessment of chemical contamination for the short finned eel and three species of recreationally targeted fish.

2.2 Identification of study sites

Sampling locations were selected based on known areas of contamination identified in previous environmental studies, observations of sites of significance for recreational fishing in the region and the advice of Fisheries Victoria.

The Maribyrnong estuary extends to Canning Street in Avondale Heights and the Yarra estuary to Dights Falls in Kew. Popular fishing sites are spread throughout the estuary, with the 'Warmies', in the lowest reach, identified as a particularly popular fishing site. The study focused on sampling fish and eels from the five areas described in Table 1 (see Appendix 1 for Map).

Table 1. Reaches - site locations (refer to Appendix 1 for site map).

Reach number	Location
1	The upper urban reach of Maribyrnong River estuary (Maribyrnong)
2	The upper urban reach of the Yarra River estuary (Herring Island)
3	The urban reach of the lower Maribyrnong River, focusing in the Whitehall St, Yarraville region
4	The urban section of the Yarra River immediately upstream of the junction with the Maribyrnong (South Wharf No. 6-10, Docklands)
5	The lower Yarra estuary (near the 'Warmies').

2.3 Species selection

The USEPA Guidelines (USEPA 2000) recommend selecting two species of fish for estuarine studies. Species should be selected based on popularity as a targeted recreational species and the likelihood of contaminant accumulation, taking into account the proportion of life cycle spent in the estuary and feeding behaviour.

Fisheries Victoria creel surveys indicate that black bream and yellow-eyed mullet are the most popular fish species targeted by recreational fishers using the Estuary. In addition, at the 'Warmies' tailor is present and recreationally targeted (Walker et al 1998). Tailor has aggressive feeding habits and oily flesh, making it a possible accumulator of organic contaminants. Walker *et al* (1998) found tailor to be present in low numbers at sites downstream of the

¹ This study uses the Tier 1 and Tier 2 format recommended by the USEPA. The Preliminary Investigation provides a limited Tier 1 Investigation for specific parameters (Arsenic and PCBs). This study is a combination of Tier 1 and Tier 2 Phase 1 aimed at providing adequate information to support decisions regarding consumption of fish from the Estuary.

'Warmies', however this species is seasonal and is not present further up the estuary.² Black bream are the most characteristic estuarine species spending the majority of its life in the estuary, most other species targeted recreationally move between the marine and estuarine environments.

A previous study (EPA/MW, 2005) identified PCB contamination in short finned eels. As a result, eels were included in this study although there is currently limited information available about the human consumption of eels from the lower Yarra River.

This study targeted eels and the three most popular recreational species (black bream, yellow-eyed mullet and tailor). In recognition of the impact of seasonal factors on fish catches in the estuary, an adaptive approach was taken to fish species selection. The study targeted the species as listed in the proposal however, where low numbers of targeted fish species were caught it was recognised that recreational fishers would similarly be unable to catch the particular species and a recreationally popular fish present in the catch was substituted.

2.4 Fish sampling

The project design targeted collection of 30 bream, 30 mullet and, at the 'Warmies', 30 tailor, with the aim of forming three composites each consisting of 10 fish for each species, from each river reach. Similarly, 12 short finned eels (three composites each consisting of four fish) were targeted from each of the five reaches.

Fish sampling was undertaken in accordance with a Fisheries Research Permit, during April and May 2006 using mesh nets for the bream, mullet and tailor and fyke nets for the eels. Nets were set prior to dusk to allow for effective overnight fishing, with retrieval at dawn.

The targeted fish numbers and species range were not met at all sites. Black bream were caught at all sites, short finned eels were caught in the upper (fresher) sections of the estuaries, mullet were caught only at the 'Warmies' and mulloway were caught at the Herring Island and Docklands sites in the Yarra estuary.

2.5 Fish processing

All fish were assigned an ID# and sample code and details were recorded on sample sheets.

Fish were weighed to the nearest gram and their length measured (see Appendix 3.2 for details).

Bream, mullet and mulloway were dissected to obtain skinless fish fillets. Eels were gutted, and sliced in half on one side of the backbone from behind the head down to the tail to obtain fillets. Fish bones were also retained for possible future analysis. Fillets were organised in sets of two, three, four, or ten as specified, in preparation for processing and compositing at the National Measurement Institute (NMI) (Appendix 3.1, gives details of composites). Samples were stored on ice, until delivered to the laboratories for processing.

2.6 Target analytes

Contaminants of interest in this study were determined based on:

1. The USEPA target analyte list; this list provides suggested contaminants for a broad screen, based on their potential to bioaccumulate in fish and their toxicological significance to humans.
2. Existing and emerging information about contaminants identified through:
 - Water, sediment and biota sampling; and
 - Investigation of other pollution sources that may impact on the estuary (e.g. adjacent contaminated sites).

Analytes tested were:

- (i) heavy metals (cadmium, copper, chromium, zinc, lead, selenium, arsenic and mercury).
- (ii) organochlorine pesticides (OCs), organophosphate pesticides (OPs) chlorophenoxy herbicides, polycyclic aromatic hydrocarbons (PAH), tributyl tin (TBT), total petroleum hydrocarbon (TPH)
- (iii) polychlorinated biphenyls (PCB): a total of 21 congeners were tested.
- (iv) dioxins (PCDD), furans (PCDF), and brominated diphenyl ethers (PBDEs) were analysed at ultra-trace levels

Tributyl tin (TBT) and chlorophenoxy herbicides, both of which are listed as optional on the USEPA target analytes list, were included. Tributyl tin (an antifoulant used on ships) is known to be present at low concentration in the lower reaches of the rivers, including the port area (Knuckey *et al* 1997).

² As discussed in section 3.1, Tailor was not represented in the fish actually caught and Mulloway was substituted into the study.

Polybrominated diphenyl ethers (PBDEs) (flame retardants) have recently been added to the USEPA target list as an emergent issue and were added to the analyte list.

2.7 Laboratories

NMI conducted all processing of samples and completed all general analysis and relevant QC analyses including spikes, recoveries, duplicates, blank and some Standard Reference Material results.

Sample processing involved weighing the skinless fish fillets to ensure that all fillets were approximately of the same weight (within 1 gram). Fillets were then individually freeze-dried, ground and homogenised. Equal aliquots of the homogenised fillet material were then taken to make up the appropriate composites (Appendix 3).

Advanced Analytical in Sydney carried out QC/QA testing on approximately 10% of composites (four in total) for general analysis of organics and metals.

Agriquality New Zealand, carried out QC testing on approximately 10% of composites (two in total) for PCDDs, PBDEs, and dioxin-like PCBs.

2.8 Assessment criteria

Contaminant concentrations measured in fish have generally been compared with

- Food Standards Australia and New Zealand Maximum Residue Levels (FSANZ MRLs), which are based on typical consumption levels.
- USEPA Screening Values (SVs)³ that are based on risks associated with high levels of fish consumption.

The SVs reflect a higher dietary intake of fish by recreational fishers, compared to that of the general population, and are typically lower than the FSANZ MRL values, which are intended for use in the assessment of food for consumption by the general population.

Available information indicates that recreational fishers consume fish more frequently than the general population; therefore SVs are particularly relevant as a screening tool when considering the consumption of fish by recreational fishers in the Yarra and Maribyrnong estuary.

³ The USEPA SVs are risk-based, and application of the SVs is linked in USEPA guidance (USEPA, 2000) to a specified sampling approach using composites of 4 to 10 individual fish blended to form each sample for analysis.

3. RESULTS AND DISCUSSION

3.1 Sampling results

Fishing was undertaken between early April 2006 and mid May 2006, resulting in a total of 252 fish being caught across the five reaches of the Estuary. A summary of the sampling outcomes is as follows:

- The required number of black bream was caught in all reaches.
- Mullet was caught in Reach 4 (six flat tail mullet) and Reach 5 (30 yellow-eyed mullet).
- Eel numbers were low, with only two caught in Reach 1 and eleven caught in Reach 2 (ie. the upper reaches). This is consistent with the understanding that eels prefer freshwater for most of their life cycle (ie. other than when migrating for spawning or returning as elvers).
- Small numbers of mulloway and snapper were also caught.
- The original study proposal included tailor from the 'Warmies', as recreational fishers target this species at the mouth of the estuary. None were caught at the 'Warmies' reflecting their limited seasonal distribution.

To meet the study requirements of two recreationally targeted species and a robust number of fish from each reach, mulloway was included in the study. Advice from Fisheries Victoria indicated that mulloway are targeted both for food and as a 'sport fishing' species. Consequently, four species were studied; black bream, mullet, mulloway and short finned eels.

The extent of recreational eel fishing in the lower Yarra and Maribyrnong Rivers is not well documented but is thought to be limited. Eels were included in this study based on the results of the preliminary study, which identified elevated PCB concentrations in short finned eels. Table 2 shows the number of fish analysed from each site. Appendix 3.1 gives details of the composites.

Table 2. Fish sampling results

	BLACK BREAM	YELLOW-EYE MULLET	FLAT TAIL MULLET	MULLOWAY	SHORT FINNED EELS	OTHER
Scientific Name	<i>Acanthopagrus butcheri</i>	<i>Aldrichetta forsteri</i>	<i>Liza argeneas</i>	<i>Argyrosomus hololepidotus</i>	<i>Anguilla australis</i>	
Reach 1 Maribyrnong	30	0	0	0	2	16 Snapper
Reach 2 Herring Is	30	0	0	7	11	0
Reach 3 Whitehall	30	0	0	0	0	1 Sea Mullet
Reach 4 Docklands	30	0	6	2	0	8 Snapper
Reach 5 'Warmies'	30	30	0	0	0	10 Flathead 8 Wrasse

3.2 Analytical results – persistent organic pollutants

3.2.1 Polychlorinated biphenyls (Appendix 4 Tables A4.1 and A4.4)

PCBs are a group of oily, persistent, thermally stable, non-flammable chemicals, which in the past were used as insulating materials in electrical equipment such as transformers. PCBs were also used as plasticisers (softening materials) in plastics and in a variety of other industrial applications from the 1930s until the 1980s. PCBs are very stable, resistant to chemical and microbiological degradation and are extremely persistent organic pollutants in the environment. PCBs can also contain small amounts of dioxin impurities. These organics are fat-soluble and thus tend to accumulate in adipose (fat) tissue and are then distributed through the food chain. The production and use of PCBs has been discontinued but large amounts remain in electrical equipment, plastic products and in the environment.

PCBs were detected in all composite fish samples and the total PCB content (for each composite) was found to be above the USEPA SV (Appendix 2). The data shows that of the 21 PCB congeners tested, 12 were not detected, two were detected in all composites and the remaining 7 congeners were detected in some composites. Congeners 105, 126 and 128 were detected in the *2005 Preliminary Investigation of Contaminants within Fish (Melbourne Water and EPA)*, but were not detected in this study. Figures 1 and 2 compare congener patterns between the 2005 and 2006 studies.

The results for PCB concentrations in fish from the 2005 and 2006 studies are shown in Figures 3 and 4. Eels from Reach 1 (Maribyrnong) and Reach 2 (Herring Island) were found to have the highest concentrations of PCBs. Eel composite #18 had 0.45 mg/kg of total PCBs, which is above the USEPA SVs (0.02 mg/kg) and just below the FSANZ MRL (0.5 mg/kg.).

