Appendix L .

Toxicity Assessment of Barossa Condensate
(Jacobs 2017)

Barossa Environmental Studies

ConocoPhillips

Toxicity Assessment of Barossa-3 Condensate

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Abbreviations and Glossary

ACR	acute to chronic ratio
Acute toxicity	A lethal or adverse sub-lethal effect that occurs after a short exposure period relative to the organism's life span.
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
Chronic toxicity	An adverse effect that occurs after exposure for a substantial proportion of the organism's life span or an adverse sub-lethal effect on a sensitive early life stage.
Contaminant	A substance, inorganic or organic, at or near levels that could be toxic to some organisms.
BTEX	Benzene, toluene, ethylbenzene, and xylenes (meta-, para- and ortho-xylene)
EC_{50}	The concentration of a given contaminant that will cause a sub-lethal effect in 50% of a collection of organisms over a given period of time. Effects can be larval abnormalities, reproductive impairment, and growth inhibition or fertilisation success.
ESA	Ecotox Services Australasia
FSW	Filtered seawater
IC_{10}	The concentration of a given contaminant that will cause the inhibition of growth or reproduction in 10% of a collection of organisms over a given period of time.
IC_{50}	The concentration of a given contaminant that will cause the inhibition of growth or reproduction in 50% of a collection of organisms over a given period of time.
Larva(e)	The early free-living, immature form of any animal that changes structurally when it becomes an adult.
LC_{50}	The concentration of a given contaminant that will cause a lethal effect in 50% of a collection of organisms over a given period of time.
LOEC	(Lowest Observed Effect Concentration). The lowest concentration of a material used in a toxicity test that has a statistically significant adverse effect on the exposed population of test organisms as compared with the controls.
MAH	Monocyclic aromatic hydrocarbons
NATA	National Association of Testing Authorities
NOEC	(No Observed Effect Concentration). The highest concentration of a toxicant at which no statistically significant effect is observable, compared to the controls; the statistical significance is measured at the 95% confidence level.
PAH	Polycyclic aromatic hydrocarbons
PQL	Practical quantitation limit
QA	Quality assurance
SSD	Species sensitivity distribution
Toxicity	The quality or degree of being poisonous or harmful, to humans or biota.

TRH	Total recoverable hydrocarbons
WAF	Water accommodated fraction

Executive Summary

ConocoPhillips Australia Exploration Pty Ltd (ConocoPhillips) are proposing to develop natural gas resources as part of the Barossa area development, located in waters up to 300 m deep in the Bonaparte Basin, in Commonwealth waters offshore of northern Australia. Numerous shoals (submerged calcareous banks or 'seamounts') exist in the broader region around the Barossa area development; the closest being Evans Shoal, 60 km to the west, Tassie Shoal, 70 km south-west and Lynedoch Bank, 40 km to the south-east. In addition, the new Oceanic Shoals Commonwealth marine reserve (multiple use zone) lies to the south and south-east of the permit area.

ConocoPhillips intends to derive threshold concentrations of un-weathered and weathered Barossa-3 condensate to inform the assessment of the potential for toxicity impacts from hydrocarbon from the Barossa field to sensitive marine biota. The aim of this study is to assess the toxicity of the following:

1. Un-weathered Barossa-3 condensate (full suite of toxicants)
2. Weathered Barossa-3 condensate (limited tests involving fish only).

The toxicity tests were undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well established. These ecotoxicology tests are mainly focused on the early life stages of test organisms, when organisms are typically at their most sensitive to hydrocarbons. For the un-weathered condensate, static toxicity tests were conducted on seven mainly tropical species, representing seven taxonomic groups. It was considered that fish would be the more likely receptor to be exposed to the weathered condensate during a hydrocarbons spill, and consequently fish were the focus species for the weathered condensate study.

The moderate guideline value for 95% species protection of un-weathered Barossa-3 condensate was 1146 µg/L and the moderate guideline value for 99% species protection was 456 µg/L. The IC_{10} values for the un-weathered Barossa-3 condensate ranged from 1,051 to 15,875 µg/L. According to the GESAMP (2002) classification, un-weathered Barossa-3 condensate has almost negligible chronic aquatic toxicity.

Neither the un-weathered nor weathered Barossa-3 condensate was particularly toxic to fish larvae. A lower concentration of un-weathered condensate was required to affect the balance of 10% of fish larvae compared with the weathered condensate while a lower concentration of weathered condensate was required to affect the biomass of 10% of fish larvae compared to the un-weathered condensate.

The un-weathered Barossa-3 condensate was more toxic to copepod development and macroalgal growth and less toxic to fish larvae and oyster larval development. Neff (1979) also found that toxicity was most pronounced among crustaceans and least among telesost or ray finned fishes.

From the chemical analysis of the Barossa-3 condensate the most obvious difference between the un-weathered and weathered condensate was in the benzene, toluene, ethylbenzene, and xylenes (BTEX) results. BTEX falls into the class of monocyclic aromatic hydrocarbons (MAHs). The weathered Barossa-3 condensate had much lower concentrations than the un-weathered Barossa-3 condensate, particularly benzene and toluene. BTEX compounds are acutely toxic to aquatic organisms if exposure is sustained. Because of the volatility of BTEX, aquatic organisms typically only experience short exposure times in the order of 12 hours which may circumvent toxic effects.

Of the polycyclic aromatic hydrocarbons (PAH's) analysed for this study, naphthalene was the only chemical that was higher in the weathered condensate compared to the un-weathered condensate. All other PAHs

measured were below the laboratory detection limit or in the case of fluorene and phenanthrene was similar between weathered and un-weathered condensate. However, the myriad of other chemicals present in the condensate were not required to be measured for the purposes of this exercise. Neff et al. (2000) demonstrated that the MAHs are the most important contributors to the acute toxicity of the water accommodated fractions (WAFs) of fresh oils, while the contribution of PAHs to WAF toxicity increases with weathering. However it is generally not well understood which of the many components of oil are responsible for the many toxicity effects induced by oil.

1. Introduction

1.1 Background

ConocoPhillips Australia Exploration Pty Ltd (ConocoPhillips), as proponent on behalf of the current and future joint ventures, are proposing to develop natural gas resources as part of the Barossa area development, located approximately 300 kilometres (km) north of Darwin, Northern Territory (**Figure 1-1**). The Barossa field is situated in petroleum retention lease permit NT/RL5 (referred to as the 'permit area' in this report).

1.2 Overview of existing regional environment

The Barossa area is located in the Northern Marine Region, which comprises the Commonwealth waters of the Gulf of Carpentaria, Arafura Sea and Timor Sea as far west as the Northern Territory and Western Australian border. The Northern Marine Region contains internationally significant breeding and/or feeding grounds for a number of listed threatened and migratory marine species, including nearshore dolphins, turtles, dugongs, seabirds and migratory shorebirds afforded protection under national legislation and international conventions.

The Timor and Arafura Seas support a variety of shark, pelagic finfish and crustacean species of commercial and recreational game-fishing importance, e.g. trawl and various finfish fisheries. The shelf break and slope of the Arafura Shelf is characterised by patch reefs and hard substrate pinnacles that support a diverse array of invertebrate groups, with polychaetes and crustaceans being the most prolific (Heyward et al. 1997, CEE 2002). Surveys indicate that between 50 m and 200 m depth, the seabed consists of predominantly soft, easily resuspended sediments (Heyward et al. 1997, URS 2005, 2007). The diversity and coverage of epibenthos is low and organisms present are predominantly sponges, gorgonians and soft corals (Heyward et al. 1997, URS 2005, 2007).

Numerous shoals (submerged calcareous banks or 'seamounts') exist in the broader region around the permit area; the closest being Evans Shoal, 60 km to the west, Tassie Shoal, 70 km south-west and Lynedoch Bank, 40 km to the south-east. In addition, the new Oceanic Shoals Commonwealth marine reserve (multiple use zone) lies to the south and south-east of the permit area.

1.3 Scope of work

ConocoPhillips intends to derive species sensitivity guideline values (99%, 95% etc.) of un-weathered and weathered Barossa-3 condensate, which have toxic effects on sensitive marine biota, to inform the assessment of the potential for toxicity impacts from hydrocarbons from the Barossa field. The scope consisted of the following components:

Definition of Scope of Ecotoxicity Testing

- Jacobs provided advice on ecotoxicity testing methods including sample collection and numbers of species to test, and liaised with the NATA accredited laboratory that undertook the testing. For this study, Jacobs used the services of Ecotox Services Australasia (ESA).

Interpretation of the Ecotoxicological Data

- Following the ecotoxicity assessment, Jacobs interpreted the ecotoxicity data to inform definition of species protection guideline values as relevant to the Barossa field.

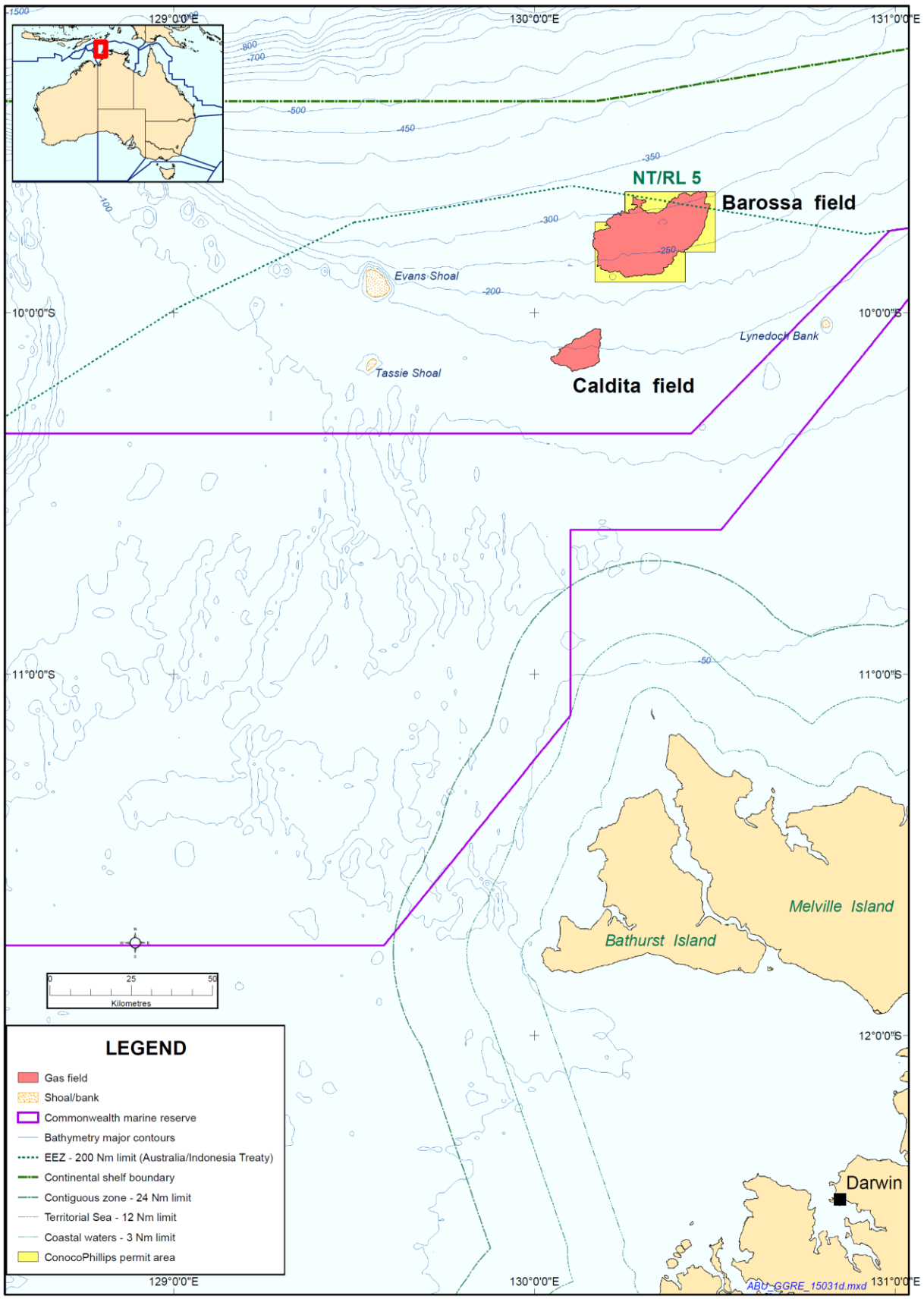

Figure 1-1: Barossa field location

2. Methods

ConocoPhillips sent samples of Barossa-3 condensate to the ESA laboratory in September 2015 for detailed ecotoxicological studies and hydrocarbon chemical analysis. The laboratory-based toxicity tests used a range of Water Accommodated Fraction (WAF) concentrations of weathered and un-weathered condensate to expose the different test organisms.

The toxicity tests were undertaken on a broad range of taxa of ecological relevance for which accepted standard test protocols are well-established. These ecotoxicology tests are mainly focused on the early life stages of test organisms, when organisms are typically at their most sensitive to hydrocarbons. For the un-weathered condensate, static toxicity tests were conducted on seven mainly tropical species, representing seven taxonomic groups demonstrating different levels if the food chain (**Table 2-1**).

Table 2-1: Analytical methods, test species, life stages, durations and test end-points for ecotoxicology

Test Species	Life Stage	Test Duration and End-Point	Type*	Protocol
Microalga (*Isochrysis aff. galbana*)	-	72-hour Growth inhibition (cell yield)	Chronic	ESA SOP 110 (ESA, 2014a). Based on Stauber *et al*. (1994)
Macroalage (*Ecklonia radiata)*	Gametophyte	14-day Growth rate	Chronic	ESA SOP 116 (ESA, 2014f). Based on Bidwell *et al*. (1998) and Burridge et al. (1999)
Sea Urchin (*Heliocidaris tuberculata)*	Gamete	1-hour Fertilisation rate	Chronic	ESA SOP 104 (ESA, 2014b). Based on USEPA (2002a), Simon and Laginestra (1997)
Sea Urchin (*Heliocidaris tuberculata)*	Larvae	72-hour Development rate	Chronic	ESA SOP 105 (ESA, 2014c). Based on APHA (1998), Simon and Laginestra (1997) and Doyle *et. al.* (2003)
Milky Oyster (*Saccostrea echinata)*	Embryo	48-hour Development rate	Chronic	ESA SOP 106 (ESA, 2014d). Based on APHA (1998) and Krassoi (1995)
Copepod (*Parvocalanus crassirostris*)	Juveniles	5-day Development rate	Acute	ESA SOP 124 (ESA, 2014e).
Sea anemone (*Aiptasia pulchella*)	Pedal lacerate	8-day Development rate	Chronic	ESA SOP 128 (ESA, 2014g) based on Howe et al. (2014)
Fish (Barramundi) (*Lates calcarifer*)	Larvae	7-day Biomass	Chronic	ESA SOP 122 (ESA, 2012). Based on USEPA (2002a)
Fish (Barramundi) (*Lates calcarifer*)	Larvae	7-day Imbalance	Chronic	ESA SOP 122 (ESA, 2012). Based on USEPA (2002a)

*Based on test classification according to Warne et al. (2014) guidelines

Based on stochastic modelling results from the RPS APASA (2015) hydrocarbon spill modelling study, the minimum contact time of moderate dissolved aromatic hydrocarbon exposure from a subsea well blowout to the nearest submerged receptors of Evans Shoal, Tassie Shoal and Lynedoch Bank (all less than 100 km from the Barossa Field) was greater than 24 hours in all seasons. Due mainly to the evaporative loss of volatiles, less than 20% of the original volume of condensate would remain after this time. However, the open waters of the Timor Reef Fishery could be affected during a well blowout event during any season, given the Barossa Field is located within this fishery. The times to contact with dissolved aromatic hydrocarbons (90 - 100 m depth layer) were 2.4 hrs for all seasons, with the probability of exposure ranging between 14% and 37%. Considering the predicted exposure to the nearest submerged receptors and the Timor Reef Fishery, it was decided that fish

would be the most likely receptor to be exposed to the weathered condensate, and consequently were the focus species for the weathered condensate study.