The data obtained for this study is consistent with the findings of the *Preliminary Investigation of Contaminants Within Fish by Melbourne Water and EPA Victoria in 2005*. The 2005 investigation found that contaminant levels in fish, such as bream were lower than in eels. Likewise this study indicates that in the Yarra and Maribyrnong River estuary eels carry higher levels of PCBs contamination.

PCBs were detected in all bream composites tested. The PCB results for bream varied slightly between reaches, however all results were in the range 0.03 to 0.12 mg/kg, with bream from Reach 4 (composite#29) having the highest levels.

A comparison of fish species found that generally eels had the highest concentrations of PCBs, with the lowest results similar to the levels found in the highest composites for the other species.

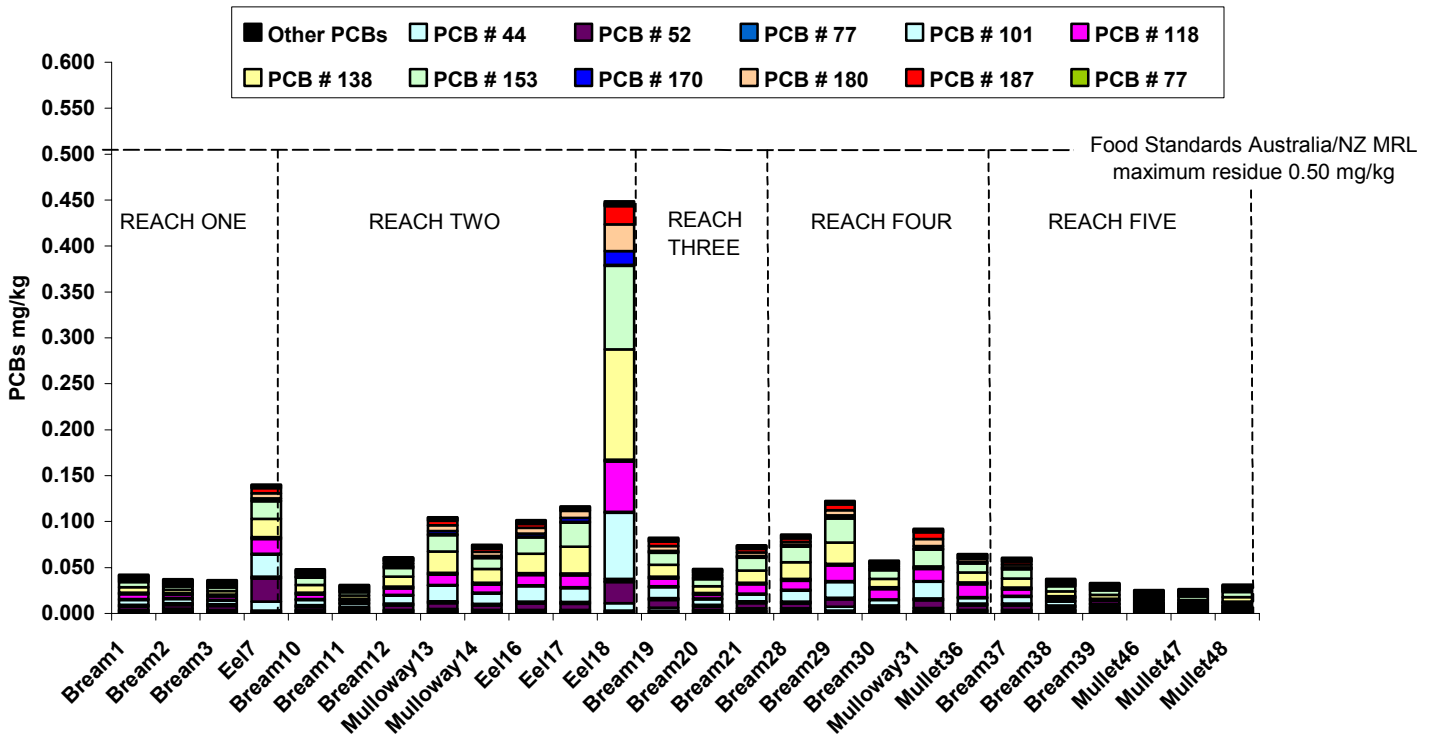


Figure 1: PCB congener results Yarra/Maribyrnong fish study 2006

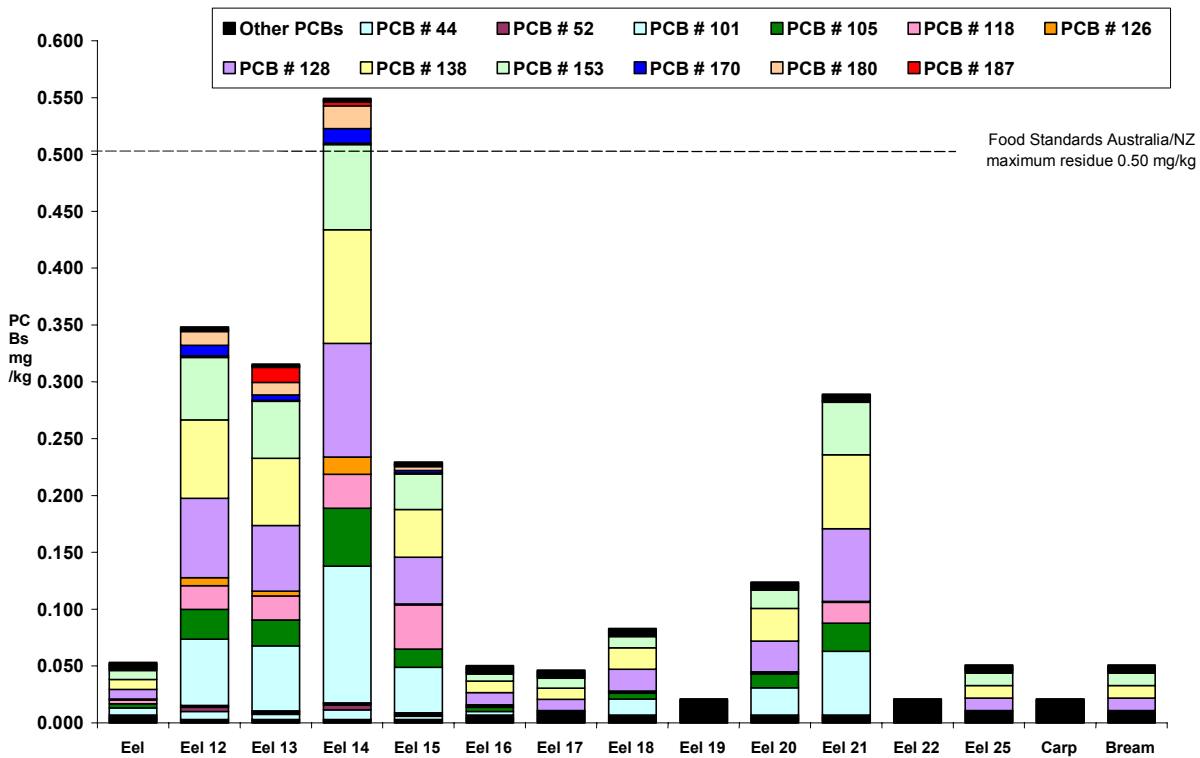


Figure 2: PCB congener results Yarra/Maribyrnong fish study 2005

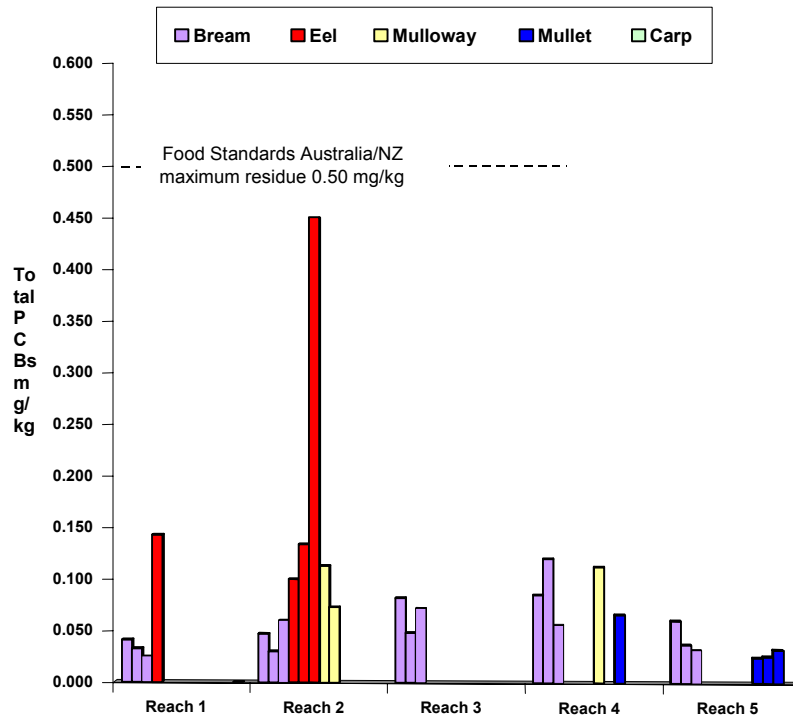


Figure 3: Results for PCBs, for all fish & eel composites, by river reaches 2006

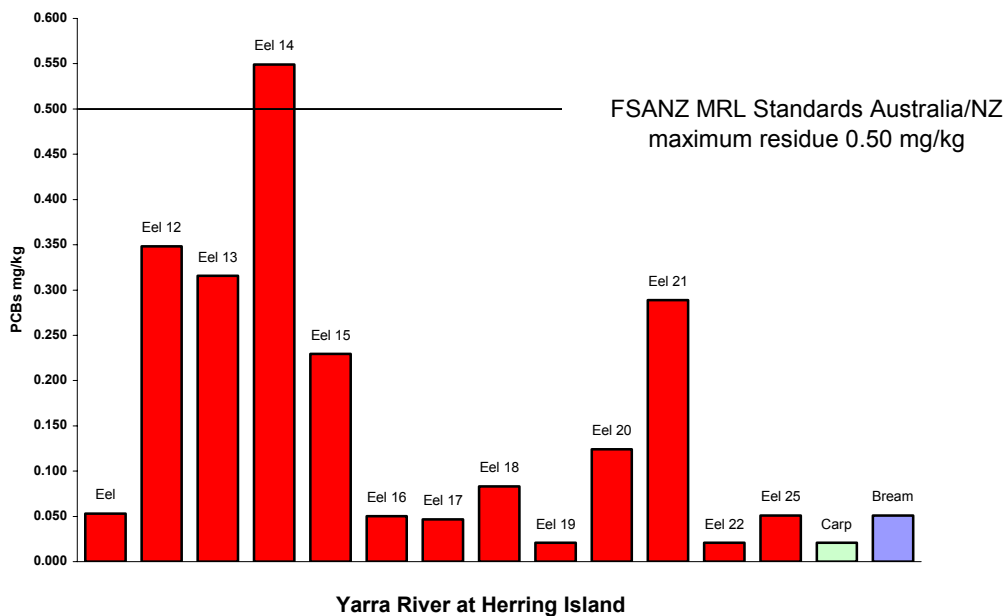


Figure 4: PCBs in individual eels from Herring Island - Preliminary Study 2005

3.2.2 Dioxins and dioxin-like PCBs (Appendix 4, tables A4.2 and A4.3)

The term dioxin is generally applied to a complex group of polychlorinated dibenzo dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Of the 210 known dioxins a group of 17 PCDDs and PCDFs are considered by the World Health Organisation to be of toxicological concern. In addition to the group of 17 PCDD/PCDFs of toxicological concern are 12 dioxin-like PCBs, which display dioxin-like toxicity.