Aliquots of the Barossa-3 condensate sample were weathered by ESA using the Mackay Chamber Testing techniques for a 12 hour weathering period, with a wind speed of 5.5 m/s (10.7 knots) and water temperature of 28.8°C. The weathering information was based upon the season in which spawning occurs for goldband snapper (*Pristipomoides multidens*), which is the key target species of the Timor Reef Fishery. The most vulnerable life stages for fish are their egg and larval life stages, therefore goldband snapper are most susceptible to hydrocarbons during the spawning period, which is January to April with a peak during March (Newman 2003).

ESA prepared the WAF by combining a prescribed quality of weathered or un-weathered condensate to 0.45 µm filtered seawater in a 1:9 ratio. The combined samples were mixed for 24 hrs using a magnetic stirrer. The WAF and condensate mixture was allowed to settle for 1 hour before the WAF was siphoned off into clean amber glass reagent bottles until required for toxicity testing and total recoverable hydrocarbon (TRH) analysis. The WAFs were serially diluted with filtered seawater (FSW) to prepare the remaining test concentrations.

For each toxicity test, sub-samples of the WAF were sent to Envirolab Services Pty Ltd to be analysed for the determination of TRH, polycyclic aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene and xylenes (BTEX) concentrations of the solution. Total recoverable hydrocarbon concentration is representative of the sum of the hydrocarbons in each test solution for C_6–C_{40}.

ESA performed a full suite of toxicity testing (nine tests with seven test species as detailed in **Table 2-1**) on the un-weathered Barossa-3 condensate and a limited number of tests (7-day fish imbalance and biomass toxicity test) on the weathered Barossa-3 condensate.

Toxicity test results for the WAF are expressed in terms of loading rate of condensate (grams of oil per litre of seawater; **Table 2-2**) and TRH concentrations (µg/L).

Table 2-2: Test dilutions used in toxicity tests

Dilution Factor	1X	2X	4X	8X	16X	32X	64X	128X	Filtered Seawater
% of treatment	100%	50%	25%	12.5%	6.25%	3.125%	1.56%	0.78%	0%
Loading Rate (g/L)-Barossa-3	77.2	38.6	19.3	9.7	4.8	2.4	1.2	0.6	0
Loading Rate (g/L)-Barossa-3 weathered	79.5	39.8	19.9	9.9	5	2.5	1.2	0.6	0

2.1 Quality assurance

Specific quality assurance (QA) procedures for undertaking toxicity testing, procurement and culturing of test organisms, maintenance and calibration of instrument, cleaning, chain of custody and sample handling procedures were in accordance with ESA standard laboratory procedures. ESA is the only National Association of Testing Authorities (NATA) accredited laboratory undertaking toxicity testing in Australia and five of the nine toxicity tests conducted for this study were NATA certified. The 8-day sea anemone pedal lacerate development test using *Aiptasia pulchella*, the 5-day copepod development toxicity test using *Parvocalanus crassirostris*, the

7-day fish imbalance and 7-day fish biomass tests involving barramundi (*Lates calcarifer*) are not NATA certified but only because these are new tests developed by ESA; the quality assurance procedures for these tests are similar to the certified tests.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. A FSW control and a WAF control were tested concurrently with each test. The WAF control is a way of determining if the process of creating a WAF causes toxicity to test animals. **Appendix A** gives specific quality assurance controls for each of the toxicity tests. The acceptance criteria for each of these measures had to be met in order for the tests to be considered valid. Tests that were invalid were repeated with un-weathered treatment and test organisms, therefore the results presented here represent the final tests in which all acceptance criteria were met.

2.2 Chemical analyses

A total of 39 sub-samples of the WAF were sent by ESA to Envirolab Services for testing in three separate batches. **Table 2-3** lists the practical quantitation limits (PQLs) for the hydrocarbons analysed during this study. The laboratory used for analysis is NATA certified for the parameters measured. As part of their procedures the Envirolab undertakes the required blanks, testing of standards and replicate tests to the satisfaction of NATA requirements.

Table 2-3: Laboratory practical quantitation limits for each of the hydrocarbons analysed

Analyte	PQL (µg/L)
BTEX	
Benzene	1
Toluene	1
Ethylbenzene	1
m+p xylene	2
o-xylene	1
Total Recoverable Hydrocarbons	
C_6-C_{10}	10
>C_{10}-C_{16}	50
>C_{16}-C_{34}	100
>C_{34}-C_{40}	100
Polycyclic Aromatic Hydrocarbons	
Naphthalene	1
Acenaphthylene	1
Acenaphthene	1
Fluorene	1
Phenanthrene	1
Anthracene	1
Fluoranthene	1
Pyrene	1
Benzo(a)anthracene	1
Chrysene	1
Benzo(b,j+k)fluoranthene	2
Benzo(a)pyrene	1
Indeno(1,2,3-c,d)pyrene	1
Dibenzo(a,h)anthracene	1
Benzo(g,h,i)perylene	1

2.3 Data presentation and statistical analysis

The toxicity test data are presented in several ways. Firstly the concentration at which no observed effects are noted (no observed effect concentration, NOEC) is generally used as the most conservative measure of toxicity in that it is the lowest concentration at which no test organisms are affected. The lowest observed effects concentration (LOEC) is the concentration where the first statistically detectable toxicity is observed. The concentration that causes one or more specified effects in 50% of the test organisms in the prescribed test duration (EC_{50}) or which inhibits growth or reproduction of 50% of the test organisms in the prescribed test duration (IC_{50}) are statistically calculated. Similarly IC/EC_{10} values are statistically calculated.

Burrlioz 2.0 is a statistical software package for use in environmental management of species with regard to understanding the effects of levels of toxins in an environment. Depending on the number of observations, Burrlioz 2.0 uses either the log-logistic ($n < 8$) or the Burr Type III ($n \geq 8$) model, to estimate the greatest concentration of a toxin at which no observed effect to a species will be detected. The ANZECC/ARMCANZ (2000) guidelines recommend using the Burrlioz program and stipulate that:

The program determines by statistical means the distribution that best fits the available toxicity data and calculates the 95% protection level (with median confidence) or any other nominated protection level.

For this assessment, the Burrlioz 2.0 program was used to analyse the toxicity results and to plot species sensitivity distributions (SSD) to derive the concentration that protects 80%, 90%, 95% and 99% of species with 50% confidence (PC80(50), PC90(50), PC95(50) and PC99(50) respectively). Analysis by the Burrlioz 2.0

program is designed to utilise EC/IC_{10} values derived from chronic toxicity tests to provide high reliability guideline values. Warne et al (2014) recommend:

EC/IC/LCx where x≤10 are to be used in preference to NOEC and then NOEC estimated values derived from LOEC and LC_{50} values.

In cases where there are insufficient chronic data to derive a guideline value, acute toxicity data can be converted to provide an estimate of chronic toxicity. ANZECC/ARMCANZ (2000) guidelines use LC_{50} or EC_{50} data derived from acute tests in the Burrlioz 2.0 program; however, a chemical-specific acute to chronic ratio (ACR) must be applied to convert the data to a chronic equivalent. A chemical-specific ACR is derived from chronic and acute tests performed on a given species for a test chemical or solution. If this has not been undertaken, the ANZECC/ARMCANZ (2000) guidelines suggest the use of a default value of 10 be applied, meaning that the LC_{50} or EC_{50} data are divided by ten (10) before they are entered into the Burrlioz 2.0 program. The default ACR value of ten was applied to the EC_{50} result for the Acute Copepod Development Test.

It is also worth noting that the Burrlioz 2.0 program is a distribution-fitting application and the more ecotoxicity tests used, the more reliable the guideline values calculated. As a minimum, Warne et al. (2014) state:

The minimum data requirements for using a SSD have not changed from the ANZECC/ARMCANZ (2000) Guidelines i.e. toxicity data for at least five species that belong to at least four taxonomic groups, but using toxicity data from at least 8 species is strongly encouraged and from more than 15 species is considered optimal.

For this investigation, nine tests comprised of seven different taxonomic groups (microalga, macroalga, echinoderm, crustacean, mollusc, cnidarian and fish) were used. As a number of the tests used the same species (e.g. sea urchin *Heliocidaris tuberculata*) a single toxicity value needed to be obtained for each species. At this point in time the laboratory has a limit on the number of tropical test species available, as the new guidelines become more prevalent this will likely change. The lowest value for all combinations of a species and endpoint is adopted as the toxicity value to represent the sensitivity of the species in the SSD calculations (Warne et al. 2014). Therefore, from the nine tests used in the assessment, seven values were used to derive the species protection guideline values. Of the input values, six were derived from chronic tests and one from an acute test.

Burrlioz 2.0 calculates the species protection levels (99%, 95%, etc) based on toxicity data, which are either an EC/IC_{10} or an EC/IC_{50} divided by a factor of ten (10). For a 99% species protection value the Burrlioz 2.0 program assimilates all the test data to derive a value that protects an even higher proportion of the species (i.e. where only one species is affected rather than 10% or 50% of individuals); hence, the values derived will routinely be much lower than the input values from the toxicity testing.

3. Results

The laboratory reports from ESA for each of the toxicity tests are presented in **Appendix B** for un-weathered and weathered treatments of Barossa-3 condensate.

The statistical outputs for the Barossa-3 condensate un-weathered and weathered toxicity tests are summarised in **Table 3-1** and **Table 3-2** respectively. Note that for the chronic tests the IC/EC_{10} values were used as inputs to the Burrlioz 2.0 program, whereas for the Acute Copepod Development Test the EC_{50} value was divided by 10. This factor is applied to ensure that a conservative approach is taken to derive PC95 and PC99 percentages and dilutions in the absence of sufficient chronic toxicity data. The Burrlioz distribution fitting for 95% and 99% species protection of un-weathered Barossa-3 condensate are graphed in **Figure 3-1** to **Figure 3-2**; however, guideline values for all species protection levels (80, 90, 95 and 99%) are highlighted in **Table 3-3**. The Burrlioz output reports are located in **Appendix C.**

Microalga Growth Inhibition Test (72 hour)

For the un-weathered Barossa-3 condensate, algal cell yield was significantly inhibited in the WAF with a loading density corresponding to a TRH concentration of 12,850 µg/L. There was zero cell yield in higher concentrations of the un-weathered condensate (**Appendix B**). The IC_{10} value for the un-weathered condensate was 4,355 µg/L (**Table 3-1**).

Macroalgal Growth Test (14 day)

The WAF of un-weathered Barossa-3 condensate caused significantly lower gametophyte length of the macroalgae *Ecklonia radiata* at a TRH concentration of 3180 µg/L (**Appendix B**). The IC_{10} value for the un-weathered condensate was 1,873 µg/L (**Table 3-1**).

Sea Urchin Fertilisation Success Test (1 hour)

The un-weathered Barossa-3 condensate caused a significantly lower percentage of sea urchin eggs to be fertilised at a TRH concentration of 720 µg/L and no eggs were fertilised at concentrations of 30,860 µg/L or higher (**Appendix B**). The EC_{10} value for the un-weathered condensate was 9,206 µg/L (**Table 3-1**).

Sea Urchin Larval Development Test (72 hour)

The WAF of un-weathered Barossa-3 condensate caused a significant decrease in the number of normally developed sea urchin larvae. No normally developed larvae were observed in the WAF with the highest loading density (corresponding to a TRH concentration of 69,620 µg/L) and a TRH of concentration of 30,860 µg/L caused significantly fewer normally developed larvae (**Appendix B**). The EC_{10} value for the un-weathered condensate was 15,481 µg/L (**Table 3-1**).

Oyster Larval Development Test (48 hour)

Significantly fewer normally developed milky oyster larvae were observed in the WAF's containing a TRH of 14,060 µg/L of un-weathered Barossa-3 condensate and no larvae developed normally with higher concentrations of un-weathered condensate (**Appendix B**). The IC_{10} value for the un-weathered condensate was 11,478 µg/L (**Table 3-1**).

Copepod Acute Development Toxicity Test (5 day)

There was a significant change to the number of healthy copepods affected by un-weathered Barossa-3 at a TPH concentration of 15,830 µg/L compared with the WAF control and at this and higher concentrations of un-weathered condensate all copepods were affected (**Appendix B**). The IC_{10} value for the un-weathered condensate was 27.2 µg/L (**Table 3-1**).

Sea Anemone Pedal Lacerate Development Test (8 day)

The WAF of un-weathered Barossa-3 condensate caused a significant decrease in the number of normally developed sea anemone pedal lacerates. No normally developed larvae were observed in the WAF with the highest loading density (corresponding to a TRH concentration of 63,990 µg/L; **Appendix B**). The IC_{10} value for the un-weathered condensate was 8,862 µg/L (**Table 3-1**).

Fish Imbalance Test (7 day)

The number of healthy fish larvae (unhealthy larvae measured as a loss of balance or equilibrium when swimming and inability to catch prey) in the WAF of un-weathered Barossa-3 condensate was significantly less at a TRH concentration of 29,770 µg/L and there were no healthy fish larvae at higher concentrations (**Appendix B**). The number of healthy fish larvae exposed to weathered Barossa-3 condensate at the highest loading density was not significantly different compared to the FSW control (i.e. 0%; **Appendix B**). The IC_{10} values for the un-weathered and weathered condensate were 15,875 and 19,596 µg/L respectively (**Table 3-1** and **Table 3-2**).