PCDDs and PCDFs were not produced deliberately, they are formed as a by-product of chemical and combustion processes. These range from natural events such as bush fires to man made processes such as the manufacturing of chemicals, pesticides, steel and paints, pulp and paper bleaching, exhaust emissions and incineration.

The Expert Panel, reporting to the NSW Food Authority for the 2006 study *Dioxins in Seafood in Port Jackson and its Tributaries*, has endorsed the use of 6 pg TEQ/g fresh weight as a 'temporary Action Level for dioxin in seafood' pending further information. This value is consistent with the recent FSANZ risk assessment and is similar to the European Union's amended Maximum Level for fish and fish products of 4 pg TEQ/g fresh weight for PCDDs/Fs or 8 pg TEQ/g fresh weight for the combined amount of PCDDs/Fs and dioxin-like PCBs. (EUSC 2001)

The Action Level endorsed for the NSW Authority of 6 pg TEQ/g fresh weight can be used as an appropriate reference point to guide the assessment of dioxin concentrations in fish in this investigation given it has been derived locally for a similar purpose.

Ten composites were analysed for dioxins and dioxin-like PCBs (Table 3). These included bream composites from all reaches, eel composites from Reaches 1 and 2 and a mullet composite from Reach 5. Dioxins and dioxin-like PCBs were detected in all composites analysed, with the two eel composites found to have the highest concentrations. The results are shown in Figure 5. Only one composite (Composite#7, eel, Reach 1, 7.2pg/g) reported concentrations above the NSW temporary action level of 6pg/g.

Figure 5 shows the toxic equivalents from all sources (dioxins and dioxin like PCBs) detected in fish tissue. Appendix 4 Table A4.4 shows the contribution of dioxins and dioxin like PCBs to the overall toxic equivalents (TEQ) reported for each sample.

PCBs were responsible for the largest contribution to the total TEQ ranging from 62% and 76% for bream in Reaches 1 and 2 to 92% for eels in Reach 1.

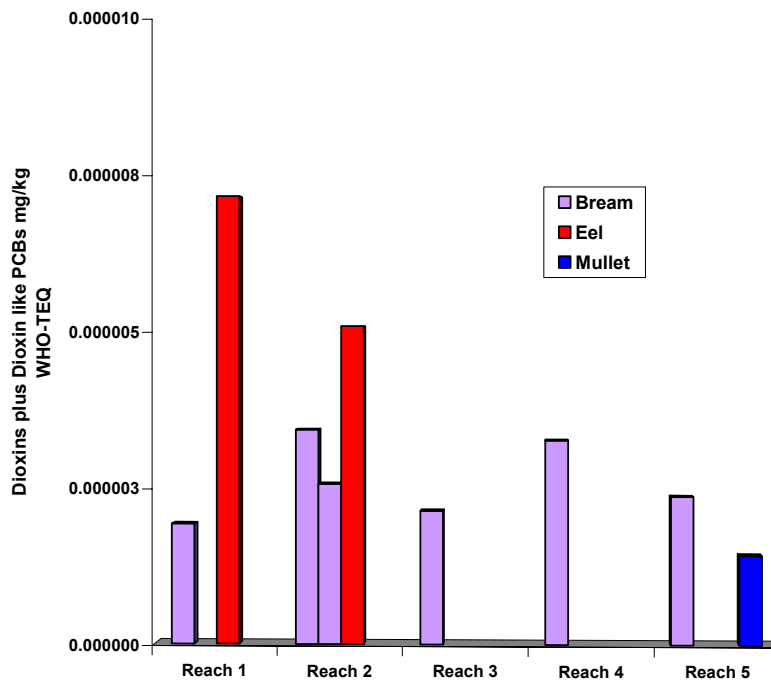


Figure 5 Toxic Equivalents (dioxins and dioxin like PCBs) in fish 2006

3.3 Organochlorine pesticides (OC) (Appendix 4, Table A4.5)

Organochlorines were widely used in Australia’s agricultural and pest control industries during the 1950’s and 1970’s. The use of organochlorine pesticides has been phased out in Australia since the 1980’s. These chemicals are thought to be widespread and are persistent in the environment. Refer to Appendix 4, Table 4.5 for details of the organochlorine pesticide results.

3.3.1 DDT, DDD and DDE

DDD and DDE were detected at trace levels (below USEPA SVs of 0.117 mg/kg total DDT/DDD/DDE) in fish and eels composites from all reaches. DDT was found at close to the limits of detection (0.01 mg/kg) in eel composites from Reaches 1 and 2. All results were below the USEPA SV.

3.3.2 Aldrin and dieldrin

Aldrin breaks down rapidly in biological systems and in the environment. Dieldrin breaks down slowly and once stored in adipose tissue its elimination is very slow.

Aldrin was not detected in any samples. Dieldrin was detected in all eel samples, and in one mullet composite from Reach 4 (The Docklands) at levels in between the USEPA SV (0.0025 mg/kg) and the MRL (0.1 mg/kg). Dieldrin concentrations in eels were 0.029 mg/kg in Reach 1 (Maribyrnong), from 0.036 to 0.075 mg/kg in Reach 2 (Herring Island). Dieldrin in mullet from Reach 4 was 0.021 mg/kg.

3.3.3 Heptachlor epoxide

Heptachlor epoxide was detected in one eel composite from Reach 2 (Herring Island, composite #18) however the concentration of 0.022 mg/kg is below the MRL of 0.05 mg/l. No USEPA SV was available. All other composites were below the detection limit.

3.4 Organophosphate pesticides and phenoxy acid herbicides (Appendix 4 Tables A4.6 and A4.7)

All organophosphate pesticide and phenoxy acid herbicide results were below the limits of detection (0.01 mg/kg and 0.1 mg/kg respectively); and the USEPA Screening Values for organophosphate pesticides (diazinon 2.8 mg/kg; chlorpyrifos 1.2 mg/kg and ethion 2 mg/kg). There are no listed USEPA Screening Values for phenoxy acid herbicides.

3.5 Polycyclic aromatic hydrocarbons (PAHS) (Appendix 4, Table A4.8)

Polycyclic aromatic hydrocarbons (PAHs) are components of many hydrocarbon products and are formed in combustion processes. PAHs are listed as contaminants of concern for fish investigations by the USEPA however they are readily metabolised in higher organisms including fish.

PAHs were detected in one eel composite (composite #17) from Herring Island and one bream composite (composite #1) from Maribyrnong (Appendix 4, Table 4.8). The reporting limit for PAHs (<0.01 mg/kg) is above the SV (0.0055 mg/kg) for total PAHs. Where detected but not above the reporting limit, the analytical laboratory reported PAH results as 'trace levels'. No other samples (other than composites #1 or #17) showed detectable concentrations of PAHs, even at trace levels, giving confidence that the USEPA SVs were not exceeded.

3.6 Petroleum hydrocarbons (TPH) (Appendix 4, Table A4.9)

All petroleum hydrocarbon results were below the limits of detection. There is no USEPA screening value for petroleum hydrocarbons and the threshold for tainting and unacceptable taste is below the level for health concerns and above the limits of detection. (ANZECC, 2000)

3.7 Metals (Appendix 4, Table A4.10)

All composites were analysed for heavy metals. The metals and metalloids analysed were total and inorganic arsenic, cadmium, chromium, copper, lead, mercury, selenium and zinc. The results are summarised as follows:

- Cadmium (Cd) and chromium (Cr) levels were consistently less than the detection limit of 0.005 mg/kg compared to a SV of 4 mg/kg for cadmium. No USEPA SV was identified for chromium.
- Copper was detected at concentrations between 0.1 and 0.5 mg/kg. There is no USEPA SV for copper.
- Lead was at levels below 0.07 mg/kg (USEPA SV 0.5 mg/kg) and mercury results were below 0.18 mg/kg (USEPA SV 0.4 mg/kg).
- Selenium was consistently below 0.5 mg/kg (compared to a USEPA SV 20 mg/kg) and zinc results were all below 12 mg/kg. No USEPA SV was identified for zinc.
- No inorganic arsenic was detected with all results below 0.04 mg/kg. The detection limit was above the USEPA SV of 0.026 mg/kg therefore the USEPA protocol of assigning a result equal to half the detection limit was applied; this gives all samples a result of 0.02 mg/kg, which is below the screening value for inorganic arsenic.

The concentrations of metals in fish (including eel) samples did not exceed USEPA SVs where these were available. The data suggests no significant metal contamination of any of the fish tested; this is consistent with previous investigations (Knuckey et al, 1997, EPA/MW, 2005).

3.8 Tributyl tin antifoulant (Appendix 4 Table A4.11)

All tributyl tin levels (measured as total tin) were below 0.0053 mg/kg compared to the USEPA SV of 1.2 mg/kg.

3.9 Polybrominated diphenyl ethers – PBDE (Appendix 4 Table A4.12)

PBDE flame-retardants were detected in all fish composites analysed. Previous studies have indicated concentration in the sediments in the lower Yarra to be typical of an estuary in an urbanised catchment. Concentrations varied between the different congeners ranging from below detection to 158 000 pg/g. This is an emerging area of investigation, with no published USEPA SV. The results have been referred to the Expert Panel for further assessment.

4. CONCLUSION

Bream, mulloway, mullet and eels collected from the Yarra and Maribyrnong estuaries were tested for a wide range of organic contaminants and heavy metals: The results of this investigation is summarised as follows:

- Overall the concentrations of organochlorines (DDT, dieldrin), PAHs, total petroleum hydrocarbons and metals in fish are similar to that reported by Knuckey et al (1997).
- PCBs were detected in all fish samples, with the highest levels found in eels. The reported concentrations were consistently above the USEPA SVs but below the MRLs.
- Organochlorine pesticides were detected mainly in eels. Dieldrin was detected at concentrations, above the SVs but below MRL. DDT, DDD and DDE were detected at low levels, below USEPA SVs. Heptachlor epoxide was detected in one eel composite, above the USEPA SV (no MRL was identified).
- Polycyclic aromatic hydrocarbons (PAHs) were reported to be above the USEPA SVs for one eel composite (out of four eel composites) and just above for one bream (out of 15 composite). No MRL were identified for PAHs. All other fish were below the USEPA SV.
- Organophosphate pesticides (OPs), chlorophenoxy herbicides, total petroleum hydrocarbons (TPH) and tributyl tin were all below the detection limit.
- Heavy metals (cadmium copper, chromium, zinc, lead, selenium, arsenic, and mercury) were below the USEPA SVs, where these were available.
- Dioxins and dioxin-like PCBs were detected in all tested composites. The Expert Panel concluded that the results were lower than or comparable to the levels established by the European Commission in February 2006 of 4 to 8 pg TEQ/g dioxins and dioxin-like PCBs and that no restrictions on consumption were required.
- Polybrominated diphenyl ethers (PBDE - flame retardants) were detected in all composites tested. The Expert panel concluded that, though there is no current advice on acceptable intake levels, there was a suitable safety margin between the levels detected and levels associated with possible health effects.

All results were referred to the Expert Panel for review and comment regarding the adequacy of the information as the basis for providing public health advice and the need for specific advice to the community. The Expert Panel has been asked to comment on the significance of the reported concentrations of PCBs, dioxins and PBDEs and the need for advice to be provided to recreational fishers and others consuming fish from the estuary. The Expert Panel concluded that chemicals other than PCBs do not warrant further assessment or advice. The Expert Panel provided advice about limiting consumption of fish containing PCBs. (Refer to *Expert Panel Report - Yarra and Maribyrnong River Fish Study*.)

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APPENDIX 1 SAMPLING SITES

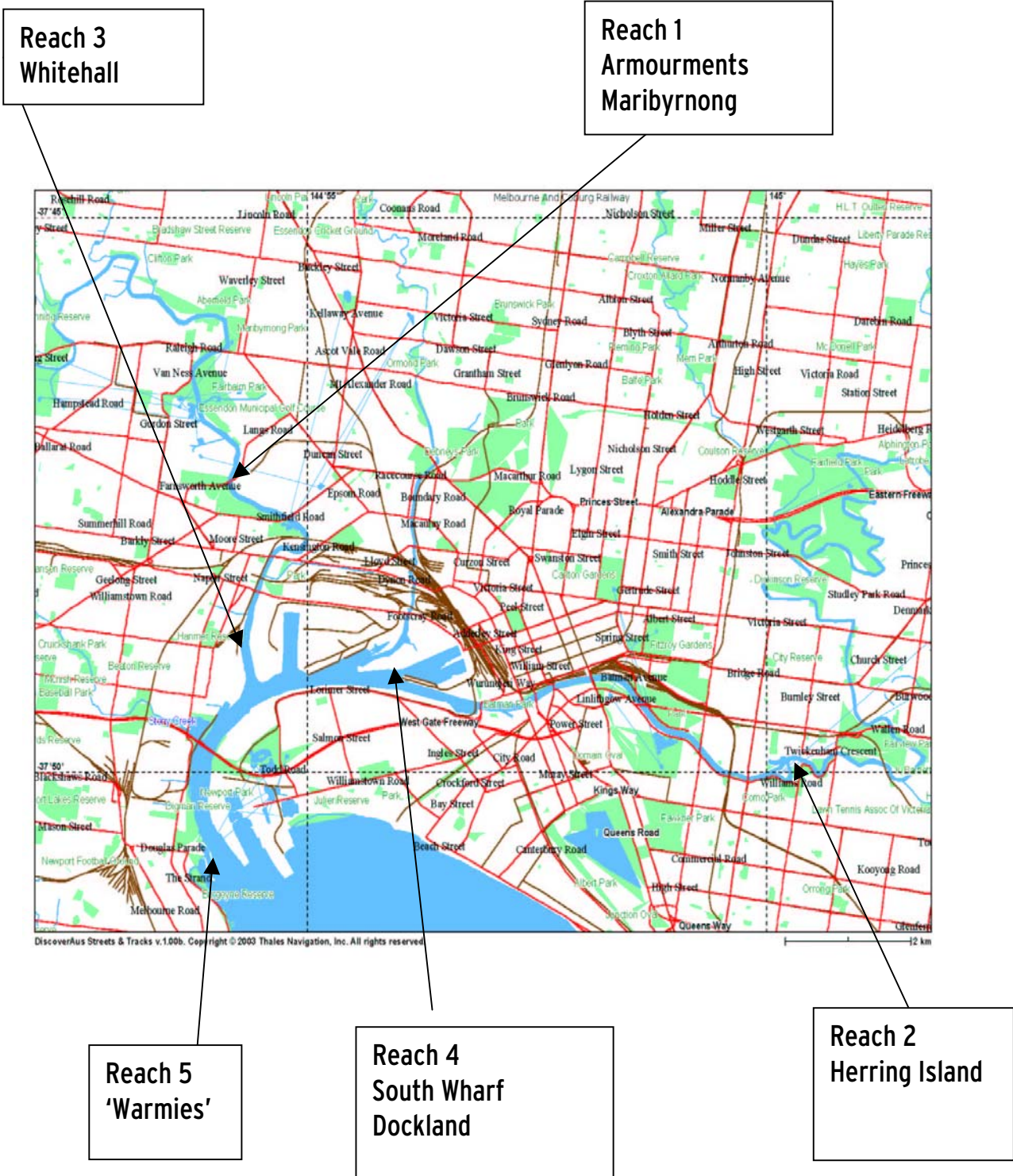


Figure A1.1: Location Map: Sampling Reaches in the Maribyrnong-Yarra Estuary

APPENDIX 2 SCREENING VALUES AND ACTION LEVELS

1. Units expressed in mg/kg
2. USEPA values = Recommended values as per USEPA Guidelines
3. MRL = ANZ Food Standards Maximum Residue Limit

Table 2.1: Screening values and residue limits

Compound	USEPA values	MRL	European Union Limit	NSW FOOD AUTHORITY
Dioxins plus dioxin-like PCBs	2.56 X 10 ⁻⁷	NA	80 X 10 ⁻⁷	60 X 10 ⁻⁷
Total PCB	0.02	0.5		
Total PAHs	0.0055			
TPH various fractions	NA			
Tributyltin as Sn	1.2			
Metals				
Arsenic				
Arsenic inorganic	0.026	2		
Cadmium	4			
Chromium				
Copper				
Lead		0.5		
Mercury	0.4	0.5		
Selenium	20			
Zinc				
OCs				
HCB				
Heptachlor		0.05		
Heptachlor oxide	0.00439			
Aldrin				
gamma-BHC (Lindale)	0.0307	1		
alpha-BHC	0.025	0.01		
beta-BHC	0.025	0.01		
delta-BHC	0.025	0.01		
trans-Chlordane	total 0.114	total 0.05		
cis-Chlordane				
Oxychlordane				
Dieldrin	0.0025	0.1		
pp-DDE	total 0.117	total 1		
pp-DDD				
pp-DDT				
Endrin	1.2			
Endrin Aldehyde				
Endrin Ketone				
alpha-Endosulfan	total 24			
beta-Endosulfan				
Endosulfan Sulfate				
Methoxychlor				

APPENDIX 3: TISSUE COMPOSITES AND ANALYSIS DETAILS

Table A3.1: Details of composites and analysis

Composite no	No of fillets per composite	Details of fish	Sample numbers	Ultra- Trace PCDD PBDE Dioxin-like PCBs	General Analysis: Organics And Metals
FISH COMP1	10 fillets	Reach 1, Bream	BB73-82		tested
FISH COMP2	10 fillets	Reach 1, Bream	BB83-92	tested	tested
FISH COMP3	10 fillets	Reach 1, Bream	BB93-102		tested
FISH COMP7	2 fillets	Reach 1, Eel	SFE133-134	tested	tested
FISH COMP10	10 fillets	Reach 2, Bream	BB1-10	tested	tested*
FISH COMP11	10 fillets	Reach 2, Bream	BB11-20		tested
FISH COMP12	10 fillets	Reach 2, Bream	BB21-30	tested	tested
FISH COMP13	3 fillets	Reach 2, Mulloway	MWY01-03		tested
FISH COMP14	3 fillets	Reach 2, Mulloway	MWY04-06		tested
FISH COMP16	4 fillets	Reach 2, Eel	SFE61-64		tested
FISH COMP17	4 fillets	Reach 2, Eel	SFE65-68	tested	tested*
FISH COMP18	4 fillets	Reach 2, Eel	SFE69-72		tested
FISH COMP19	10 fillets	Reach 3, Bream	BB145-154		tested
FISH COMP20	10 fillets	Reach 3, Bream	BB155-164	tested	tested
FISH COMP21	10 fillets	Reach 3, Bream	BB165-174		tested
FISH COMP28	10 fillets	Reach 4, Bream	BB217-226		tested
FISH COMP29	10 fillets	Reach 4, Bream	BB227-236	tested	tested
FISH COMP30	10 fillets	Reach 4, Bream	BB237-246		tested
FISH COMP31	2 fillets	Reach 4, Mulloway	MWY28-29		tested
FISH COMP36	6 fillets	Reach 4, Mullet	MUL 247-252		tested
FISH COMP37	10 fillets	Reach 5, Bream	BB289-298	tested	tested
FISH COMP38	10 fillets	Reach 5, Bream	BB299-308	tested	tested
FISH COMP39	10 fillets	Reach 5, Bream	BB309-318		tested*
FISH COMP 46	10 fillets	Reach 5 Mullet	MUL 319 - 328	tested*	tested*
FISH COMP 47	10 fillets	Reach 5 Mullet	MUL 329 - 338		tested
FISH COMP 48	10 fillets	Reach 5 Mullet	MUL 339 - 348		tested

* Samples tested for QC/QA as well.

Table A3.2 Weight and length information

Reach 1 - Armourment Maribyrnong

Label #	Length (mm)	Weight (g)	
Black Bream (<i>Acanthopagrus butcheri</i>)			
BB73	353	1065	Composite 1
BB74	270	495	
BB75	298	536	
BB76	290	576	
BB77	288	520	
BB78	260	367	
BB79	248	346	
BB80	229	365	
BB81	225	242	
BB82	211	225	
Composite 2			
BB83	202	172	Composite 2
BB84	198	169	
BB85	191	149	
BB86	171	131	
BB87	197	145	
BB88	183	120	
BB89	173	112	
BB90	164	94	
BB91	168	94	
BB92	157	73	
Composite 3			
BB93	312	684	Composite 3
BB94	297	542	
BB95	266	423	
BB96	270	424	
BB97	244	328	
BB98	222	241	
BB99	199	165	
BB100	188	142	
BB101	192	141	
BB102	175	115	
Short-finned Eel (<i>Anguilla Australia</i>)			
SFE133	610	356	Composite 7
SFE134	408	101	

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Reach 2 - Herring Island - Yarra River

Label #	Length (mm)	Weight (g)	
Black Bream (<i>Acanthopagrus butcheri</i>)			
BB1	288	495	Composite 10
BB2	265	415	
BB3	265	437	
BB4	232	302	
BB5	230	267	
BB6	217	247	
BB7	217	205	
BB8	218	243	
BB9	220	227	
BB10	205	189	
BB11	260	400	Composite 11
BB12	242	322	
BB13	235	287	
BB14	228	254	
BB15	170	105	
BB16	278	493	
BB17	248	341	
BB18	243	351	
BB19	246	316	
BB20	219	243	
BB21	242	310	Composite 12
BB22	231	277	
BB23	212	285	
BB24	220	220	
BB25	190	144	
BB26	217	214	
BB27	182	131	
BB28	182	125	
BB29	168	92	
BB30	151	70	
Mulloway			
MWY01	695	3110	Composite 13
MWY02	695	3053	
MWY03	718	3392	
MWY04	645	2645	
MWY05	390	3158	
MWY06	830	4861	
Short-finned Eel (<i>Anguilla Australia</i>)			
SFE61	780	920	Composite 16
SFE62	670	590	
SFE63	650	480	
SFE64	720	750	Composite 17
SFE65	520	268	
SFE66	500	242	
SFE67	860	1180	Composite 18
SFE68	760	818	
SFE69	775	877	
SFE70	665	503	
SFE71	630	426	
SFE72	820	1150	