Fish Biomass Toxicity Test (7 day)

The biomass of fish larvae in the WAF of un-weathered Barossa-3 condensate was significantly lower at a TRH concentration of 29,770 µg/L and there were no unaffected fish larvae at higher concentrations (**Appendix B**). The biomass of the fish larvae exposed to weathered Barossa-3 condensate at the highest loading density was not significantly different compared to the FSW control (i.e. 0%; **Appendix B**). The IC_{10} values for the un-weathered and weathered condensate were 17,016 and 13,908 µg/L respectively (**Table 3-1** and **Table 3-2**).

99 and 95% Species Protection

The 95% species protection guideline value of un-weathered Barossa-3 condensate was 456 µg/L (**Figure 3-1** and **Table 3-3**), while the 99% species protection guideline values of un-weathered Barossa-3 condensate was 1146 µg/L (**Figure 3-2** and **Table 3-3**). The IC_{10} values for the un-weathered Barossa-3 condensate ranged from 1,051 to 15,875 µg/L. The reliability of the guideline value was moderate based on the classification scheme outlined in Warne et al. (2014) based on the number of species in which toxicity data are available (n=7), type of toxicity data (mixture of chronic and estimated chronic) and visual assessment of the goodness of fit of the SSD to the toxicity data (good).

Neither the un-weathered nor weathered Barossa-3 condensate was particularly toxic to fish larvae. A lower concentration of un-weathered condensate was required to affect the balance of 10% of fish larvae compared with the weathered condensate (**Table 3-1** and **Table 3-2**) while a lower concentration of weathered condensate was required to affect the biomass of 10% of fish larvae compared to the un-weathered condensate (**Table 3-1** and **Table 3-2**).

Hydrocarbon Concentrations of Weathered and Un-weathered Condensate

The major difference between the hydrocarbon components of the Barosssa-3 weathered and un-weathered condensate was the large reduction in benzene and toluene after 12 hours of weathering (**Table 3-4**). Ethylbenzene and xylenes also decreased but to a much smaller degree. The aliphatic fraction C_{16}-C_{34} and naphthalene increased in weathered condensate but the other PAHs remained unchanged, with most being below the detection limit of the laboratory in both weathered and un-weathered condensates.

Table 3-1: Summary of toxicity tests for un-weathered Barossa-3 condensate (concentrations in µg/L)

Test	NOEC	EC_{10} or IC_{10}	EC_{50} or IC_{50}	Burrlioz Input Values
Microalgal Growth	6670	4355.2	8529.3	4355.2
Macroalgal Germination Success	1673	1873.9	57196.9	1873.9
Sea Urchin Fertilisation	350	9206.2	13202.7	9206.2
Sea Urchin Larval Development	14060	15481.6	20104.4	-
Milky Oyster Larval Development	7160	11478.4	18747.2	11478.4
Copepod Development	8560	27.2	10506.9	1050.7*
Sea Anemone Pedal Lacerate Development	28040	8862.4	30720.0	8862.4
Fish Imbalance	15830	15875.5	23182.2	15875.5
Fish Growth (Biomass)	15830	17016.3	24006.3	-

- indicates that the lowest value for the species was used
* indicates a default acute to chronic ratio was applied to the EC_{50} value

Table 3-2: Summary of toxicity tests for weathered Barossa-3 condensate (concentrations in µg/L)

Test	NOEC	EC_{10} or IC_{10}	EC_{50} or IC_{50}
Fish Imbalance	22480	19596.3	>22480
Fish Growth (Biomass)	22480	13908.1	>22480

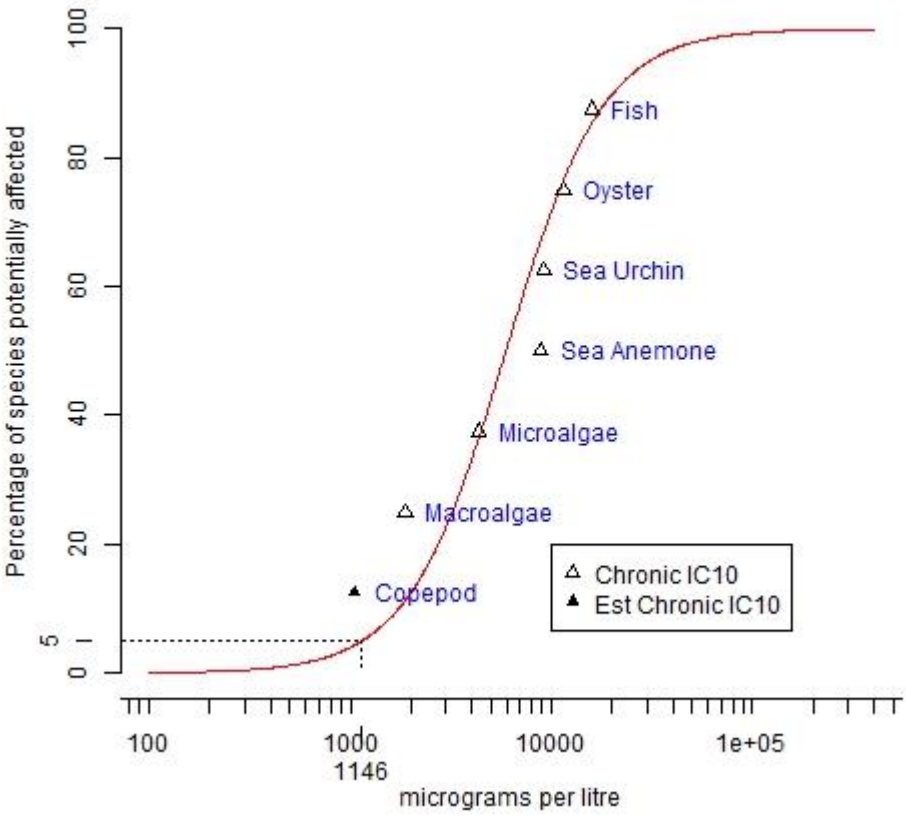

Figure 3-1: Burrlioz distribution fitting for 95% species protection of un-weathered Barossa-3 condensate

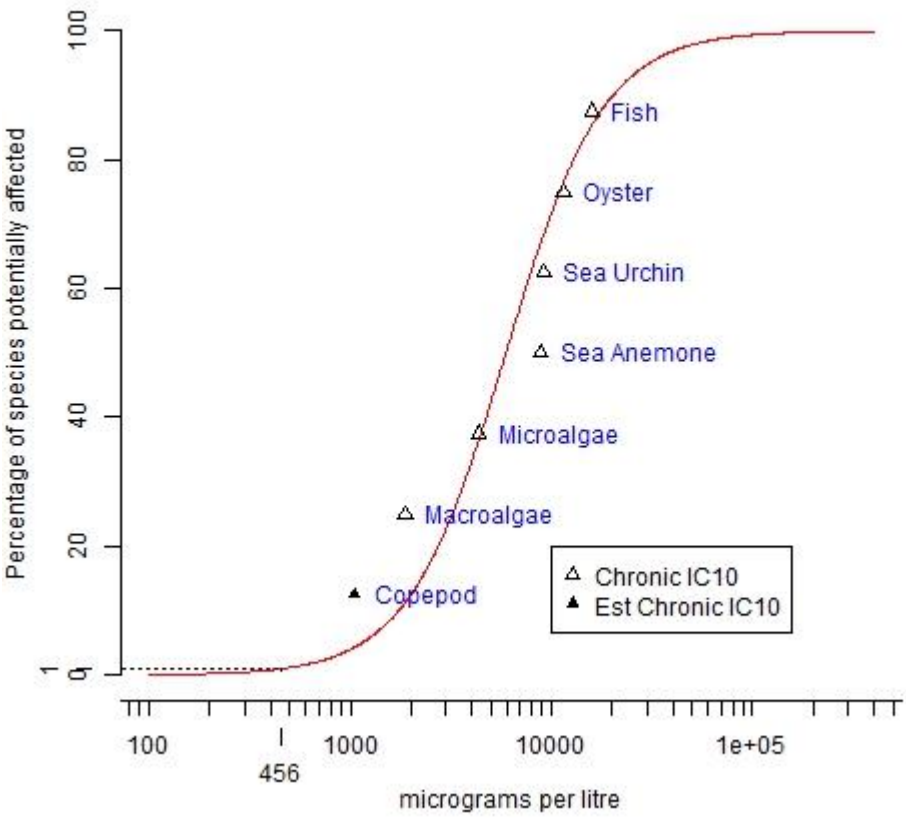

Figure 3-2: Burrlioz distribution fitting for 99% species protection of un-weathered Barossa-3 condensate

Table 3-3: Moderate reliability guideline values derived from Burrlioz species sensitivity distribution curve for un-weathered Barossa-3 condensate

Treatment	Level of Species Protection	Derived Guideline Value for TRH concentration (µg/L)
Un-weathered Barossa-3 condensate	99%	456
	95%	1146
	90%	1739
	80%	2735

Table 3-4: Hydrocarbon concentrations of weathered and un-weathered Barossa-3 condensate

Analyte	100% Un-weathered Condensate (µg/L)	100% Weathered Condensate (µg/L)
BTEX		
Benzene	27000	630
Toluene	21000	7400
Ethylbenzene	490	400
m+*p* xylene	5000	4000
o-xylene	1500	1400
Total Recoverable Hydrocarbons		
C_6-C_{10} (less BTEX)	7000	5200
>C_{10}-C_{16} (less naphthalene)	1200	800
>C_{16}-C_{34}	1900	2600
>C_{34}-C_{40}	140	<100
Polycyclic Aromatic Hydrocarbons		
Naphthalene	250	400
Acenaphthylene	<1	<1
Acenaphthene	<1	<1
Fluorene	3	4
Phenanthrene	2	2
Anthracene	<1	<1
Fluoranthene	<1	<1
Pyrene	<1	<1
Benzo(a)anthracene	<1	<1
Chrysene	<1	<1
Benzo(b,j+k)fluoranthene	<2	<1
Benzo(a)pyrene	<1	<1
Indeno(1,2,3-c,d)pyrene	<1	<1
Dibenzo(a,h)anthracene	<1	<1
Benzo(g,h,i)perylene	<1	<1

4. Conclusions

A large number of studies have been published describing the toxicity of total petroleum hydrocarbon and hydrocarbon components (including French-McCay, 2002; Lewis and Pryor, 2013; Neff et al. 2000). The common theme in the findings is that the observed toxicity of crude and refined hydrocarbons is primarily attributable to volatile and water-soluble aromatic hydrocarbons (MAHs) including BTEX, low molecular weight PAHs such as naphthalene and phenanthrene and higher molecular weight PAHs).

The moderate reliability guideline value for 95% species protection of un-weathered Barossa-3 condensate was 1,146 µg/L and the moderate guideline value for 99% species protection was 456 µg/L. The IC_{10} values for the un-weathered Barossa-3 condensate ranged from 1,051 to 15,875 µg/L. According to the GESAMP (2002) classification, un-weathered Barossa-3 condensate has almost negligible chronic aquatic toxicity.

Neither the un-weathered nor weathered Barossa-3 condensate was particularly toxic to fish larvae. A lower concentration of un-weathered condensate was required to affect the balance of 10% of fish larvae compared with the weathered condensate while a lower concentration of weathered condensate was required to affect the biomass of 10% of fish larvae compared to the un-weathered condensate.

The un-weathered Barossa-3 condensate was more toxic to copepod development and macroalgal growth and less toxic to fish larvae and oyster larvae development. Neff (1979) also found that toxicity was most pronounced among crustaceans and least among teleost or ray-finned fishes.

From the chemical analysis of the Barossa-3 condensate undertaken by Envirolab Services (**Appendix B**), the most obvious difference between the un-weathered and weathered condensate was in the BTEX results. BTEX is the collective name for benzene, toluene, ethylbenzene, and xylenes and falls into the class of MAH. The weathered Barossa-3 condensate had much lower concentrations than the un-weathered Barossa-3 condensate, particularly of benzene and toluene. BTEX compounds are acutely toxic to aquatic organisms if exposure is sustained. Because of the volatility of BTEX, aquatic organisms typically only experience short exposure times in the order of 12 hours which may circumvent toxic effects.

Of the PAHs analysed for this study, naphthalene was the only one measured by Envirolab Services that was higher in the weathered condensate compared to the un-weathered condensate. All other PAHs measured were below the laboratory detection limit or in the case of fluorene and phenanthrene were similar between weathered and un-weathered condensate. However, the myriad of other chemicals present in the condensate were not required to be measured for the purposes of this exercise. Neff et al. (2000) demonstrated that the MAHs are the most important contributors to the acute toxicity of the WAFs of fresh oils, while the contribution of PAHs to WAF toxicity increases with weathering. However it is generally not well understood which of the many components of oil are responsible for the many toxicity effects induced by oil.

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Appendix A. Summary of Quality Assurance for Ecotox Tests

Table A.1: Specific quality assurance (QA) criteria for the Microalga Growth Test

QA Measure	Acceptance Criteria	This Test	Criterion Met?
FSW control mean cell density	≥ 160,000 cells/mL	202,000 ± 32,000 cells/mL	Yes
Control coefficient of variation	< 20%	16.0%	Yes
Reference toxicant test within Cusum chart limits	15.1-46.7 µg/L Cu/L	19.0 µg/L Cu/L	Yes

Table A.2: Specific quality assurance (QA) criteria for the Macroalgal Growth Test

QA Measure	Acceptance Criteria	This Test	Criterion Met?
FSW control mean % germination @ 72 hrs	≥ 70%	90.3 ± 1.12	Yes
Reference toxicant test	86.0-1262.1 µg/L Cu/L	408.5 µg/L Cu/L	Yes

Table A.3: Specific quality assurance (QA) criteria for the Sea Urchin Fertilisation Success Test

QA Measure	Acceptance Criteria	This Test	Criterion Met?
FSW control mean % fertilised eggs	≥ 70%	78.8 ± 3.2%	Yes
Reference toxicant test within Cusum chart limits	23.7-105.6 µg/L Cu/L	26.7 µg/L Cu/L	Yes

Table A.4: Specific quality assurance (QA) criteria for the Sea Urchin Larval Development Test

QA Measure	Acceptance Criteria	This Test	Criterion Met?
FSW control mean % normal larvae	≥ 70%	80.8 ± 5.0%	Yes
Reference toxicant test within Cusum chart limits	10.5-23.1 µg/L Cu/L	12.2 µg/L Cu/L	Yes

Table A.5: Specific quality assurance (QA) criteria for the Milky Oyster Larval Development Test

QA Measure	Acceptance Criteria	This Test	Criterion Met?
FSW control mean % normal larvae	≥ 70%	74.5 ± 4.8%	Yes
Reference toxicant test within Cusum chart limits	10.2-20.0 µg/L Cu/L	14.5 µg/L Cu/L	Yes

Table A.6: Specific quality assurance (QA) criteria for the Acute Copepod Development Toxicity Test

QA Measure	Acceptance Criteria	This Test	Criterion Met?
FSW control mean % unaffected larvae	≥ 70%	70 0 ± 10.7%	Yes
Reference toxicant test within Cusum chart limits*	n/a	2.8 µg/L Cu/L	n/a

* Cusum chart data unavailable due to insufficient tests conducted to build database

Table A.7: Specific quality assurance (QA) criteria for the Sea Anemone Pedal Lacerate Development Test

FSW control mean % normal pedal lacerates	≥ 90%	100 ± 0.0%	Yes
Reference toxicant test within Cusum chart limits*	n/a	11.5 µg/L Cu/L	n/a

* Cusum chart data unavailable due to insufficient tests conducted to build database

Table A.8: Specific quality assurance (QA) criteria for the Larval Fish Imbalance and Growth (Biomass) Test

FSW control mean % unaffected larvae	≥ 80%	100.0 ± 0.0%	Yes
Control Mean Growth	≥ 20% of initial weight	52.6%	Yes
Reference toxicant test within Cusum chart limits	n/a	17.3 mg NH_4^+/L	n/a

* Cusum chart data unavailable due to insufficient tests conducted to build database

Appendix B. Laboratory Reports

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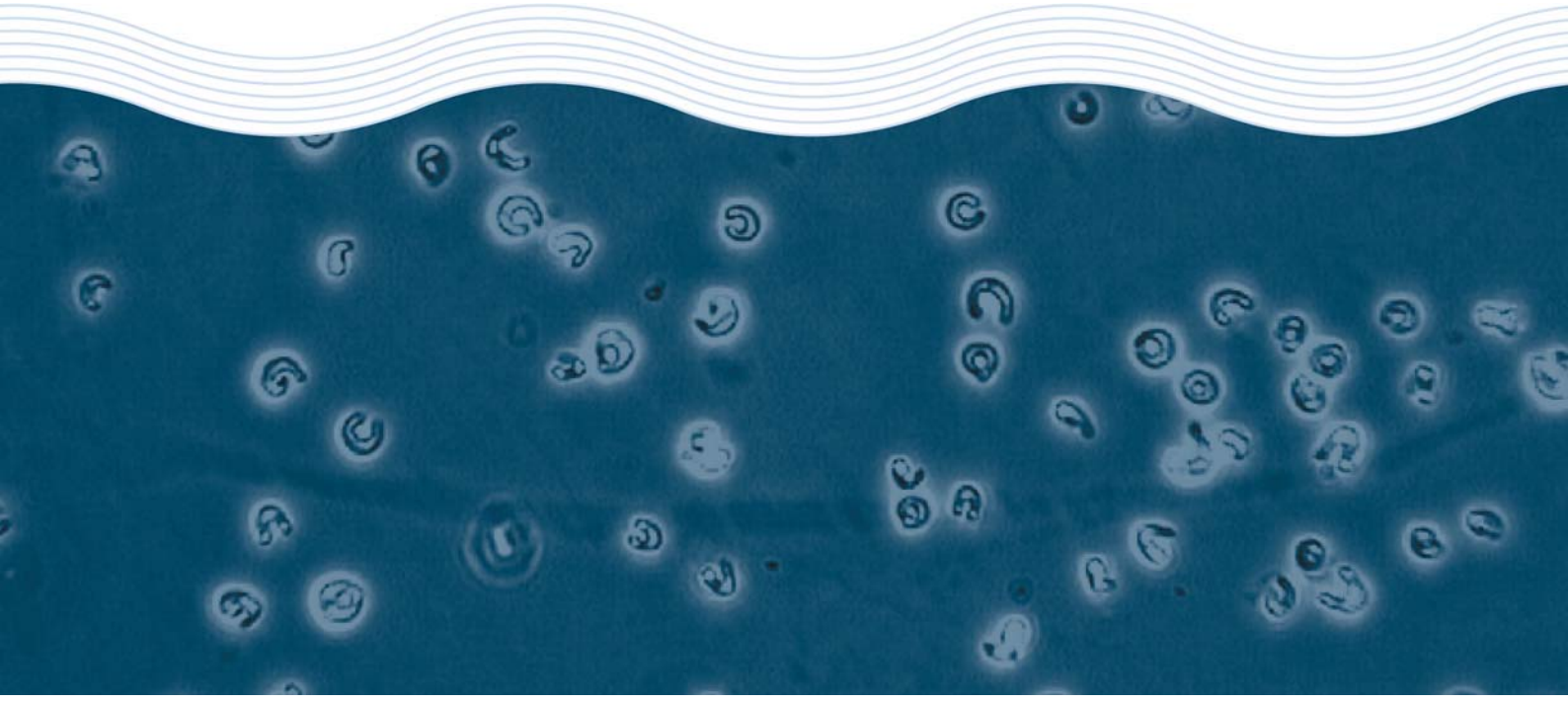
Toxicity Assessment of Fresh and Weathered Barossa Field Condensate

Jacobs SKM

Comprehensive Test Report

November 2015



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Toxicity Assessment of Fresh and Weathered Barossa Field Condensate

Jacobs SKM

Comprehensive Test Report

November 2015

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1. Executive Summary

1.1 Executive Summary

Ecotox Services Australasia Pty Ltd (ESA) was commissioned by Jacobs Group (Australia) Pty Ltd to undertake marine toxicity tests with a condensate sample from the Barossa field development site.

The following toxicity tests were undertaken on Water Accommodated Fractions (WAFs) of Barossa Field Condensate:

- 1-hr fertilisation test using the sea urchin *Heliocidaris tuberculata* (based on USEPA Method 1008 and Environment Canada (1992), modified for use with *H. tuberculata* by Simon and Laginestra 1997, and Doyle *et al*. 2003).
- 72-hr larval development test using the sea urchin *Heliocidaris tuberculata* (based on APHA Method 8810D, modified for use with *H. tuberculata* by Simon and Laginestra 1997)
- 48-hr larval abnormality test using the milky oyster *Saccostrea echinata* (based on APHA Method 8610 and USEPA OPPTS 850.1055, Krassoi 1995)
- 72-hr growth (cell-yield) test using the marine micro-alga *Isochrysis aff. galbana* (based on Stauber *et al*., 1994 for *N. closterium.*)
- 14-day macroalgal growth test using *Ecklonia radiata* (based on Bidwell *et al.* 1998 and Burridge *et al.* 1999).
- 8-day sea anemone pedal lacerate development toxicity test using *Aiptasia pulchella* (based on Howe *et al.* 2014)
- 5-day copepodid development toxicity test using the juvenile calanoid copepod *Parvocalanus crassiostris* (based on Rose *et al* 2006).
- 7-d fish imbalance and growth test with barramundi *Lates calcarifer* (based on USEPA 2002b).

All eight toxicity tests were performed on WAFs generated from either the fresh or weathered Barossa Field Condensate (ESA identification number 7323). Sub-samples of the WAFs and individual dilution treatments were shipped to Envirolab Services Pty Ltd for Total Recoverable Hydrocarbons (TRH, C6-C36), Total Petroleum Hydrocarbons (TPHs) and BTEX. The TRH data, in addition to loading rate of condensate in the WAF generation systems, were used to determine toxicity test end-points.

Test data for the Barossa Field Condensate, based on loading rates, are summarised in **Table 1.1**. The bioassays were performed at the ESA laboratory in Lane Cove. This report describes the results of each of the toxicity tests performed. Test reports for each of the tests are given in **Appendices C to J.** Statistical printouts for each test are given in **Appendices K** to **R**. The analytical reports for TRH analysis of the WAF samples are provided in **Appendix B** of this report.

Test results indicated the following:

- ***1-hr Sea Urchin Fertilisation Test*:**
  Based on the loading rate, the WAF of the Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 14.6, 18.6 (8.97-19.12), 0.6 and 1.2g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 9206.2 (7702.42-10203.00), 13202.7 (12495.20-13763.40)µg/L, 350 and 720µg/L, respectively.

- ***72-hr Sea Urchin Larval Development Test*:**
  Based on the loading rate, the WAF of the Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 21.0 (18.90-2276), 26.5 (24.67-28.01), 19.3 and 38.6g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 15481.6 (13727.10-16947.80), 20104.4 (18575.70-21450.10), 14060 and 30860µg/L, respectively.

- ***48-hr Milky Oyster Larval Development Test*:**
  Based on the loading rate, the WAF of the Barossa Field Condensate sample had an EL10, EL50, NOEL and LOEL 15.7 (11.78-18.35), 24.7 (24.11-25.32), 9.7 and 19.3g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 11478.4 (9026.54-13230.50), 18747.2 (18266.80-19240.30), 7160 and 14060µg/L, respectively.

- ***72-hr Micro-algal Growth Inhibition Test*:**
  Based on the loading rate, the WAF of the Barossa Field Condensate had an IL10, IL50, NOEL and LOEL of 6.4 (2.18-10.68), 12.6 (7.45-15.09), 9.7 and 19.3g/L, respectively. Expressed as TRH concentration, the corresponding IC10, IC50, NOEC and LOEC were 4355.2 (1641.13-7401.38), 8529.3 (5094.77-10126.00), 6670 and 12850µg/L, respectively.

- ***14-d Macroalgal Growth Test:***
  Based on the loading rate, the WAF of the Barossa Field Condensate had an IL10, IL50, NOEL and LOEL of 2.7, 64.8, 2.4 and 4.8g/L, respectively. Expressed as TRH concentration, the corresponding IC10, IC50, NOEC and LOEC were 1873.9, 57196.9, 1673 and 3180µg/L, respectively.

- ***8-dSea Anemone Development Test:***
  Based on the loading rate, the WAF of the Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 11.2, 40.1 (31.78-50.60), 38.6 and 77.2g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 8862.4, 30720.0 (23961.00-39385.50), 28040, 63990µg/L, respectively.

- ***5-d Copepodid development Test***
  Based on the loading rate, the WAF of the Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 1.0, 12.2 (10.84-13.73), 9.7 and 19.3g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 27.2, 10506.9 (9451.82-11679.80), 8560 and 15830µg/L, respectively.

- ***7-d Fish Imbalance and Growth Test*:**
  Based on the loading rate, the WAF of the fresh Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 19.4 (13.58-23.28), 29.3 (24.71-34.66),

19.3 and 38.6g/L, respectively, for the imbalance endpoint. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 15875.5 (11275.40-18756.60). 23182.2 (19851.60-27226.80), 15830 and 29770µg/L, respectively. The EL10, EL50, NOEL and LOEL for the biomass endpoint were 20.9 (8.44-22.09), 30.6 (27.79-31.44), 19.3 and 38.6g/L, respectively expressed as loading rate, and 17016.3 (7373.18-18757.60), 24006.3 (21800.80-24621.00), 15830 and 29770µg/L, respectively, expressed as TRH concentration.

Based on the loading rate, the WAF of the Weathered Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 69.1, >79.5, 79.5 and >79.5g/L, respectively, for the imbalance endpoint. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 19596.3, >22480, 22480 and >22480µg/L, respectively. The EL10, EL50, NOEL and LOEL for the biomass endpoint were 48.6, >79.5, 79.5 and >79.5g/L, respectively expressed as loading rate, and 13908.1, >22480.0, 22480 and >22480µg/L, respectively, expressed as TRH concentration.

Table 1.1. Summary of toxicity test data for the Barossa Field Condensate

		Barossa Field Condensate		Weathered Barossa Field Condensate	
Toxicity Test	**Endpoint**	**Loading Rate (g/L)**	**TRH Concentration (µg/L)**	**Loading Rate (g/L)**	**TRH Concentration (µg/L)**
1-hr sea urchin fertilisation	1-hr EL10	14.6*	9206.2 (7702.42-10203.00)	-	-
	1-hr EL50	18.6 (8.97-19.12)	13202.7 (12495.20-13763.40)	-	-
	NOEL	0.6	350	-	-
	LOEL	1.2	720	-	-
72-hr sea urchin larval development	72-hr EL10	21.0 (18.90-22.76)	15481.6 (13727.10-16947.80)	-	-
	72-hr EL50	26.5 (24.67-28.01)	20104.4 (18575.70-21450.10)	-	-
	NOEL	19.3	14060	-	-
	LOEL	38.6	30860	-	-
48-hr milky oyster larval development	48-hr EL10	15.7 (11.78-18.35)	11478.4 (9026.54-13230.50)	-	-
	48-hr EL50	24.7 (24.11-25.32)	18747.2 (18266.80-19240.30)	-	-
	NOEL	9.7	7160	-	-
	LOEL	19.3	14060	-	-
72-hr micro-algal growth	72-hr lL10	6.4 (2.18-10.68)	4355.2 (1641.13-7401.38)	-	-
	72-hr lL50	12.6 (7.45-15.09)	8529.3 (5094.77-10126.00)	-	-
	NOEL	9.7	6670	-	-
	LOEL	19.3	12850	-	-
14-d macroalgal growth	14-d lL10	2.7*	1873.9*	-	-
	14-d lL50	64.8*	57196.9*	-	-
	NOEL	2.4	1673	-	-
	LOEL	4.8	3180	-	-

		Barossa Field Condensate		Weathered Barossa Field Condensate	
Toxicity Test	**Endpoint**	**Loading Rate (g/L)**	**TRH Concentration (µg/L)**	**Loading Rate (g/L)**	**TRH Concentration (µg/L)**
8-d sea anemone development	8-d EL10	11.2*	8862.4*	-	-
	8-d EL50	40.1 (31.78-50.60)	30720.0 (23961.00-39385.50)	-	-
	NOEL	38.6	28040	-	-
	LOEL	77.2	63990	-	-
5-d copepodid development	5-d EL10	1.0**	27.2*	-	-
	5-d EL50	12.2 (10.84-13.73)	10506.9 (9451.82-11679.80)	-	-
	NOEL	9.7	8560	-	-
	LOEL	19.3	15830	-	-
7-d fish imbalance	7-d EL10	19.4 (13.58-23.28)	15875.5 (11275.40-18756.60)	69.1*	19596.3*
	7-d EL50	29.3 (24.71-34.66)	23182.2 (19851.60-27226.80)	>79.5	>22480.0
	NOEL	19.3	15830	79.5	22480
	LOEL	38.6	29770	>79.5	>22480
7-d fish biomass	7-d EL10	20.9 (8.44-22.09)	17016.3 (7373.18-18757.6)	48.6*	13908.1
	7-d EL50	30.6 (27.79-31.44)	24006.3 (21800.80-24621.00)	>79.5	>22480.0
	NOEL	19.3	15830	79.5	22480
	LOEL	38.6	29770	>79.5	>22480

*95% confidence limits are not available/reliable
** Based on extrapolated data

1.2 Glossary of Terms

The following glossary is based on that provided by Environment Canada (1997)

Acute toxicity is an adverse effect (lethal or sub-lethal) induced in the test organisms within a short period of exposure to a test material, usually a few days.