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Reach 3 - Whitehall

Label	Length (mm)	Weight (g)	
Black Bream (<i>Acanthopagrus butcheri</i>)			
BB145	299	545	Composite 19
BB146	296	520	
BB147	297	525	
BB148	280	450	
BB149	250	351	
BB150	269	425	
BB151	270	420	
BB152	266	455	
BB153	252	369	
BB154	262	399	
BB155	252	383	Composite 20
BB156	235	286	
BB157	182	132	
BB158	194	168	
BB159	181	126	
BB160	177	107	
Bb161	374	1286	
BB162	338	847	
BB163	323	712	
BB164	294	558	
BB165	309	623	Composite 21
BB166	289	539	
BB167	290	570	
BB168	269	408	
BB169	270	433	
BB170	280	501	
BB171	260	416	
BB172	257	381	
BB173	290	483	
BB174	281	501	

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Reach 4 - Docklands - Urban Yarra

Label #	Length (mm)	Weight (g)	
Black Bream (<i>Acanthopagrus butcheri</i>)			
BB217	254	370	Composite 28
BB218	233	307	
BB219	210	187	
BB220	192	143	
BB221	231	307	
BB222	281	480	
BB223	300	586	
BB224	342	845	
BB225	383	1242	
BB226	367	1059	
Black Bream (<i>Acanthopagrus butcheri</i>)			
BB227	262	393	Composite 29
BB228	316	668	
BB229	343	945	
BB230	318	704	
BB231	300	608	
BB232	290	537	
BB233	294	578	
BB234	288	510	
BB235	278	486	
BB236	280	512	
Black Bream (<i>Acanthopagrus butcheri</i>)			
BB237	296	580	Composite 30
BB238	276	440	
BB239	278	481	
BB240	289	538	
BB241	260	400	
BB242	270	466	
BB243	268	412	
BB244	237	293	
BB245	220	247	
BB246	211	231	
Mulloway (<i>Argyrosomus hololepidotus</i>)			
MWY028	632	2300	Composite 31
MWY029	742	3316	
Flat Tail Mullet (<i>Aldrichetta argentea</i>)			
MUL247	343	560	Composite 32
MUL248	275	300	
MUL249	260	275	
MUL250	267	264	
MUL251	269	269	
MUL252	236	185	

Weight and length information

Reach 5 - 'Warmies'

Label #	Length (mm)	Weight (g)	
Black Bream (<i>Acanthopagrus butcheri</i>)			
BB289	287	502	Composite 37
BB290	280	474	
BB291	256	391	
BB292	260	394	
BB293	260	406	
BB294	250	338	
BB295	270	437	
BB296	258	398	
BB297	266	386	
BB298	250	320	
BB299	250	377	Composite 38
BB300	232	254	
BB301	237	295	
BB302	270	399	
BB303	226	256	
BB304	280	453	
BB305	238	254	
BB306	302	549	
BB307	278	457	
BB308	241	344	
BB309	223	240	Composite 39
BB310	227	263	
BB311	198	188	
BB312	216	209	
BB313	201	177	
BB314	215	198	
BB315	208	187	
BB316	203	187	
BB317	190	132	
BB318	194	153	

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Weight and length information

Reach 5 - 'Warmies'

Label #	Length (mm)	Weight (g)	
Yellow eyed mullet (<i>Aldrichetta forsteri</i>)			
MUL319	332	469	Composite 46
MUL320	290	329	
MUL321	338	553	
MUL322	310	346	
MUL323	326	432	
MUL324	285	287	
MUL325	295	290	
MUL326	380	597	
MUL327	295	271	
MUL328	327	433	
MUL329	283	273	Composite 47
MUL330	305	353	
MUL331	342	475	
MUL332	323	427	
MUL333	315	352	
MUL334	242	177	
MUL335	295	307	
MUL336	278	246	
MUL337	304	353	
MUL338	296	325	
MUL339	240	162	Composite 48
MUL340	354	518	
MUL341	290	282	
MUL342	272	237	
MUL343	281	234	
MUL344	330	404	
MUL345	307	328	
MUL346	305	296	
MUL347	220	138	
MUL348	280	238	

APPENDIX 4 ANALYTICAL RESULTS TABLES

- Table A4.1: Analytical results for PCBs (congeners) - study 2006**
- Table A4.2: Results for dioxins - study 2006.**
- Table A4.3: Analytical results for dioxins and dioxin-like PCBs**
- Table A4.4: Analytical results for general PCB congeners, dioxins, dioxin-like PCBs and lipid content**
- Table A4.5: Analytical results for organochlorine pesticides**
- Table A4.6: Analytical results for organophosphate pesticides**
- Table A4.7: Analytical results for phenoxy acid herbicides**
- Table A4.8: Analytical results for PAHs**
- Table A4.9: Analytical results for TPH**
- Table A4.10: Analytical results for Metals**
- Table A4.11: Analytical results for tributyl tins**
- Table A4.12: Analytical results for PBDE**

Table A4.1: Analytical results for PCB congeners - Yarra/Maribyrnong Fish Study 2006 PCBc

Congeners		PCB # 8	PCB # 18	PCB # 28	PCB # 44	PCB # 52	PCB # 66	PCB # 77	PCB # 101	PCB # 105	PCB # 118
Reporting limits 0.002 mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
COMP	SAMPLE										
1	R1 BREAM	<0.002	<0.002	<0.002	<0.002	0.0035	<0.002	<0.002	0.0053	<0.002	0.0050
2	R1 BREAM	<0.002	<0.002	<0.002	0.0021	0.0041	<0.002	<0.002	0.0044	<0.002	0.0037
3	R1 BREAM	<0.002	<0.002	<0.002	<0.002	0.0040	<0.002	<0.002	0.0039	<0.002	0.0036
7	R1 EEL	<0.002	<0.002	<0.002	0.01	0.025	<0.002	<0.002	0.024	<0.002	0.016
10	R2 BREAM	<0.002	<0.002	<0.002	<0.002	0.0029	<0.002	<0.002	0.0059	<0.002	0.0047
11	R2 BREAM	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0036	<0.002	0.0023
12	R2 BREAM	<0.002	<0.002	<0.002	<0.002	0.0047	<0.002	<0.002	0.0087	<0.002	0.0068
13	R2 MULLOWAY	<0.002	<0.002	<0.002	0.0020	0.0062	<0.002	<0.002	0.0170	<0.002	0.0110
14	R2 MULLOWAY	<0.002	<0.002	<0.002	<0.002	0.0046	<0.002	<0.002	0.0110	<0.002	0.0089
16	R2 EEL	<0.002	<0.002	<0.002	<0.002	0.0068	<0.002	<0.002	0.0170	<0.002	0.0110
17	R2 EEL	<0.002	<0.002	<0.002	<0.002	0.0066	<0.002	<0.002	0.015	<0.002	0.013
18	R2 EEL	<0.002	<0.002	<0.002	0.0083	0.0230	<0.002	0.0022	0.0720	<0.002	0.0550
19	R3 BREAM	<0.002	<0.002	<0.002	0.0034	0.0083	<0.002	<0.002	0.0120	<0.002	0.0083
20	R3 BREAM	<0.002	<0.002	<0.002	<0.002	0.0033	<0.002	<0.002	0.0062	<0.002	0.0037
21	R3 BREAM	<0.002	<0.002	<0.002	0.0026	0.0057	<0.002	<0.002	0.0074	<0.002	0.0099
28	R4 BREAM	<0.002	<0.002	<0.002	0.0025	0.0054	<0.002	<0.002	0.0120	<0.002	0.0098
29	R4 BREAM	<0.002	<0.002	<0.002	0.0042	0.0080	<0.002	<0.002	0.0170	<0.002	0.0170
30	R4 BREAM	<0.002	<0.002	<0.002	<0.002	0.0027	<0.002	<0.002	0.0058	<0.002	0.0110
31	R4 MULLOW	<0.002	<0.002	<0.002	0.003	0.0084	<0.002	<0.002	0.018	<0.002	0.013
36	R4 MULLET	<0.002	<0.002	<0.002	<0.002	0.0048	<0.002	<0.002	0.0059	<0.002	0.014
37	R5 BREAM	<0.002	<0.002	<0.002	<0.002	0.0048	<0.002	<0.002	0.0073	<0.002	0.0070
38	R5 BREAM	<0.002	<0.002	<0.002	<0.002	0.0028	<0.002	<0.002	0.0042	<0.002	0.0029
39	R5 BREAM	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0029	<0.002	0.0030
46	R5 MULLET	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
47	R5 MULLET	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
48	R5 MULLET	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0020

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.1: Analytical results for PCB congeners - Yarra/Maribyrnong Fish Study 2006 (cont.)

PCB Congeners		PCB # 126	PCB # 128	PCB # 138	PCB # 153	PCB # 169	PCB # 170	PCB # 180	PCB # 187	PCB # 195	PCB # 206	PCB # 209	Total PCB*
Reporting limits 0.002 mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
COMP	SAMPLE												
1	R1 BREAM	<0.002	<0.002	0.0057	0.0058	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0413
2	R1 BREAM	<0.002	<0.002	0.0034	0.0036	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0363
3	R1 BREAM	<0.002	<0.002	0.0038	0.0040	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0353
7	R1 EEL	<0.002	<0.002	0.02	0.019	<0.002	0.002	0.005	0.006	<0.002	<0.002	<0.002	0.1394
10	R2 BREAM	<0.002	<0.002	0.0086	0.0078	<0.002	<0.002	0.0021	<0.002	<0.002	<0.002	<0.002	0.047
11	R2 BREAM	<0.002	<0.002	0.0035	0.0035	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0299
12	R2 BREAM	<0.002	<0.002	0.0110	0.0095	<0.002	<0.002	0.0028	0.0027	<0.002	<0.002	<0.002	0.0602
13	R2 MULLOWAY	<0.002	<0.002	0.0230	0.0180	<0.002	0.0034	0.0064	0.0048	<0.002	<0.002	<0.002	0.1034
14	R2 MULLOWAY	<0.002	<0.002	0.0150	0.0120	<0.002	<0.002	0.0045	0.0035	<0.002	<0.002	<0.002	0.0735
16	R2 EEL	<0.002	<0.002	0.0210	0.0180	<0.002	0.0029	0.0065	0.0042	<0.002	<0.002	<0.002	0.1004
17	R2 EEL	<0.002	<0.002	0.029	0.026	<0.002	0.004	0.008	<0.002	<0.002	<0.002	<0.002	0.1155
18	R2 EEL	<0.002	<0.002	0.1200	0.0910	<0.002	0.0150	0.0290	0.0200	<0.002	<0.002	<0.002	0.4465
19	R3 BREAM	<0.002	<0.002	0.0130	0.0130	<0.002	<0.002	0.0053	0.0049	<0.002	<0.002	<0.002	0.0812
20	R3 BREAM	<0.002	<0.002	0.0075	0.0076	<0.002	<0.002	0.0026	0.0027	<0.002	<0.002	<0.002	0.0476
21	R3 BREAM	<0.002	<0.002	0.0130	0.0140	<0.002	<0.002	0.0037	0.0038	<0.002	<0.002	<0.002	0.0731
28	R4 BREAM	<0.002	<0.002	0.0180	0.0170	<0.002	<0.002	0.0031	0.0039	<0.002	<0.002	<0.002	0.0847
29	R4 BREAM	<0.002	<0.002	0.0230	0.0260	<0.002	0.0024	0.0058	0.0061	<0.002	<0.002	<0.002	0.1215
30	R4 BREAM	<0.002	<0.002	0.0091	0.0095	<0.002	<0.002	0.0022	0.0023	<0.002	<0.002	<0.002	0.0566
31	R4 MULLOW	<0.002	<0.002	0.021	0.018	<0.002	0.003	0.008	0.007	<0.002	<0.002	<0.002	0.111
36	R4 MULLET	<0.002	<0.002	0.011	0.01	<0.002	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	0.0637
37	R5 BREAM	<0.002	<0.002	0.0100	0.0100	<0.002	<0.002	0.0033	0.0032	<0.002	<0.002	<0.002	0.0596
38	R5 BREAM	<0.002	<0.002	0.0052	0.0055	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0366
39	R5 BREAM	<0.002	<0.002	0.0044	0.0047	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.032
46	R5 MULLET	<0.002	<0.002	0.0026	0.0029	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0245
47	R5 MULLET	<0.002	<0.002	0.0028	0.0037	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0255
48	R5 MULLET	<0.002	<0.002	0.0048	0.0057	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0305