Bioassay is a test (=assay) in which the strength or potency of a substance is measured by the response of living organisms or living system. ***Toxicity test*** is a more specific and preferred term for environmental work.

Chronic toxicity implies long-term effects that are related to changes in metabolism, growth, reproduction, or ability to survive

Control is a treatment in an investigation that duplicates all the factors that might affect results, except the specific condition being studied. In toxicity tests, the control must duplicate all the conditions in the exposure treatment(s) but must contain no test material. The control is used as a check for toxicity due to basic conditions such as quality of dilution water or health and handling of the test organisms. Control is synonymous with ***negative control***. See also ***positive control***.

ECx is the median effective concentration. That is the concentration of material in water that is estimated to cause a specified percent effect (eg. EC10, EC50) of the test organisms. In most instances the EC50 and its 95% confidence limits are statistically derived by analysing the percentages of organisms affected at various test concentrations, after a fixed period of exposure. The duration of exposure must be specified (eg. 48h).

ELx is the median effective loading rate. That is the loading rate of material in water (eg. mg/L) that is estimated to cause cause a specified percent effect (eg. EC10, EC50) of the test organisms. In most instances the EL50 and its 95% confidence limits are statistically derived by analysing the percentages of organisms affected at various test loading densities, after a fixed period of exposure. The duration of exposure must be specified (eg. 48h).

Endpoint means the measurement(s) or value(s) that characterise the results of a test (LL50, EL50, IL50). It also means the reaction of the organism to show the effect which is intended to mark completion of the test (eg. death, number of shell abnormalities).

ILx is the inhibiting loading rate for a specified percent effect (eg. IL50). It represents a point estimate of a loading rate of test material that causes a designated percent inhibition (*p*) compared to the control, in a quantitative biological measurement such as microalgal cell yield attained at the end of a test.

ICx is the inhibiting concentrations for a specified percent effect (eg. IC50). It represents a point estimate of a concentration of test material that causes a designated percent inhibition (*p*) compared to the control, in a quantitative biological measurement such as microalgal cell yield attained at the end of a test.

LOEC is the lowest-observed-effect concentration. This represents the lowest concentration of a test material for which a statistically significant effect on the test organisms was observed, relative to the control.

LOEL is the lowest-observed-effect loading rate. This represents the lowest loading densities of a test material for which a statistically significant effect on the test organisms was observed, relative to the control.

NOEC is the no-observed-effect concentration. This represents the highest test concentration of a test material for which no statistically significant effect on the test organisms was observed, relative to the control.

NOEL is the no-observed-effect loading rate. This represents the highest test loading rate of a test material for which no statistically significant effect on the test organisms was observed, relative to the control.

Positive Control is a toxicity test with a reference toxicant, used to assess the sensitivity of the organisms at the time of the test material is evaluated and the precision of the results obtained by the laboratory for that chemical.

Reference toxicant is a standard chemical used to measure the sensitivity of the test organisms to establish confidence in the toxicity data obtained for a test material. In most instances, a toxicity test with a reference toxicant is performed to assess the sensitivity of the organisms at the time the test material is evaluated and the precision of the results obtained by the laboratory for that chemical.

Replicate is a single test chamber containing a prescribed number of test organisms in either one loading rate of test solution or in dilution water as a control. In a toxicity test comprising five test concentrations and a control, and using four replicates, 24 test chambers would be used. For each loading rate or control, there would be 4 test chambers or replicates. A replicate must be an independent unit, and therefore, any transfer of test material or organisms from one replicate to another would invalidate a statistical analysis based on replication.

Static describes toxicity tests in which test solutions are not renewed during the test.

Sub-lethal means detrimental to the organism, but below the level that directly causes death within the test period.

Toxic means poisonous. A toxic material can cause adverse effects on living organisms, if present in sufficient amount at the right location.

Toxicant is a toxic material.

2. Introduction

Ecotox Services Australasia Pty Ltd (ESA) was commissioned by Jacobs Group (Australia) Pty Ltd to undertake marine toxicity tests with a condensate sample from the Barossa field development site.

The following toxicity tests were undertaken on Water Accommodated Fractions (WAFs) of Barossa Field condensate:

- 1-hr fertilisation test using the sea urchin *Heliocidaris tuberculata* (based on USEPA Method 1008 and Environment Canada (1992), modified for use with *H. tuberculata* by Simon and Laginestra 1997, and Doyle *et al*. 2003).
- 72-hr larval development test using the sea urchin *Heliocidaris tuberculata* (based on APHA Method 8810D, modified for use with *H. tuberculata* by Simon and Laginestra 1997)
- 48-hr larval abnormality test using the milky oyster *Saccostrea echinata* (based on APHA Method 8610C and USEPA OPPTS 850.1055, Krassoi 1995)
- 72-hr growth (cell-yield) test using the marine micro-alga *Isochrysis aff. galbana* (based on Stauber *et al*., 1994 for *N. closterium.*)
- 14-day macroalgal growth test using *Ecklonia radiata* (based on Bidwell *et al.* 1998 and Burridge *et al.* 1999).
- 8-day sea anemone pedal lacerate development toxicity test using *Aiptasia pulchella* (based on Howe *et al.* 2014)
- 5-day copepodid development toxicity test using the juvenile calanoid copepod *Parvocalanus crassiostris* (based on Rose *et al* 2006).
- 7-d fish imbalance and growth test with barramundi *Lates calcarifer* (based on USEPA 2002b).

The condensate sample was shipped to ESA in 20L steel cans and was received in good condition (**Appendices A**). The Barossa Field Condensate was assigned ESA identification number 7323. The condensate sample was stored at room temperature until used for preparing Water Accommodated Fractions (WAFs).

WAFs of the condensate sample were prepared by adding a prescribed quantity of condensate to 0.45μm filtered seawater (FSW) in 2 litre glass bottles in general accordance with CONSERF procedures (Singer *et al*., 2000). The mixing ratio was 1 part condensate: 9 parts filtered seawater. The preparations were stirred for 24 hours using a magnetic stirrer in such a manner as to avoid the formation of a vortex that may form dispersed droplets. The WAF and the overlying condensate layer were allowed to settle for 1 hour before the underlying WAF was siphoned off into clean glass bottles and tested on the day of preparation.

The WAFs were prepared in general accordance with CONSERF procedures (Singer *et al*., 2000), the principal departure being the individual WAFs were not prepared for each test treatment. After consideration, it was determined that a dilution of a single or combined WAF was to be undertaken to prepare test solutions for each toxicity test. The results reported herein are for toxicity tests where dilutions were prepared from a WAF at a mixing ratio of 1 part condensate: 9 parts filtered seawater.

The bioassays were performed at the ESA laboratory in Lane Cove, NSW. This report describes the results of each of the toxicity tests performed. Test reports for each test performed are given in **Appendices C to J**. The statistical printouts from the Toxcalc

analytical software for each test are given in **Appendices K** to **R**. Toxicity tests reported herein were undertaken in September to October 2015.

The toxicity test endpoints reported herein are expressed as loading rate of condensate (expressed in terms of grams of condensate/L), and as Total Recoverable Hydrocarbon (TRH, total of C6-C36) determined by subcontracted chemical analyses of each test treatment. Sub-samples of the test treatments (ie dilutions of each WAF) were sent by same-day express courier to Envirolab Services Pty Ltd, Chatswood NSW. The analytical report for the TRH analyses is provided in **Appendix B** of this report.

3. 1-hr Sea Urchin Fertilisation Test

3.1 Summary of Test Methodology

The 1-hr sea urchin fertilisation test using the gametes of *Heliocidaris tuberculata* was undertaken in accordance with ESA Standard Operating Procedure 104, which is based on methods described by USEPA method 1008 (2002) and Environment Canada (1992), ASRM (1995) and APGHA (1998), modified for use by Simon and Langistera (1996) and adapted for use with *H. tuberculata* by Simon and Laginestra (1997). Tests were performed in a constant temperature chamber of 20±1°C with a 16:8h light: dark photoperiod for the entire exposure. Clean seawater was collected from the Sydney region and filtered to 0.45μm on return to the laboratory. Sea urchins used for the tests were obtained by field collection from South Maroubra, NSW and spawned within 6-hr of collection.

The definitive test reported here was initiated on 10 September 2015. The tests were undertaken in 9mL borosilicate glass tissue culture tubes, with four replicate tubes per treatment. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Dissolved oxygen was measured using a WTW Oxi 330 Oximeter, with a WTW CellOx 325 probe. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4°C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier.

Sperm were exposed to each of the test treatments for 1 hour, after which eggs were added to the test solutions and incubated with the sperm for 20 minutes. The test was then terminated by the addition of buffered formalin. One milliliter of test solution was drawn directly from the bottom of each test vessel and placed in a Sedgwick-Rafter counting chamber. The first 100 eggs were examined and the number of fertilised eggs was recorded. Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in reductions in fertilisation to 10% and 50% of the test population (1-hr EL and EC values) was determined by either Maximum Liklihood Probit or Trimmed Spearman Karber or Probit Method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

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Table 3.1. Summary of test conditions for the sea urchin fertilisation test

Test species	Sea urchin *Heliocidaris tuberculata*
Test type	Static, non-renewal
Test duration	1-hour
Test end-point	Fertilisation
Test temperature	20±1ºC
Test salinity	35±1‰
Test chamber size / volume	5mL in 9 mL tissue culture tube
Source of test organisms	Field collection, Sydney coastal region
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Test acceptability criteria	≥70% fertilisation in controls, reference toxicant results within prescribed range

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a separate positive control test was conducted using copper. The test was performed in the same manner as the test with the WAF. The results of the reference toxicant test were compared with the results from previous testing using a control chart.

3.2 Results

The results for the WAF of the Barossa Field Condensate using the sea urchin fertilisation test are summarised in **Table 3.2** below. The mean and standard deviation of the responses of test organisms to each test treatment are given in the summary reports given in **Appendix C**. The statistical output from the Toxcalc statistical analyses are given in **Appendix K**.

Table 3.2. The 1-hr EL/EC10 and EL/EC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the sea urchin fertilisation success test.

Sample	1-hr EL/EC10	1-hr EL/EC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	14.6*	18.6 (8.97-19.12)	0.6	1.2
Barossa Field Condensate – TRH concentration (µg/L)	9206.2 (7702.42-10203.00)	13202.7 (12495.20-13763.40)	350	720

*95% confidence limits are not reliable

Based on the loading rate, the WAF of the Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 14.6, 18.6 (8.97-19.12), 0.6 and 1.2g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 9206.2 (7702.42-10203.00), 13202.7 (12495.20-13763.40), 350 and 720µg/L, respectively.

The WAF control was not toxic to sea urchin fertilisation.

3.3 Quality Assurance

The sea urchin fertilisation test undertaken with the pepared WAF met all quality assurance criteria. The mean percentage of fertilised eggs in the laboratory control in the test was 78.8%, exceeding the minimum control criteria of 70%. Water quality parameters were also within test acceptability ranges.

The 1-hr EC50 estimate for the copper reference toxicant tests run concurrently with the WAF sample fell within the reference toxicant cusum chart control limits (**Table 3.3**). This indicated that the toxicity test was within the expected range with respect to performance and sensitivity.

Table 3.3 The Quality Assurance limits for the sea urchin fertilisation test.

QA Measure	Criterion	This Test
Control % normally developed	$\geq$ 70%	78.8%
Reference toxicant EC50	23.7-105.6µg Cu/L	26.7µg Cu/L

4. 72-hr Sea Urchin Larval Development Test

4.1 Summary of Test Methodology

The 72-hr sea urchin larval development test using the fertilised eggs of *Heliocidaris tuberculata* was undertaken in accordance with ESA Standard Operating Procedure 105, which is based on methods described by ASTM (1995) and APHA (1998), and adapted for use with *H. tuberculata* by Simon and Laginestra (1997) and Doyle *et al*. (2002). Tests were performed in a constant temperature chamber of 20±1°C with a 16:8h light: dark photoperiod for the entire 72-hr exposure. Clean seawater was collected from the Sydney region and filtered to 0.45μm on return to the laboratory. Sea urchins used for the tests were obtained by field collection from South Maroubra, NSW and spawned within 6-hr of collection.

The definitive test reported here was initiated on 10 September 2015. The tests were undertaken in 9mL borosilicate glass tissue culture tubes, with four replicate tubes per treatment. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Dissolved oxygen was measured using a WTW Oxi 330 Oximeter, with a WTW CellOx 325 probe. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4°C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier.

Fertilised eggs were exposed to each of the test treatments for 72 hours, after which the test was terminated by the addition of buffered formalin. One milliliter of test solution was drawn directly from the bottom of each test vessel and placed in a Sedgwick-Rafter counting chamber. The first 100 larvae were examined and the number of normally developed larvae was recorded. Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in reductions in normal development to 10% and 50% of the test population (72-hr EL and EC values) was determined by either Maximum Liklihood Probit or Trimmed Spearman Karber or Probit Method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

Table 4.1. Summary of test conditions for the sea urchin larval development test

Test species	Sea urchin *Heliocidaris tuberculata*
Test type	Static, non-renewal
Test duration	72-hour
Test end-point	Normal pluteus larvae
Test temperature	20±1°C
Test salinity	35±1‰
Test chamber size / volume	5mL in 9 mL tissue culture tube
Source of test organisms	Field collection, Sydney coastal region
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Test acceptability criteria	≥70% normal larvae in controls, reference toxicant results within prescribed range

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a separate positive control test was conducted using copper. The test was performed in the same manner as the test with the WAF. The results of the reference toxicant test were compared with the results from previous testing using a control chart.

4.2 Results

The results for the WAF of the Barossa Field Condensate using the sea urchin larval development test are summarised in **Table 4.2** below. The mean and standard deviation of the responses of test organisms to each test treatment are given in the summary reports given in **Appendix D**. The statistical output from the Toxcalc statistical analyses are given in **Appendix L**.

Table 4.2. The 72-hr EL/EC10 and EL/EC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the sea urchin larval development test.

Sample	72-hr EL/EC10	72-hr EL/EC50	NOEL/ NOEC	LOEL/ LOEC
Barossa field condensate – Loading rate (g/L)	21.0 (18.90-22.76)	26.5 (24.67-28.01)	19.3	38.6
Barossa field condensate – TRH concentration (µg/L)	15481.6 (13727.10-16947.80)	20104.4 (18575.70-21450.10)	14060	30860

Based on the loading rate, the WAF of the Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 21.0 (18.90-2276), 26.5 (24.67-28.01), 19.3 and 38.6g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 15481.6 (13727.10-16947.80), 20104.4 (18575.70-21450.10), 14060 and 30860µg/L, respectively.

The WAF control was not toxic to sea urchin larvae.

4.3 Quality Assurance

The sea urchin larval development test undertaken with the prepared WAF met all quality assurance criteria. The mean percentage of normal pluteus larvae in the laboratory control in the test was 80.8%, exceeding the minimum control criteria of 70%. Water quality parameters were also within test acceptability ranges.

The 72-hr EC50 estimate for the copper reference toxicant tests run concurrently with the WAF sample fell within the reference toxicant cusum chart control limits (**Table 4.3**). This indicated that the toxicity test was within the expected range with respect to performance and sensitivity.

Table 4.3 The Quality Assurance limits for the sea urchin larval development test.

QA Measure	Criterion	This Test
Control % normally developed	$\geq$ 70%	80.8%
Reference toxicant EC50	10.5-23.1µg Cu/L	12.2µg Cu/L

5. 48-hr Oyster Larval Development Test

5.1 Summary of Test Methodology

The 48-hr larval development toxicity test using the larvae of the milky oyster *Saccostrea echinata* was undertaken in accordance with ESA Standard Operating Procedure 106, which is based on methods described by USEPA (1996) and APHA (1998), with *S. glomerata* by Krassoi (1995). Tests were performed in a constant temperature chamber of 29±1°C with a 16:8h light: dark photoperiod for the entire 48-hr exposure. Clean seawater was collected from the Sydney region and filtered to 0.45μm on return to the laboratory. Oysters used for the tests were obtained from a rocky shore oyster lease in Mackay, QLD.

The definitive test reported here was initiated on 10 September 2015. The tests were undertaken in 9mL borosilicate glass tissue culture vials, with four replicate vials per treatment. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF.

Oysters were spawned by gonad stripping. Viable gametes were selected on the basis of fertilisation success trials and visual examination of gamete maturity. The eggs were fertilised by adding spermatozoa to the egg suspension.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Dissolved oxygen was measured using a WTW Oxi 330 Oximeter, with a WTW CellOx 325 probe. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4°C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier.

Fertilised eggs were exposed to each test treatment for 48 hours after which a formalin solution was added to each vessel. One mL of test solution was drawn directly from the bottom of each test vessel and placed in a Sedgwick-Rafter counting chamber. The first 100 oyster larvae were examined and the number of normal and abnormal D-veliger larvae was recorded. Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in reductions in normal development to 10% and 50% of the test population (48-hr EL and EC values) was determined by either Maximum Liklihood Probit or Trimmed Spearman Karber or Probit Method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

Table 5.1. Summary of test conditions for the milky oyster larval development test

Test species	Milky oyster *Saccostrea echinata*
Test type	Static, non-renewal
Test duration	48 hours
Test end-point	Larval development to D-veliger stage
Test temperature	29±1°C
Test salinity	35±1‰
Test chamber size / volume	5mL in 9 mL tissue culture tube
Source of test organisms	Oyster farms, Mackay QLD
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Test acceptability criteria	>70% normally developed larvae in controls, reference toxicant results within prescribed range

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a separate positive control test was conducted, using copper. The test was performed in the same manner as for the test with the WAF. The results of this test were compared with the results from previous testing using a control chart.

5.2 Results

The results for the WAF of the Barossa Field Condensate using the milky oyster larval development test are summarised in **Table 5.2** below. The mean and standard deviation of the responses of test organisms to each test treatment are given in the summary reports given in **Appendix E**. The statistical output from the Toxcalc statistical analyses are given in **Appendix M**.

Table 5.2. The 48-hr EL/EC10 and EL/EC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the sea urchin larval development test.

Sample	48-hr EL/EC10	48-hr EL/EC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	15.7 (11.78-18.35)	24.7 (24.11-25.32)	9.7	19.3
Barossa Field Condensate – TRH concentration (µg/L)	11478.4 (9026.54-13230.50)	18747.2 (18266.80-19240.30)	7160	14060

Based on the loading rate, the WAF of the Barossa Field Condensate sample had an EL10, EL50, NOEL and LOEL 15.7 (11.78-18.35), 24.7 (24.11-25.32), 9.7 and 19.3g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 11478.4 (9026.54-13230.50), 18747.2 (18266.80-19240.30), 7160 and 14060µg/L, respectively.

The WAF control was not toxic to the oyster larvae.

5.3 Quality Assurance

The milky oyster larval development toxicity test met all quality assurance criteria. The mean percentage of normally developed D-veliger larvae in the filtered seawater controls in the test was 74.5%, which exceeded the minimum control criteria of 70%. Water quality parameters for control samples were also within test acceptability ranges.

The 48-hr EC50 estimates for the copper reference toxicant tests run concurrently with the prepared WAF fell within the reference toxicant cusum chart control limits (**Table 5.3**). This indicated that the toxicity tests were within the expected range with respect to performance and sensitivity.

Table 5.3. Quality Assurance limits for the 48-hr milky oyster larval development test.

QA Measure	Criterion	This Test
Control % normally developed	$\geq$ 70%	74.5%
Reference toxicant EC50	10.2-20.0µg Cu/L	14.5µg Cu/L

6. 72-hr Micro-Algal Growth Inhibition Test

6.1 Summary of Test Methodology

The 72-hr micro-algal growth inhibition (cell yield) test using Isochrysis *aff. galbana* was undertaken in accordance with ESA Standard Operating Procedure 110 which is based on methods described by Stauber *et al*. (1994). Tests were performed in a constant temperature of 29±1°C. Clean seawater was collected from the Sydney region and filtered to 0.45μm on return to the laboratory. *Isochrysis* used for the tests were obtained from the CSIRO Marine Algal Supply Service, Hobart and cultured in the ESA laboratory using Guillards F/2 culture media.

The definitive test reported here was initiated on 11 September 2015. Guillards F/2 nutrient stock solutions were added to each of the WAF treatments and control treatment at a quarter of the usual concentration added to algal culture media so as to provide the minimum nutrients required for micro-algal growth. The tests were undertaken in 20mL borosilicate glass scintillation vials containing 10mL of test solution, with four replicate vials per treatment. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF.

Micro-algae used to inoculate the test vessels were first concentrated from cultures in log-growth phase by centrifugation, and then re-suspended using dilution water. This process was repeated a second time to remove all traces of original culture medium. The density of the micro-algae was determined using a haemocytometer, and test vessels were inoculated with the micro-algae such that the final concentration at t=0 was 10,000 cells/ml. The test vessels were incubated for 72-hr in a constant temperature cabinet equipped with cool-white fluorescent tubes to provide 4440-8880 Lux lighting on a 12:12 light:dark cycle.

The pH and salinity of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4°C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier

At the end of the incubation period, algal density for each replicate vial was determined by measuring absorbance at 750nm using a spectrophotometer. The algal counts were recorded as the number of cells per mL based on a standard curve of cell density against absorbance at 750nm. Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in inhibition of growth to 10% and 50% of the test population (72-hr IL and IC values) was determined by the Non-Linear Interpolation Method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

Table 6.1 Summary of test conditions for the micro-algal growth inhibition test

Test species	*Isochrysis aff. galbana* (Tahitian isolate)
Test type	Static, non-renewal
Test duration	72-hour
Test end-point	Cell yield (density)
Test temperature	29 ± 1°C
Test salinity	35 ± 1‰
Test chamber size / volume	10mL in 20mL scintillation vials
Source of test organisms	Laboratory culture
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Test acceptability criteria	>160,000 cells/mL in controls, reference toxicant results within prescribed range, CV <20% for control replicates

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a positive (toxic) control test was conducted using copper. The test was performed in the same manner as the WAF test. The results of this test were compared with the results from previous testing using a control chart.

6.2 Results

The results for the WAF of the Barossa Field condensate using the micro-algal growth inhibition assay are summarised in **Table 6.2** below. The mean and standard deviation of the responses of test organisms to each test treatment are given in the summary reports given in **Appendix F**. The statistical output from the Toxcalc statistical analyses are given in **Appendix N.**

Table 6.2. The 72-hr IL/IC10 and IL/IC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the micro-algal growth inhibition test.

Sample	72-hr IL/IC10	72-hr IL/IC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	6.4 (2.18-10.68)	12.6 (7.45-15.09)	9.7	19.3
Barossa Field Condensate – TRH concentration (µg/L)	4355.2 (1641.13-7401.38)	8529.3 (5094.77-10126.00)	6670	12850

Based on the loading rate, the WAF of the Barossa Field Condensate had an IL10, IL50, NOEL and LOEL of 6.4 (2.18-10.68), 12.6 (7.45-15.09), 9.7 and 19.3g/L,

respectively. Expressed as TRH concentration, the corresponding IC10, IC50, NOEC and LOEC were 4355.2 (1641.13-7401.38), 8529.3 (5094.77-10126.00), 6670 and 12850µg/L, respectively.

The WAF control was not toxic to the micro-alga.

6.3 Quality Assurance

The microalgal growth inhibition test undertaken with the prepared WAF met all quality assurance criteria for the test. The mean cell density per 1mL in the filtered seawater control treatment in the test was 212 000, exceeding the minimum control criteria of 160,000 cells/mL. The coefficient of variation was 16.0% and below the criteria of ≤20%. Water quality parameters for control samples were also within test acceptability ranges.

The 72-hr IC50 estimate for the copper reference toxicant test run concurrently with the WAF test fell within the reference toxicant cusum chart control limits (**Table 6.3**). This indicated that the toxicity test was within the expected range with respect to performance and sensitivity.

Table 6.3 The Quality Assurance limits for the marine microalga *I.galbana* growth inhibition test.

QA Measure	Criterion	This Test
Control density x 10^4 cells/mL	16.0	21.2
Control coefficient of variation	<20%	16.0%
Reference toxicant Cusum limits	15.1-46.7µg Cu/L	19.0µg Cu/L

7. 14-d Macro-Alagl Growth Toxicity Test

7.1 Summary of Test Methodology

The 14-day growth toxicity test using the zoospores of the brown kelp *Ecklonia radiata* was undertaken in accordance with ESA Standard Operating Procedure 116, which is based on methods described by Bidwell *et al*. (1998) and Burridge *et al*. (1999). The test was extended to 14 days to encompass the growth endpoint. Tests were performed in a constant temperature chamber of 18±1°C with ambient laboratory lumination for the entire 14-d exposure. Clean seawater was collected from the Sydney region and filtered to 0.45μm on return to the laboratory.

The definitive test reported here was initiated on 10 September 2015. The test was undertaken in 9mL borosilicate glass tissue culture petri dishes, with four replicate vials per treatment. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF.

Kelp used for the test was obtained from Mercury Passage, Tasmania and shipped via overnight freight to the ESA laboratory. The kelp was induced to spawn using temperature shock. A concentrated suspension of motile zoospores a density of 20,000 – 75,000 zoospores/mL was prepared in FSW, using a haemocytometer. The zoospore suspension was added to the test vessels and allowed to settle on to cover slips placed on the bottom of the test vessels for 1 hour, before the excess FSW was pipetted from the dishes, and the WAF sample and controls pipetted in. After the sample had been added to the test vessels, the petri dishes were arranged randomly in a temperature controlled chamber for the duration of the test.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Dissolved oxygen was measured using a WTW Oxi 330 Oximeter, with a WTW CellOx 325 probe. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4°C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier.

After 14 days exposure, each cover slip containing the settled zoospores was drawn directly from the bottom of each petri dish and placed on a clean microscope slide. The first 10 individuals were examined under 400x magnification and photographed. The length of the gametophyte was recorded. The average length of the 10 gaemetophyte were calculated for each replicate. Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in reductions in growth to 10% and 50% of the test population (14-d IL and IC values) was determined by the Non-Linear Interpolation Method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

Table 7.1. Summary of test conditions for the macro-algal growth germination test

Test species	Brown kelp *Ecklonia Radiata*
Test type	Static, non-renewal
Test duration	14 days
Test end-point	Growth of gametophyte
Test temperature	18 ± 1ºC
Test salinity	35±1‰.
Test chamber size / volume	5mL in 9 mL petri dish
Source of test organisms	Mercury Passage, Tasmania
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Test acceptability criteria	>70% of zoospores germinated in controls after 72 hours, reference toxicant results within prescribed range

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a separate positive (toxic) control test was conducted, using copper. The test was performed in the same manner as for the test with the WAF. The results of this test were compared with the results from previous testing using a control chart.

7.2 Results

The results for the WAF of the Barossa Field Condensate using the macro-algal growth test are summarised in **Table 7.2** below. The mean and standard deviation of the responses of test organisms to each test treatment are given in the summary reports given in **Appendix G**. The statistical output from the Toxcalc statistical analyses are given in **Appendix O**.

Table 7.2. The 14-d IL/IC10 and IL/IC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the macro-algal growth test.

Sample	14-d IL/IC10	14-d IL/IC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	2.7*	64.8*	2.4	4.8
Barossa Field Condensate – TRH concentration (µg/L)	1873.9*	57196.9*	1673	3180

*95% confidence limits are not reliable

Based on the loading rate, the WAF of the Barossa Field Condensate had an IL10, IL50, NOEL and LOEL of 2.7, 64.8, 2.4 and 4.8g/L, respectively. Expressed as TRH

concentration, the corresponding IC10, IC50, NOEC and LOEC were 1873.9, 57196.9, 1673 and 3180µg/L, respectively.

The WAF control was not toxic to the zoospores.

7.3 Quality Assurance

The macro-algal growth toxicity test met all quality assurance criteria. The mean percentage of germinated zoospores after 72 hours in the filtered seawater controls was 90.3%, which exceeded the minimum control criteria of 70.0%. Water quality parameters for the control sample were also within test acceptability ranges.

The 72-hr EC50 estimate for the copper reference toxicant test run concurrently with the WAF sample fell within the reference toxicant cusum chart control limits (**Table 7.3**). This indicated that the toxicity test was within the expected range with respect to performance and sensitivity.

Table 7.3. Quality Assurance limits for the 72-hr macro-algal germination test.

QA Measure	Criterion	This Test
Control % spore germination	$\geq$ 70%	90.3%
Reference toxicant EC50	86.0-1262.1µg Cu/L	408.5µg Cu/L

8. 8-day Sea Anemone Toxicity Test

8.1 Summary of Test Methodology

The 8-day toxicity test using the sea anemone *Aiptasia pulchella* was undertaken in accordance with ESA Standard Operating Procedure 128, which is based on general methods described by the Howe *et al.* (2014). Tests were performed in a constant temperature chamber at m25±1°C with a 16:8h light: dark photoperiod for the entire 96-hr exposure. Clean seawater was collected from the Sydney region and filtered to 0.45μm on return to the laboratory. Pedal lacerates were sourced from in-house laboratory cultures.

The definitive tests reported here were initiated on 27 October 2015. The tests were undertaken in 100 mL borosilicate glass beakers containing 80mL of test solution. WAFs were prepared for the condensate sample and tested using 3 replicate beakers. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Dissolved oxygen was measured using a WTW Oxi 330 Oximeter, with a WTW CellOx 325 probe. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4°C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier.