* Values determined using 1/2 of the less than reporting limit; Uncertainty (95% confidence) 20%

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.2: Analytical results for dioxins - Yarra/Maribyrnong Fish Study 2006 (fresh weight)

Congeners		PCDD/F CONGENERS (DF) level pg/g fresh																	Lipid %	WHO TEQ (middle bound) pg/g	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
COMP	Sample	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g		
2	R1 Bream	0.4	0.59	<0.02	0.053	<0.1	<0.03	<0.03	<0.03	<0.02	<0.02	<0.04	<0.04	<0.05	<0.02	<0.04	<0.03	<0.3	1.3	0.73	
7	R1 Eel	<0.2	0.37	<0.05	<0.1	<0.2	<0.05	<0.07	<0.07	<0.08	0.2	0.51	<0.1	<0.1	<0.07	0.49	<0.1	<10	6	0.59	
10	R2 Bream	0.5	0.56	0.025	0.13	0.15	<0.05	<0.03	<0.03	<0.03	<0.03	<0.05	<0.03	0.042	<0.01	0.16	<0.02	<1.4	2.1	0.84	
12	R2 Bream	0.36	0.65	<0.02	0.099	0.12	<0.05	<0.05	<0.05	<0.04	<0.04	<0.04	<0.05	<0.04	<0.03	0.13	<0.04	1.2	1.6	0.87	
17	R2 Eel	<0.03	0.32	<0.04	<0.07	0.57	<0.06	<0.06	<0.09	<0.06	0.29	0.59	0.11	<0.09	<0.06	1.1	<0.05	15	7.9	1	
20	R3 Bream	0.44	0.32	<0.03	0.11	<0.008	<0.04	<0.04	<0.04	<0.03	<0.02	0.052	<0.02	<0.03	<0.01	<0.07	<0.02	<0.3	1.4	0.44	
29	R4 Bream	0.84	0.16	0.032	0.16	0.13	<0.02	<0.02	<0.02	<0.02	0.021	0.072	<0.03	<0.01	<0.02	<0.07	<0.02	<0.2	2.8	0.47	
29	dup	0.82	0.28	<0.04	0.16	0.12	<0.02	<0.02	<0.02	<0.02	0.027	<0.06	<0.02	<0.01	<0.009	<0.06	<0.02	<0.2	2.8	0.57	
37	R5 Bream	0.84	0.16	0.058	0.13	0.14	<0.03	<0.03	<0.03	<0.04	<0.03	0.073	<0.02	<0.03	<0.02	<0.1	<0.04	<0.9	2.2	0.47	
37	Dup	0.75	0.17	<0.05	0.14	0.13	<0.03	<0.03	<0.05	<0.03	<0.03	0.064	<0.02	<0.04	<0.02	<0.09	<0.05	<2	2	0.46	
38	R5 Bream	0.48	0.091	<0.06	0.12	<0.2	<0.03	<0.03	<0.03	<0.03	<0.03	0.067	<0.03	<0.03	<0.02	<0.09	<0.04	<0.9	1.8	0.3	
38	QC	0.59	0.114	0.115	0.155	0.18	0.038	0.04	0.035	ND	ND	0.091	ND	ND	ND	0.076	ND	0.23	2.1	0.46	
46	R5 Mullet	0.62	0.1	<0.02	0.094	0.11	<0.01	<0.02	<0.02	<0.02	<0.02	0.048	<0.01	<0.03	<0.01	<0.04	<0.04	<1	2.3	0.33	
46	QC	0.67	0.13	0.04	0.11	0.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.18	2.5	0.34	

ND - Not detected:

Estimated maximum concentration

Congeners

1 =	2,3,7,8-TCDF	10 =	1,2,3,4,7,8-HxCDD
2 =	2,3,7,8-TCDD	11 =	1,2,3,6,7,8-HxCDD
3 =	1,2,3,7,8-PeCDF	12 =	1,2,3,7,8,9-HxCDD
4 =	2,3,4,7,8,-PeCDF	13 =	1,2,3,4,6,7,8-HpCDF
5 =	1,2,3,7,8-PeCDD	14 =	1,2,3,4,7,8,9-HpCDF
6 =	1,2,3,4,7,8-HxCDF	15 =	1,2,3,4,6,7,8-HpCDD
7 =	1,2,3,6,7,8-HxCDF	16 =	OCDF
8 =	2,3,4,6,7,8-HxCDF	17 =	OCDD
9 =	1,2,3,7,8,9-HcCDF		

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.3: Analytical results for dioxin-like PCBs - Yarra/Maribyrnong Fish Study 2006 (fresh weight)

PCBs Congener No		77	81	105	114	118	123	126	156	157	167	169	189	Lipid %	WHO TEQ (middle bound) pg/g
COMPOSITE	Sample	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	Pg/g	pg/g	pg/g	pg/g		
2	R1 Bream	92	4.9	870	31	2700	45	7.4	130	34	75	0.11	7.3	1.3	1.2
7	R1 Eel	10	0.8	6740	330	20500	340	26	1580	370	700	2.6	93	6	6.6
10	R2 Bream	58	3.6	1620	84	5390	90	15	600	140	300	0.26	29	2.1	2.6
12	R2 Bream	51	3.1	1020	45	3340	52	10	310	73	150	0.21	14	1.6	1.7
17	R2 Eel	5.3	0.48	3450	160	10900	180	16	1510	370	680	2.4	81	7.9	4.1
20	R3 Bream	83	5.7	1240	53	3490	60	10	240	57	130	0.2	15	1.4	1.7
29	R4 Bream	87	5.9	1610	76	5010	94	18	430	100	250	0.39	24	2.8	2.8
29	dup	87	6	1610	71	4850	88	17	410	98	220	0.36	24	2.8	2.7
37	R5 Bream	100	6.7	1130	64	3480	78	12	330	79	180	0.26	20	2.2	1.9
37	Dup	100	7	1180	69	3550	82	12	340	80	170	0.22	20	2	2.9
38	R5 Bream	77	5.4	820	49	2560	62	8.5	250	57	130	0.25	16	1.8	1.4
38	QC	75.1	20.5	829	51.6	2680	62.6	11.4	260	66.2	139	ND	18	2.1	1.7
46	R5 Mullet	65	5	620	31	1740	36	7.2	170	42	89	0.22	11	2.3	1.1
46	QC	57.8	4.99	566	31.8	1690	28.1	8.31	169	47.7	73	ND	12.1	2.5	1.2

Table A4.4: Analytical results for general PCB congeners, dioxins, dioxin-like PCBs and lipid content 2006

		Total general PCBs	Dioxin WHO-TEQ	Dioxin-like PCBs WHO-TEQ	Dioxins plus dioxin-like PCBs WHO-TEQ (MG/KG)	Dioxins plus dioxin-like PCBs WHO-TEQ (PG/G)	Lipid % w/w
Reporting limits mg/kg		0.002					
Comp	Sample	mg/kg	mg/kg	mg/kg	mg/kg	pg/g	
1	R1 BREAM	0.041					1.7
2	R1 BREAM	0.0325	7.3 X 10 ⁻⁷	12 X 10 ⁻⁷	19.3 X 10 ⁻⁷	1.93	1.3
3	R1 BREAM	0.025					1.4
7	R1 EEL	0.143	5.9 X 10 ⁻⁷	66 X 10 ⁻⁷	71.9 X 10 ⁻⁷	7.19	6
10	R2 BREAM	0.047	8.4 X 10 ⁻⁷	26 X 10 ⁻⁷	34.4 X 10 ⁻⁷	3.44	2.1
11	R2 BREAM	0.03					2
12	R2 BREAM	0.06	8.7 X 10 ⁻⁷	17 X 10 ⁻⁷	25.7 X 10 ⁻⁷	2.57	1.6
13	R2 MULLOWAY	0.113					1.6
14	R2 MULLOWAY	0.073					1.6
16	R2 EEL	0.1					10.6
17	R2 EEL	0.116	10 X 10 ⁻⁷	41 X 10 ⁻⁷	51 X 10 ⁻⁷	5.1	7.9
18	R2 EEL	0.451					12.6
19	R3 BREAM	0.082					1.7
20	R3 BREAM	0.048	4.4 X 10 ⁻⁷	17 X 10 ⁻⁷	21.4 X 10 ⁻⁷	2.14	1.4
21	R3 BREAM	0.072					1.9
28	R4 BREAM	0.085					2.5
29	R4 BREAM	0.12	4.7 X 10 ⁻⁷	28 X 10 ⁻⁷	32.7 X 10 ⁻⁷	3.27	2.8
29	duplicate		5.7 X 10 ⁻⁷	27 X 10 ⁻⁷	32.7 X 10 ⁻⁷	3.27	
30	R4 BREAM	0.056					2.1
31	R4 MULLOW	0.0911					1.9
36	R4 MULLET	0.064					6.3
37	R5 BREAM	0.06	4.7 X 10 ⁻⁷	19 X 10 ⁻⁷	23.7 X 10 ⁻⁷	2.37	2.1
37	duplicate		4.6 X 10 ⁻⁷	19 X 10 ⁻⁷	23.6 X 10 ⁻⁷	2.36	
38	R5 BREAM	0.037	3.0 X 10 ⁻⁷	14 X 10 ⁻⁷	17.0 X 10 ⁻⁷	1.7	1.8
38	QC NZ Lab		4.7 X 10 ⁻⁷	17.1 X 10 ⁻⁷	21.7 X 10 ⁻⁷	2.17	
39	R5 BREAM	0.032					1.3
46	R5 MULLET	0.0245	3.3 X 10 ⁻⁷	11 X 10 ⁻⁷	14.3 X 10 ⁻⁷	1.43	2.3
46	QC NZ Lab		4.0 X 10 ⁻⁷	12 X 10 ⁻⁷	16.0 X 10 ⁻⁷	1.6	
47	R5 MULLET	0.0256					1.9
48	R5 MULLET	0.032					1.2