A. pulchella pedal lacerates were isolated from in-house laboratory cultures at random and 5 lacerates were placed into each test vessel containing FSW using a Pasteur pipette. Lacerates were allowed to acclimate and re-attach to the test vessel before test solutions were placed in each beaker. The beakers were covered with cling-wrap film to minimise evaporation of test solutions. The sea anemones were observed at on three occasions during the test period and the number of surviving sea anemones were recorded.

After 8 days, the number of surviving and normally developed juvenile sea anemones and physico-chemical parameters recorded. Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in reductions in normal development to 10% and 50% of the test population (48-hr EL and EC values) was determined by either Maximum Liklihood Probit or Trimmed Spearman Karber or Probit Method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

Table 8.1. Summary of test conditions for the 8-d sea anemone toxicity test

Test species	Sea anemone *Aptasia pulchella*
Test type	Static, non-renewal
Test duration	8 days
Test end-point	Normally developed juveniles
Test temperature	25±1ºC
Test salinity	35±1‰
Test chamber size / volume	80mL in 100mL borosilicate glass beakers
Source of test organisms	In-house laboratory culture
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Test acceptability criteria	>90% developed in controls, reference toxicant results within prescribed range

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a separate positive control test was conducted using copper. The test was performed in the same manner as for the test conducted with the WAF sample. The results of this test were compared with the results from previous testing using a control chart.

8.2 Results

The results for the WAF of the Barossa Field Condensate using the sea anemone development toxicity tests are summarised in **Table 8.2** below. The mean and standard deviation of the responses of test organisms to the test treatment are given in the summary reports given in **Appendix H**. The statistical output from the Toxcalc statistical analyses are given in **Appendix P**.

Table 8.2. The 8-d EL/EC10 and EL/EC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the sea anemone *A. pulchella* toxicity test.

Sample	8-d EL/EC10	8-d EL/EC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	11.2*	40.1 (31.78-50.60)	38.6	77.2
Barossa Field Condensate – TRH concentration (µg/L)	8862.4*	30720.0 (23961.00-39385.50)	28040	63990

*95% confidence limits are not reliable

Based on the loading rate, the WAF of the Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 11.2, 40.1 (31.78-50.60), 38.6 and 77.2g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 8862.4, 30720.0 (23961.00-39385.50), 28040, 63990µg/L, respectively.

The WAF control was not toxic to the sea anemone.

8.3 Quality Assurance

The 8-d sea anemone development test undertaken with the WAF sample met all quality assurance criteria. The mean percentage normally developed in the laboratory controls in the test was 100%, meeting the minimum control normally developed criteria of ≥90%. Water quality parameters for control samples were also within test acceptability ranges (**Table 8.3**).

Table 8.3. Quality Assurance limits for the 8-d sea anemone *A. pulchella* test.

QA Measure	Criterion	This Test
Control % normally developed	≥ 90%	100%
Reference toxicant Cusum limits	n/a*	11.5µg Cu/L

* Reference toxicant cusum chart limits are not available due to limited testing

9. 5-d Juvenile Copepodid Development Test

9.1 Summary of Test Methodology

The 5-day chronic toxicity test using the juvenile tropical copepod *Parvocalanus crassiostris* was undertaken in accordance with ESA Standard Operating Procedure 124, which is based on general methods described by the USEPA (2002) for marine crustaceans, and also following the methods described for the Australian copepod *Acartia sinjiensis* (Rose *et al.*, 2006) . Tests were performed in a constant temperature chamber of 28±1°C with a 16:8h light: dark photoperiod for the entire 5-d exposure. Clean seawater was collected from the Sydney region and filtered to 0.45µm on return to the laboratory. Freshly fertilised eggs used for testing were obtained from in-house laboratory cultures, originally sourced from the Queensland Department of Primary Industries Northern Fisheries Centre, Cairns QLD.

The definitive test reported here was initiated on 22 September 2015. The test was undertaken in 24-well polycarbonate tissue culture plates, where each well contained 4mL of test solution. WAFs were prepared for the condensate sample and tested using 4 replicate wells per concentration. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Dissolved oxygen was measured using a WTW Oxi 330 Oximeter, with a WTW CellOx 325 probe. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4°C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier.

Freshly fertilised copepod eggs were isolated from 30L laboratory mass cultures. Eggs were triple rinsed in FSW to remove debris and ciliates from the water and eggs. Five eggs were transferred to each tissue culture well using a Pasteur pipette and a dissecting microscope. Once seeded, the tissue culture plates were transferred to the constant temperature chamber.

After five days exposure, the number of non-immobilised normally developed copepodids in each test well was counted under a dissecting microscope. Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in reductions in normal development to 10% and 50% of the test population (48-hr EL and EC values) was determined by either Maximum Liklihood Probit or Trimmed Spearman Karber or Probit Method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

Table 9.1. Summary of test conditions for the 5-d copepodid development toxicity test

Test species	Calanoid copepod *Parvocalanus crassiostris*
Test type	Static, non-renewal
Test duration	5 day
Test end-point	Normally developed coepodids
Test temperature	28±1°C
Test salinity	35±1‰
Test chamber size / volume	4mL well in 24-well tissue culture plates
Feeding	Isochrysis @ 16,000 cells/ copepod daily
Source of test organisms	In-house laboratory culture
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Test acceptability criteria	>70% non-immobilised copepodids in controls, reference toxicant results within prescribed range where range determined

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a separate positive control test was conducted using copper. The test was performed in the same manner as for the test conducted with the WAF sample. The results of this test were compared with the results from previous testing using a control chart.

9.2 Results

The results for the WAF of the Barossa Field Condensate using the sea anemone development toxicity tests are summarised in **Table 9.2** below. The mean and standard deviation of the responses of test organisms to the test treatment are given in the summary reports given in **Appendix I**. The statistical output from the Toxcalc statistical analyses are given in **Appendix Q**.

Table 9.2. The 5-d EL/EC10 and EL/EC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the copepod *P. crassirostris* toxicity test.

Sample	5-d EL/EC10	5-d EL/EC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	1.0*^	12.2 (10.84-13.73)	9.7	19.3
Barossa Field Condensate – TRH concentration (µg/L)	27.2*^	10506.8 (9451.82-11679.80)	8560	15830

*95% confidence limits are not reliable
^calculated from extrapolated data

Based on the loading rate, the WAF of the Barossa Field condensate had an EL10, EL50, NOEL and LOEL of 1.0, 12.2 (10.84-13.73), 9.7 and 19.3g/L, respectively. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 27.2, 10506.9 (9451.82-11679.80), 8560 and 15830µg/L, respectively.

The WAF control was not toxic to the copepod.

9.3 Quality Assurance

The 5-d copepodid development test undertaken with the WAF samples met all quality assurance criteria. The mean percentage non-immobilised normally developed copepodids in the laboratory controls was 70%, meeting the minimum control criteria of ≥70%. Water quality parameters for the control were also within test acceptability ranges (**Table 9.3**).

Table 10.4. Quality Assurance limits for the 5-d tropical copepod test.

QA Measure	Criterion	This Test
Control % normal	≥ 70%	70.0%
Reference toxicant Cusum limits	n/a*	2.8µg Cu/L

* Reference toxicant cusum chart limits are not available due to limited testing

10. 7-day Fish Imbalance and Growth Test

10.1 Summary of Test Methodology

The 7-day toxicity test using juveniles of the barramundi *Lates calcarifer* was undertaken in accordance with ESA Standard Operating Procedure 122, which is based on methods described by USEPA (2002b). Research with invertebrates in the state of New South Wales is subject to the Animal Research Act, and the toxicity test with juvenile fish was performed by ESA under the Animal Research Authority issued to ESA by the Director-General of NSW Department of Primary Industries (valid from 28 July 2014 to 28 July 2017) and Certificate of Approval from the Animal Care and Ethics Committee of the Director-General of the NSW Department of Primary Industries (valid from 16 May 2014 and 16 May 2017).

The definitive test reported here was initiated on 22 September 2015. Juvenile fish of approximately 10-30 mm in length used for the tests were obtained from a commercial hatchery in South Australia. The juvenile fish were shipped same-day express in a foam box and fish were contained within an air inflated bag containing approximately 4 litres of seawater. Upon arrival at ESA, the fish were transferred to test room of 25^{o}C and provided gentle aeration using a Schego air pump. Clean seawater for holding the fish was collected from the Sydney region and filtered to 0.45μm on return to the laboratory. The seawater was acclimated to 25^{o}C prior to use.

Toxicity tests were undertaken in 600mL glass beakers containing 500mL of test solution, with 4 replicates per treatment. A filtered seawater (FSW) control and a Water Accommodated Fraction (WAF) control were tested concurrently with the prepared WAF of the fresh and weathered condensate.

The pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured. Salinity was measured using a WTW Cond330 salinity/conductivity meter with a WTW Tetracon 325 probe. The pH was measured using a WTW pH330 meter with a WTW SenTix 41 electrode. Dissolved oxygen was measured using a WTW Oxi 330 Oximeter, with a WTW CellOx 325 probe. Sub-samples for TRH (Total Recoverable Hydrocarbons, C6-C36), PAHs (Polycyclic aromatic hydrocarbons) and BTEX (benzene, toluene, ethylbenzene, and xylenes) were collected for each WAF dilution and controls and stored at 4^{o}C in the dark until it was determined that the corresponding toxicity tests met QA criteria, upon which samples were forwarded to Envirolab Services Pty Ltd by same-day express courier.

Five juvenile fish were randomly selected and introduced into each of the test beakers. The beakers were covered with cling-wrap film to minimise evaporation and placed in a constant temperature room of 25$\pm$1^{o}C. The test vessels were monitored daily to examine fish for signs of distress or imbalance. Juvenile fish demonstrating such signs were to be removed and euthanased in accordance with ESA SOP 122. Test vessels were also routinely checked to ensure aeration was being provided.

The beakers were examined every 24 hours and the number of surviving and apparently healthy juvenile fish recorded. The test was terminated after 7 days, and the temperature, pH, salinity and dissolved oxygen concentration of a representative sample from each concentration/treatment was measured, as detailed above. At the termination of the test, the juvenile fish were euthanased by the addition of AQUI-S solution. The euthanized fish were then dried at 60ºC for 24 hours and then weighed.

Toxicity test end-points were determined using loading rates and TRH concentrations. The loading rate and TRH concentration of WAF resulting in reductions in unaffected fish and biomass to 10% and 50% of the test population (7-d EL and EC values) was determined by either Maximum Liklihood Probit, Trimmed Spearman Karber or Non-Linear Interpolation method using Toxcalc v5.0 software. The loading rate and TRH concentration causing no significant toxicity (No Observed Effect Loading Rate/Concentration – NOEL/NOEC), and the lowest loading rate causing significant toxicity (Lowest Observed Effect Loading Rate/Concentration – LOEL/LOEC) were determined by performing a Dunnett's or non-parametric test, depending on the data being normally distributed and homoscedastic.

Table 10.1 Summary of test conditions for the 7-day fish imbalance and growth test using *Lates calcarifer*

Test species	Barramundi *Lates calcarifer*
Test type	Static, non-renewal
Test duration	7 day
Test end-point	Imbalance, including survival, and biomass.
Test temperature	25 ± 1ºC
Test salinity	35 ± 2‰
Test chamber size / volume	500 mL in 600mL borosilicate glass beakers
Test Feeding	800 brine shrimp per fish, daily
Test concentrations	WAF dilutions of 100, 50, 25, 12.5 and 6.3% or lower
Source of test organisms	Hatchery reared, SA
Test acceptability criteria	≥80% survival in controls

To test the relative sensitivity of the test organisms and the proficiency of the Laboratory Technician, a separate positive control test was conducted using ammonium. The test was performed in the same manner as for the test conducted with the WAF sample. The results of this test were compared with the results from previous testing using a control chart.

10.2 Results

The results for the WAF of the fresh and weathered Barossa Field Condensate using the fish imbalance test are summarised in **Tables 10.2 and 10.3** below. The mean and standard deviation of the responses of test organisms to each test treatment are given in the summary reports given in **Appendix J**. The statistical output from the Toxcalc statistical analyses are given in **Appendix R**.

Table 10.2. The 7-d EL/EC10 and EL/EC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the Barramundi fish imbalance and growth test - Imbalance.

Sample	7-d EL/EC10	7-d EL/EC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	19.4 (13.58-23.28)	29.3 (24.71-34.66)	19.3	38.6
Barossa Field Condensate – TRH concentration (µg/L)	15875.5 (11275.40-18756.60)	23182.2 (19851.60-27226.80)	15830	29770
Weathered Barossa Field Condensate – Loading rate (g/L)	69.1*	>79.5	79.5	>79.5
Weathered Barossa Field Condensate – TRH concentration (µg/L)	19596.3*	>22480.0	22480	>22480

*95% confidence limits are not reliable/available

Table 10.3. The 7-d IL/IC10 and EL/EC50 (with 95% confidence limits), NOEL/NOEC and LOEL/NOEC (based on loading rates and TRH concentrations) for Water Accommodated Fractions (WAFs) of the Barossa Field Condensate sample using the Barramundi fish imbalance and growth test - Biomass.

Sample	7-d IL/IC10	7-d IL/IC50	NOEL/ NOEC	LOEL/ LOEC
Barossa Field Condensate – Loading rate (g/L)	20.9 (8.44-22.09)	30.6 (27.79-31.44)	19.3	38.6
Barossa Field Condensate – TRH concentration (µg/L)	17016.3 (7373.18-18757.60)	24006.3 (21800.80-24621.00)	15830	29770
Weathered Barossa Field Condensate – Loading rate (g/L)	48.6*	>79.5	79.5	>79.5
Weathered Barossa Field Condensate – TRH concentration (µg/L)	13908.1*	>22480	22480	>22480

*95% confidence limits are not reliable/available

Based on the loading rate, the WAF of the fresh Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 19.4 (13.58-23.28), 29.3 (24.71-34.66), 19.3 and 38.6g/L, respectively, for the imbalance endpoint. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 15875.5 (11275.40-18756.60). 23182.2 (19851.60-27226.80), 15830 and 29770µg/L, respectively. The EL10, EL50, NOEL and LOEL for the biomass endpoint were 20.9 (8.44-22.09), 30.6 (27.79-31.44), 19.3 and 38.6g/L, respectively expressed as loading rate, and 17016.3 (737.18-18757.60), 24006.3 (21800.80-24621.00), 15830 and 29770µg/L, respectively, expressed as TRH concentration.

Based on the loading rate, the WAF of the Weathered Barossa Field Condensate had an EL10, EL50, NOEL and LOEL of 69.1, >79.5, 79.5 and >79.5g/L, respectively, for the imbalance endpoint. Expressed as TRH concentration, the corresponding EC10, EC50, NOEC and LOEC were 19596.3, >22480.0, 22480 and >22480µg/L, respectively. The EL10, EL50, NOEL and LOEL for the biomass endpoint were 48.6, >79.5, 79.5 and >79.5g/L, respectively expressed as loading rate, and 13908.1, >22480.0, 22480 and >22480µg/L, respectively, expressed as TRH concentration.