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.5: Analytical results for organochlorine (OC) pesticides - Yarra/Maribyrnong Fish Study 2006

OCs		TCDF	Heptachlor	Hepta-chlor-epoxide	Aldrin	gamma-BHC (Lindane)	alpha-BHC	beta-BHC	delta-BHC	trans-Chlordane	cis-Chlordane	Oxy-chlordane	Dieldrin	pp-DDE	pp-DDD	pp-DDT	Endrin	Endrin Aldehyde	Endrin Ketone	alpha-Endosulfan	beta-Endo sulfan	Endo sulfan Sulfate	Methoxy chlor	
*USEPA SVS MG/KG (PPM)				0.0044		0.031	0.025	0.025	0.025	total 0.114			0.0025	total 0.117			1.2			total 24				
*MRL			0.05			1	0.01	0.01	0.01	TOTAL 0.05			0.1	total 1										
Reporting limits 0.01 mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Comp	Sample																							
1 R1	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
2 R1	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
3 R1	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
7 R1	Eel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.059	0.05	0.011	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
10 R2	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
11 R2	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
12 R2	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
13 R2	Mullow	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.023	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
14 R2	Mullow	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
16 R2	Eel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.036	0.035	0.013	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
17 R2	Eel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.071	0.056	0.013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
18 R2	Eel	<0.01	<0.01	0.022	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	0.075	0.08	0.031	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
19 R3	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	0.025	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
20 R3	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
21 R3	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
28 R4	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
29 R4	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	0.014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
30 R4	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
31 R4	Mullow	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	0.016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
36 R4	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.021	0.019	0.022	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
37 R5	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.019	0.024	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
38 R5	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
39 R5	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
46 R5	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
47 R5	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
48 R5	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.6: Analytical results for organophosphate (OP) pesticides - Yarra Maribyrnong Fish Study 2006

		OPs	Dichlorvos	Demeton-S-Methyl	Diazinon	Dimethoate	Chlorpyrifos	Chlorpyrifos Methyl	Malathion (Maldison)	Fenthion	Ethion	Fenitrothion	Chlorfenvinphos(E)	Chlorfenvinphos(Z)	Parathion (Ethyl)	Parathion Methyl	PIRIMI PHOS METHYL	Pirimiphos Ethyl	Azinphos-Methyl	Azinphos Ethyl
*USEPA values				2.8		1.2				2										
Reporting limits 0.1 mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Comp	Sample description																			
1	R1 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
2	R1 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
3	R1 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
7	R1 Eel	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
10	R2 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
11	R2 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
12	R2 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
13	R2 Mulloway	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
14	R2 Mulloway	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
16	R2 Eel	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
17	R2 Eel	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
18	R2 Eel	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
19	R3 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
20	R3 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
21	R3 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
28	R4 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
29	R4 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
30	R4 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
31	R4 Mullet	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
36	R4 Mullet	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
37	R5 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
38	R5 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
39	R5 Bream	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
46	R5 Mullet	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
47	R5 Mullet	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
48	R5 Mullet	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10

Table A4.7: Analytical results for phenoxy acid herbicides - Yarra/Maribyrnong Fish Study 2006

Herbicides		Oxyfluorfen	Dicamba	MCPA	Dichlorprop	2, 4-D	2, 4, 5-T	2, 4, 5 -TP	2, 4 - DB	MCP	Triclopyr
Reporting limits 0.1 mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Sample ref	Sample description										
COMP 1 R1	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 2 R1	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 3 R1	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 7 R1	Eel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 10 R2	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 11 R2	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 12 R2	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 13 R2	Mulloway	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 14 R2	Mulloway	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 16 R2	Eel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 17 R2	Eel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 18 R2	Eel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 19 R3	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 20 R3	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 21 R3	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 28 R4	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 29 R4	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 30 R4	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 31 R4	Mulloway	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 36 R4	Mullet	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 37 R5	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 38 R5	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 39 R5	Bream	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 46 R5	Mullet	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 47 R5	Mullet	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
COMP 48 R5	Mullet	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.8: Analytical results for polycyclic aromatic hydrocarbons (PAHs) - Yarra/Maribyrnong Fish Study 2006

PAHs		Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo (b)&(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(ah)anthracene	Benzo(ghi)perylene	total PAHs
Reporting Limit 0.01 mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
Sample ref	Sample description																
Comp 1	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.09
Comp 2	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 3	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 7	Eel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 10	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 11	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 12	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 13	Mulloway	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 14	Mulloway	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 16	Eel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 17	Eel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.015	0.011	0.022	<0.01	<0.01	<0.01	<0.01	0.11
Comp 18	Eel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 19	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 20	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 21	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 28	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 29	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 30	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 31	Mulloway	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 36	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 37	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 38	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 39	Bream	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 46	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 47	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08
Comp 48	Mullet	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	0.08

Table A4.9: Analytical results for TPHs - Yarra/Maribyrnong Fish Study 2006

TPH		TPH C6-C9	TPH C10-C14	TPH C15-C28	TPH C29-C36	Surrogate semivol Rec.	Surrogate volatile Rec
Reporting limit 25-100mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	%	%
MU %		15%	20%	20%	20%		
Sample ref	Sample description						
Comp 1	Bream	<25	<50	<100	<100	68	102
Comp 2	Bream	<25	<50	<100	<100	61	102
Comp 3	Bream	<25	<50	<100	<100	73	107
Comp 7	Eel	<25	<50	<100	<100	87	108
Comp 10	Bream	<25	<50	<100	<100	62	112
Comp 11	Bream	<25	<50	<100	<100	60	113
Comp 12	Bream	<25	<50	<100	<100	121	110
Comp 13	Mulloway	<25	<50	<100	<100	103	111
Comp 14	Mulloway	<25	<50	<100	<100	118	113
Comp 16	Eel	<25	<50	<100	<100	114	111
Comp 17	Eel	<25	<50	<100	<100	103	110
Comp 18	Eel	<25	<50	<100	<100	93	99
Comp 19	Bream	<25	<50	<100	<100	104	100
Comp 20	Bream	<25	<50	<100	<100	99	100
Comp 21	Bream	<25	<50	<100	<100	105	104
Comp 28	Bream	<25	<50	<100	<100	113	104
Comp 29	Bream	<25	<50	<100	<100	106	101
Comp 30	Bream	<25	<50	<100	<100	111	99
Comp 31	Mulloway	<25	<50	<100	<100	80	104
Comp 36	Mullet	<25	<50	<100	<100	108	106
Comp 37	Bream	<25	<50	<100	<100	139	92
Comp 38	Bream	<25	<50	<100	<100	143	102
Comp 39	Bream	<25	<50	<100	<100	139	103
Comp 46	Mullet	<25	<50	<100	<100	121	96
Comp 47	Mullet	<25	<50	<100	<100	140	102
Comp 48	Mullet	<25	<50	<100	<100	134	98

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.10: Analytical results for metals - Yarra Maribyrnong Fish Study 2006

Metals		Arsenic	Arsenic inorganic	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Zinc	Moisture
MU %		17%	17%	16%	17%	15%	15%	18%	20%	16%	
Reporting limits		0.1 mg/kg	0.04 mg/kg	0.005 mg/kg	0.25 mg/kg	0.1 mg/kg	0.1 mg/kg	0.01 mg/kg	0.1 mg/kg	1 mg/kg	%
Comp	Sample										
Comp 1	Bream	2	<0.04	<0.005	<0.05	0.24	<0.01	0.09	0.46	3.7	74.5
Comp 2	Bream	0.76	<0.04	<0.005	<0.05	0.23	<0.01	0.02	0.46	4.9	73.7
Comp 3	Bream	0.88	<0.04	<0.005	<0.05	0.2	0.01	0.05	0.42	3.7	74.8
Comp 7	Eel	0.04	<0.04	<0.005	<0.05	0.21	0.07	0.03	0.32	9.3	73.4
Comp 10	Bream	1.2	<0.04	<0.005	<0.05	0.22	0.02	0.11	0.58	4.2	74.8
Comp 11	Bream	1.5	<0.04	<0.005	<0.05	0.16	<0.01	0.1	0.56	4.2	75
Comp 12	Bream	1.7	<0.04	<0.005	<0.05	0.25	0.02	0.08	0.57	5.4	73.7
Comp 13	Mulloway	0.5	<0.04	<0.005	<0.05	0.21	<0.01	0.16	0.56	3.5	75
Comp 14	Mulloway	0.73	<0.04	<0.005	<0.05	0.2	<0.01	0.18	0.57	3.5	76.5
Comp 16	Eel	0.09	<0.04	<0.005	<0.05	0.26	0.02	0.13	0.39	8	69.6
Comp 17	Eel	0.07	<0.04	<0.005	<0.05	0.28	0.02	0.11	0.37	12	70
Comp 18	Eel	0.13	<0.04	<0.005	<0.05	0.15	<0.01	0.13	0.44	10	68.2
Comp 19	Bream	1.6	<0.04	<0.005	<0.05	0.2	0.01	0.08	0.49	4.5	76.4
Comp 20	Bream	2.4	<0.04	<0.005	<0.05	0.18	<0.01	0.1	0.46	4.6	76.5
Comp 21	Bream	2.3	<0.04	<0.005	<0.05	0.18	<0.01	0.07	0.37	3.5	75.9
Comp 28	Bream	2.3	<0.04	<0.005	<0.05	0.23	<0.01	0.09	0.48	5.3	75.7
Comp 29	Bream	2.8	<0.04	<0.005	<0.05	0.22	<0.01	0.12	0.44	4.3	75.1
Comp 30	Bream	3.1	<0.04	<0.005	<0.05	0.19	<0.01	0.08	0.49	5.2	75.9
Comp 31	Mullock	2.5	<0.04	<0.005	<0.05	0.14	<0.01	0.1	0.42	2.8	76.9
Comp 36	Mullet	0.58	<0.04	<0.005	<0.05	0.63	0.01	0.01	0.24	7.7	72.4
Comp 37	Bream	2	<0.04	<0.005	<0.05	0.45	0.01	0.1	0.38	5	76
Comp 38	Bream	2.3	<0.04	<0.005	<0.05	0.3	<0.01	0.11	0.37	4.5	75.4
Comp 39	Bream	2.2	<0.04	<0.005	<0.05	0.26	<0.01	0.08	0.39	5.4	75.9
Comp 46	Mullet	1.3	<0.04	<0.005	<0.05	0.46	0.03	0.07	0.36	6.9	75.5
Comp 47	Mullet	1.8	<0.04	<0.005	<0.05	0.5	0.01	0.08	0.39	4.5	75.4
Comp 48	Mullet	1.7	<0.04	<0.005	<0.05	0.4	0.02	0.06	0.43	4.3	75.4

Table A4.11: Analytical results for tributyl tins - Yarra Maribyrnong Fish Study 2006

Organotins		Mono butyltin as Sn	Dibutyltin as Sn	Tributyltin as Sn
Reporting limit 0.001 mg/kg (ppm)		mg/kg	mg/kg	mg/kg
Sample ref	Sample description			
Comp 1	R1 Bream	<0.001	<0.001	0.0028
Comp 2	R1 Bream	<0.001	<0.001	0.0015
Comp 3	R1 Bream	<0.001	<0.001	0.0034
Comp 7	R1 Eel	<0.001	<0.001	<0.001
Comp 10	R2 Bream	<0.001	<0.001	0.0026
Comp 11	R2 Bream	<0.001	<0.001	0.0025
Comp 12	R2 Bream	<0.001	<0.001	0.0028
Comp 13	R2 Mulloway	<0.001	<0.001	0.0052
Comp 14	R2 Mulloway	<0.001	<0.001	0.0043
Comp 16	R2 Eel	<0.001	<0.001	<0.001
Comp 17	R2 Eel	<0.001	<0.001	<0.001
Comp 18	R2 Eel	<0.001	<0.001	<0.001
Comp 19	R3 Bream	<0.001	<0.001	0.0024
Comp 20	R3 Bream	<0.001	0.0015	0.005
Comp 21	R3 Bream	<0.001	<0.001	0.0018
Comp 28	R4 Bream	<0.001	<0.001	0.0014
Comp 29	R4 Bream	<0.001	<0.001	0.002
Comp 30	R4 Bream	<0.001	<0.001	0.0024
Comp 31	R4 Mulloway	<0.001	0.0024	0.0053
Comp 36	R4 Mullet	<0.001	<0.001	<0.001
Comp 37	R5 Bream	<0.001	<0.001	0.0024
Comp 38	R5 Bream	<0.001	<0.001	0.0014
Comp 39	R5 Bream	<0.001	<0.001	0.0019
Comp 46	R5 Mullet	<0.001	<0.001	<0.001
Comp 47	R5 Mullet	<0.001	<0.001	<0.001
Comp 48	R5 Mullet	<0.001	<0.001	<0.001

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.12: Analytical results for PBDE (EPA Fish Study 2006)

		Congener No	17	28 & 33	47	49	66	71	77	85	99	100	119	126	138 & 166
Composite	Sample	Sum of congeners for	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g
2	R1 Bream	Level pg/g lipid	840	10800	125000	11500	2240	<100	<100	440	16600	28400	940	14	77
		Level pg/g fresh weight	11	140	1600	150	29	<1	<1	5.6	210	360	12	0.18	0.99
7	R1 Eel	Level pg/g lipid	330	<1000	92100	36800	70	<30	<30	<40	5100	50500	510	<10	<20
		Level pg/g fresh weight	19	<60	5480	2190	4.2	<2	<2	<2	300	3010	30	<0.6	<1
10	R2 Bream	Level pg/g lipid	660	5000	158000	13300	2090	<200	<70	<90	6930	38800	880	<7	<20
		Level pg/g fresh weight	14	100	3300	280	44	<4	<1	<2	140	810	18	<0.1	<0.4
12	R2 Bream	Level pg/g lipid	700	8400	149000	11400	3720	<200	<200	100	7980	32900	920	7.4	<50
		Level pg/g fresh weight	11	140	2420	190	61	<3	<3	1.7	130	540	15	0.12	<0.8
17	R2 Eel	Level pg/g lipid	200	<1000	32500	12400	39	<20	<10	<20	3570	25200	180	<7	<6
		Level pg/g fresh weight	16	<80	2560	970	3.1	<2	<0.8	<2	280	1980	14	<0.6	<0.5
20	R3Bream	Level pg/g lipid	280	3870	64200	7440	890	<70	<10	<50	4240	16400	460	<20	<30
		Level pg/g fresh weight	3.9	54	890	100	12	<1	<0.1	<0.7	59	230	6.4	<0.3	<0.4
29	R4Bream	Level pg/g lipid	140	<2000	59000	4700	1010	<30	<200	<10	<3000	14700	560	<10	<7
		Level pg/g fresh weight	4.1	<60	1680	130	29	<0.9	<6	<0.3	<90	420	16	<0.3	<0.2
	Dup	Level pg/g lipid	160	<2000	59300	4700	700	<90	<20	<20	2630	14900	510	<9	<10
		Level pg/g fresh weight	4.5	<60	1690	130	20	<3	<0.6	<0.6	75	420	15	<0.3	<0.3
37	R5Bream	Level pg/g lipid	150	<2000	39300	3690	1240	<10	<20	<20	<2000	11000	420	<7	<9
		Level pg/g fresh weight	3.3	<40	850	80	27	<0.2	<0.4	<0.4	<40	240	9.1	<0.2	<0.2
	Dup	Level pg/g lipid	120	<2000	39200	3600	1230	<70	<10	<30	<2000	11300	460	<10	<10
		Level pg/g fresh weight	2.6	<40	850	78	27	<2	<0.2	<0.7	<40	250	10	<0.2	<0.2
38	R5Bream	Level pg/g lipid	100	<3000	36800	2580	840	<30	<20	<30	<2000	8490	260	<10	<6
		Level pg/g fresh weight	1.8	<50	650	46	15	<0.5	<0.4	<0.5	<40	150	4.5	<0.2	<0.1
	QC	Level pg/g fresh weight			470						25	130			
46	R5Mullet	Level pg/g lipid	65	<2000	48800	1290	<100	<10	<60	<20	<800	6560	120	<7	<10
		Level pg/g fresh weight	1.5	<50	1140	30	<2	<0.2	<1	<0.5	<20	150	2.8	<0.2	<0.2
	QC	Level pg/g fresh weight			820						16	130			

17 =2,2',4-Tribrominated diphenyl ether	66 = 2,3',4,4'-Tetrabrominated diphenyl ether	100 =2,2',4,4',6-Pentabrominated diphenyl ether
28 =2,4,4'-Tribrominated diphenyl ether	71 =2,3',4',6-Tetrabrominated diphenyl ether	119 =2,3',4,4',6-Pentabrominated diphenyl ether
33 =2',3,4-Tribrominated diphenyl ether	77 =3,3',4,4'-Tetrabrominated diphenyl ether	126 =3,3',4,4',5-Pentabrominated diphenyl ether
47 =2,2',4,4'-Tetrabrominated diphenyl ether	85 =2,2',3,4,4'-Pentabrominated diphenyl ether	138 =2,2',3,4,4',5'-Hexabrominated diphenyl ether
49 =2,2',4,5'-Tetrabrominated diphenyl ether	99 =2,2',4,4',5-Pentabrominated diphenyl ether	153 =2,2',4,4',5,5'-Hexabrominated diphenyl ether

YARRA AND MARIBYRNONG ESTUARIES: INVESTIGATION OF CONTAMINANTS IN FISH

Table A4.12: Analytical results for PBDE (EPA Fish Study 2006) (cont.)

		Congener No	154	156	183	184	191	196	197	206	207	209	Lipid% w/w	Sum of congeners excluding LOD values
Composite	Sample	Sum of congeners for	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g	pg/g		
2	R1 Bream	Level pg/g lipid	10600	<30	150	32	<20	<20	35	<300	<300	<8000	1	213000
		Level pg/g fresh weight	140	<0.4	2	0.4	<0.3	<0.3	0.45	<4	<4	<100		2730
7	R1 Eel	Level pg/g lipid	8910	<10	100	<10	<20	<40	<10	<40	<20	<500	6	196000
		Level pg/g fresh weight	530	<0.6	6	<0.6	<1	<2	<0.6	<2	<1	<30		11700
10	R2 Bream	Level pg/g lipid	15500	<10	130	22	<10	19	24	<50	<50	<2000	2	249000
		Level pg/g fresh weight	320	<0.2	2.6	0.45	<0.2	0.4	0.49	<1	<1	<40		5180
12	R2 Bream	Level pg/g lipid	13100	<20	100	17	<30	44	<100	<800	<600	<20000	2	235000
		Level pg/g fresh weight	210	<0.3	1.7	0.27	<0.5	0.72	<2	<10	<10	<300		3830
17	R2 Eel	Level pg/g lipid	5120	<5	45	<20	<2	<8	6.2	<4	<10	<200	8	80200
		Level pg/g fresh weight	400	<0.4	3.5	<2	<0.2	<0.6	0.48	<0.3	<0.8	<20		6300
20	R3Bream	Level pg/g lipid	7240	<20	81	<20	<20	57	<30	1170	<1000	43700	1	153000
		Level pg/g fresh weight	100	<0.3	1.1	<0.3	<0.3	0.79	<0.4	16	<10	610		2130
29	R4Bream	Level pg/g lipid	8080	<10	110	17	<2	<20	<60	<600	<500	<20000	3	92200
		Level pg/g fresh weight	230	<0.3	3	0.49	<0.06	<0.6	<2	<20	<10	<600		2630
	Dup	Level pg/g lipid	8000	<10	95	14	<10	<40	<10	<70	<50	<2000	3	95200
		Level pg/g fresh weight	230	<0.3	2.7	0.41	<0.3	<1	<0.3	<2	<1	<60		2710
37	R5Bream	Level pg/g lipid	5900	<9	75	27	<10	<40	<30	<20	<50	<600	2	64900
		Level pg/g fresh weight	130	<0.2	1.6	0.58	<0.2	<0.9	<0.7	<0.4	<1	<10		1410
	Dup	Level pg/g lipid	5780	<8	59	21	<10	<50	<60	<30	<40	<1000	2	64900
		Level pg/g fresh weight	130	<0.2	1.3	0.47	<0.2	<1	<1	<0.7	<0.9	<20		1410
38	R5Bream	Level pg/g lipid	4430	<8	39	25	<1	15	<10	<30	<60	<600	2	55600
		Level pg/g fresh weight	78	<0.1	0.68	0.44	<0.02	0.26	<0.2	<0.5	<1	<10		980
	QC	Level pg/g fresh weight	57		0.8							23		
46	R5Mullet	Level pg/g lipid	4650	<8	110	23	<10	<30	22	<30	<7	<500	2	62000
		Level pg/g fresh weight	110	<0.2	2.6	0.53	<0.2	<0.7	0.51	<0.7	<0.2	<10		1450
	QC	Level pg/g fresh weight	83		2							18		

154 =2,2',4,4',5,6'-Hexabrominated diphenyl ether	184 =2,2',3,4,4',6,6'-Heptabrominated diphenyl ether	206 =2,2,3,3',4,4',5,5',6'-Nonabrominated diphenyl ether
156 =2,3,3',4,4',5'-Hexabrominated diphenyl ether	191 =2,3,3',4,4',5',6'-Heptabrominated diphenyl ether	207 =2,2,3,3',4,4',5,6,6'-Nonabrominated diphenyl ether
166 =2,3,4,4',5,6'-Hexabrominated diphenyl ether	196 =2,2,3,3',4,4',5,6'-Octabrominated diphenyl ether	209 = Decabromodiphenyl ether
183 =2,2',3,4,4',5',6'-Heptabrominated diphenyl ether	197 =2,2,3,3',4,4',6,6'-Octabrominated diphenyl ether	