The WAF control was not toxic to the juvenile fish.

10.3 Quality Assurance

The 7-d juvenile fish imbalance and growth test undertaken with the prepared WAFs met all quality assurance criteria. The percentage survival in the controls was 100%, which met the minimum control survival criteria of ≥80%. Water quality parameters for control samples were also within test acceptability ranges (**Table 8.4**).

Table 8.4. Quality Assurance limits for the 7-d barramundi fish imbalance and growth test (1 August 2014).

QA Measure	Criterion	This Test
Control % unaffected	≥ 80%	100%
Control mean growth	≥20% of initial weight	52.6%
Reference toxicant within cusum chart limits	n/a	17.3 mg NH_4^+/L

11. References

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Rose A, Carruthers A-M, Stauber J, Lim R and Blockwell S. (2006). Development of an acute toxicity test with the marine copepod *Acartia sinjiensis*. *Australasian Journal of Ecotoxicology*, 12: 73-81.

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Appendix A: Chain of Custody

Datasheet ID: 601.2
Last Revised: 30 April 2009

Sample Receipt Notification

Attention : Celeste Wilson

Client : Jacobs Group (Australia) Pty Ltd
11th Floor, Durack Centre
263 Adelaide Terrace

Email : CXXWilson@skm.com.au
Telephone : 08 9469 4438
Facsimile : 08 9469 4488

Date : 27/08/2015

Re : Receipt of Samples **Pages : 2**

ESA Project : PR1244 ☑ For Review ☐ Additional Documentation Required - Please Respond

Sample Delivery Details

Completed Chain of Custody accompanied samples: **YES**
Samples received in apparent good condition and correctly bottled: **YES**
Security seals on sample bottles and esky intact: **YES**

Date samples received : 27/08/2015
Time samples received : 13:00
No. of samples received : 1
Sample matrix : Other
Sample temperature : room temperature

Comments : Includes 2x20L Barossa Field Condensate (ESA ID# 7323)

Contact Details

Customer Services Officer : Tina Micevska
Telephone : 61 2 9420 9481
Facsimile : 61 2 9420 9484
Email : tmicevska@ecotox.com.au

Please contact customer services officer for all queries or issues regarding samples

Note that the chain-of-custody provides definitive information on the tests to be performed

Ecotox Services Australia
ABN 45 094 714 904
Unit 27, 2 Chaplin Drive
Lane Cove NSW 2066 Australia

Phone : 61 2 9420 9481
Fax : 61 2 9420 9484
Email : info@ecotox.com.au

Core Laboratories Australia Pty Ltd
Reservoir Fluids Laboratory
24 Hour Service

447-449 Belmont Avenue
Kewdale, W.A. 6105
Phone: (61 8) 9353 3944
Fax: (61 8) 9353 1369

Subout and Chain of Custody Record

SCCR Number: 701

Client Information: Conoco Phillips
Highway 60 & 123 (661 S Highway 123),
Bartlesville, OK, United States - 74004.

Subout Authorized By: Brenton Chatfield
Phone Number: 08 6363 2666
Client Accounting Code:

Consignee Information: Ecotox Service Australia Pty Ltd
27/2 Chaplin Drive,
Lane Cove, NSW, Australia - 2066.

Contact: Tina Micevska
Phone Number: 02 9420 9481

Job No.	Sub	Sample Date	Sample Type	Sample Container Size	Cyl No	Pressure (psig)	Temp (°F)	Sample Volume (cc)	Sample Depth (Ft.)	Sand Name	Notes
2015003-29		27/12/2014	Condensate	Can 20L				18000			Surge Tank
2015003-30		27/12/2014	Condensate	Can 20L		0	0	18000			Surge Tank

Notes:
2x 20L cans of Dead Condensate

Client: Conoco Phillips
Well: Barossa-3
Job No: 2015003

Prepared By: Kate Hughes
Billing Code:
Third Party Shipper: Enlog-RGM #AU20124283
Packaging/Handling: GO-15-429

Relinquished By: Kate Hughes
Date: 20-Aug-2015 11:20 AM
Received By: Tina @ ESA
Received Date: 27/8/15 @ 1300

7323

Appendix B: Test Report for TRH Analyses

Summary of Analytical Results for Total Recoverable Hydrocarbons (TRH's)

Barossa- Fresh

Tests	Sea urchin fert Sea urchin larval Milky oyster Ecklonia	Isochrysis	7-d Barramundi Copepod	Sea Anemone
Test Date	10/09/2015	11/09/2015	22/09/2015	27/10/2015
Envirolab Report #	134814	134814	135588	137174
Loading rate (g/L)	TRH's (C6-C36), µg/L			
0	0	0	0	0
0.6	350	-	-	-
1.2	720	650	-	-
2.4	1673	1400	-	-
4.8	3180	3248	3860	2492
9.7	7160	6670	8560	7660
19.3	14060	12850	15830	15840
38.6	30860	27960	29770	28040
77.2	69620	65830	68390	63990

Barossa- Weathered

Tests	7-d Barramundi
Test Date	22/09/2015
Envirolab Report #	135588
Loading rate (g/L)	TRH's (C6-C36), µg/L
0	0
5	1410
9.9	2770
19.9	4850
39.8	11450
79.5	22480

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 137174

Client:

Ecotox Services Australasia Pty Ltd
Unit 27, 2 Chaplin Dr
Lane Cove
NSW 2066

Attention: Tina

Sample log in details:

Your Reference:	**PR1244**		
No. of samples:	8 Waters		
Date samples received / completed instructions received	10/11/15	/	10/11/15

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	17/11/15	/	17/11/15
Date of Preliminary Report:	Not Issued		

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	137174-1	137174-2	137174-3	137174-4	137174-5
Your Reference	----------	FSW Control 27/10/15	WAF Control 27/10/15	Condensate 6.3% 27/10/15	Condensate 12.5% 27/10/15	Condensate 25% 27/10/15
Date Sampled	----------	27/10/2015	27/10/2015	27/10/2015	27/10/2015	27/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	11/11/2015	11/11/2015	11/11/2015	11/11/2015	11/11/2015
Date analysed	-	13/11/2015	13/11/2015	13/11/2015	13/11/2015	13/11/2015
$TRHC_6$ - C_9	µg/L	<10	<10	2,400	7,300	15,000
$TRHC_6$ - C_{10}	µg/L	<10	<10	2,800	7,600	16,000
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	<10	<10	190	2,300	6,000
Benzene	µg/L	<1	<1	1,300	2,600	4,800
Toluene	µg/L	<1	<1	980	2,000	4,000
Ethylbenzene	µg/L	<1	<1	23	50	93
m+p-xylene	µg/L	<2	<2	230	480	860
o-xylene	µg/L	<1	<1	76	160	290
Naphthalene	µg/L	<1	<1	12	27	79
Surrogate Dibromofluoromethane	%	120	118	113	113	101
Surrogate toluene-d8	%	94	94	98	96	99
Surrogate 4-BFB	%	89	87	88	88	102

vTRH(C6-C10)/BTEXN in Water			
Our Reference:	UNITS	137174-6	137174-7
Your Reference	----------	Condensate 50% 27/10/15	Condensate 100% 27/10/15
Date Sampled	----------	27/10/2015	27/10/2015
Type of sample		Water	Water
Date extracted	-	11/11/2015	11/11/2015
Date analysed	-	13/11/2015	13/11/2015
$TRHC_6$ - C_9	µg/L	26,000	60,000
$TRHC_6$ - C_{10}	µg/L	27,000	62,000
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	4,300	7,000
Benzene	µg/L	11,000	27,000
Toluene	µg/L	8,700	21,000
Ethylbenzene	µg/L	210	490
m+p-xylene	µg/L	2,100	5,000
o-xylene	µg/L	650	1,500
Naphthalene	µg/L	110	210
Surrogate Dibromofluoromethane	%	113	111
Surrogate toluene-d8	%	98	97
Surrogate 4-BFB	%	88	90

svTRH (C10-C40) in Water						
Our Reference:	UNITS	137174-1	137174-2	137174-3	137174-4	137174-5
Your Reference	----------	FSW Control 27/10/15	WAF Control 27/10/15	Condensate 6.3% 27/10/15	Condensate 12.5% 27/10/15	Condensate 25% 27/10/15
Date Sampled	----------	27/10/2015	27/10/2015	27/10/2015	27/10/2015	27/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	13/11/2015	13/11/2015	13/11/2015	13/11/2015	13/11/2015
Date analysed	-	15/11/2015	15/11/2015	15/11/2015	15/11/2015	15/11/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	92	190	410
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	170	320
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	110
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	74	160	330
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	62	130	250
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	100	160	360
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	87	95	89	93	98

svTRH (C10-C40) in Water			
Our Reference:	UNITS	137174-6	137174-7
Your Reference	----------	Condensate 50% 27/10/15	Condensate 100% 27/10/15
Date Sampled	----------	27/10/2015	27/10/2015
Type of sample		Water	Water
Date extracted	-	13/11/2015	13/11/2015
Date analysed	-	15/11/2015	15/11/2015
TRHC$_{10}$ - C$_{14}$	µg/L	860	1,800
TRHC$_{15}$ - C$_{28}$	µg/L	900	1,700
TRHC$_{29}$ - C$_{36}$	µg/L	280	490
TRH>C$_{10}$ - C$_{16}$	µg/L	720	1,400
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	610	1,200
TRH>C$_{16}$ - C$_{34}$	µg/L	1,000	1,900
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	140
Surrogate o-Terphenyl	%	106	96

PAHs in Water Our Reference: Your Reference	UNITS ----------	137174-1 FSW Control 27/10/15	137174-2 WAF Control 27/10/15	137174-3 Condensate 6.3% 27/10/15	137174-4 Condensate 12.5% 27/10/15	137174-5 Condensate 25% 27/10/15
Date Sampled	----------	27/10/2015	27/10/2015	27/10/2015	27/10/2015	27/10/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	13/11/2015	13/11/2015	13/11/2015	13/11/2015	13/11/2015
Date analysed	-	13/11/2015	13/11/2015	13/11/2015	13/11/2015	13/11/2015
Naphthalene	µg/L	<1	<1	11	23	50
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	<1	<1
Phenanthrene	µg/L	<1	<1	<1	<1	<1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	11	23	50
Surrogate p-Terphenyl-d14	%	84	88	87	94	89

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	137174-6 Condensate 50% 27/10/15 27/10/2015 Water	137174-7 Condensate 100% 27/10/15 27/10/2015 Water
Date extracted	-	13/11/2015	13/11/2015
Date analysed	-	13/11/2015	13/11/2015
Naphthalene	µg/L	91	250
Acenaphthylene	µg/L	<1	<1
Acenaphthene	µg/L	<1	<1
Fluorene	µg/L	2	3
Phenanthrene	µg/L	2	2
Anthracene	µg/L	<1	<1
Fluoranthene	µg/L	<1	<1
Pyrene	µg/L	<1	<1
Benzo(a)anthracene	µg/L	<1	<1
Chrysene	µg/L	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2
Benzo(a)pyrene	µg/L	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5
Total +ve PAH's	µg/L	95	260
Surrogate p-Terphenyl-d14	%	94	80

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			11/11/2015	137174-1	11/11/2015 || 11/11/2015	LCS-W3	11/11/2015
Date analysed	-			13/11/2015	137174-1	13/11/2015 || 13/11/2015	LCS-W3	13/11/2015
TRHC$_6$ - C$_9$	µg/L	10	Org-016	<10	137174-1	<10 || <10	LCS-W3	94%
TRHC$_6$ - C$_{10}$	µg/L	10	Org-016	<10	137174-1	<10 || <10	LCS-W3	94%
Benzene	µg/L	1	Org-016	<1	137174-1	<1 || <1	LCS-W3	98%
Toluene	µg/L	1	Org-016	<1	137174-1	<1 || <1	LCS-W3	99%
Ethylbenzene	µg/L	1	Org-016	<1	137174-1	<1 || <1	LCS-W3	101%
m+p-xylene	µg/L	2	Org-016	<2	137174-1	<2 || <2	LCS-W3	86%
o-xylene	µg/L	1	Org-016	<1	137174-1	<1 || <1	LCS-W3	106%
Naphthalene	µg/L	1	Org-013	<1	137174-1	<1 || <1	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	110	137174-1	120 || 127 || RPD: 6	LCS-W3	97%
Surrogate toluene-d8	%		Org-016	95	137174-1	94 || 90 || RPD: 4	LCS-W3	101%
Surrogate 4-BFB	%		Org-016	88	137174-1	89 || 80 || RPD: 11	LCS-W3	106%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			13/11/2015	[NT]	[NT]	LCS-W1	13/11/2015
Date analysed	-			13/11/2015	[NT]	[NT]	LCS-W1	13/11/2015
TRHC$_{10}$ - C$_{14}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	107%
TRHC$_{15}$ - C$_{28}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	104%
TRHC$_{29}$ - C$_{36}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	93%
TRH>C$_{10}$ - C$_{16}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W1	107%
TRH>C$_{16}$ - C$_{34}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	104%
TRH>C$_{34}$ - C$_{40}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W1	93%
Surrogate o-Terphenyl	%		Org-003	72	[NT]	[NT]	LCS-W1	125%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			13/11/2015	[NT]	[NT]	LCS-W1	13/11/2015
Date analysed	-			13/11/2015	[NT]	[NT]	LCS-W1	13/11/2015
Naphthalene	µg/L	1	Org-012	<1	[NT]	[NT]	LCS-W1	91%
Acenaphthylene	µg/L	1	Org-012	<1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	1	Org-012	<1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	1	Org-012	<1	[NT]	[NT]	LCS-W1	111%
Phenanthrene	µg/L	1	Org-012	<1	[NT]	[NT]	LCS-W1	98%
Anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	1	Org-012	<1	[NT]	[NT]	LCS-W1	101%
Pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	LCS-W1	106%
Benzo(a)anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Chrysene	µg/L	1	Org-012	<1	[NT]	[NT]	LCS-W1	111%
Benzo(b,j+k) fluoranthene	µg/L	2	Org-012	<2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	LCS-W1	97%
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012	<1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	Org-012	<1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	Org-012	<1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	83	[NT]	[NT]	LCS-W1	92%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NR: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

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Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 135588

Client:

Ecotox Services Australasia Pty Ltd
Unit 27, 2 Chaplin Dr
Lane Cove
NSW 2066

Attention: Tina

Sample log in details:

Your Reference:	**PR1244**		
No. of samples:	12 Waters		
Date samples received / completed instructions received	08/10/15	/	08/10/15

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	15/10/15	/	14/10/15
Date of Preliminary Report:	Not Issued		

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	135588-1	135588-2	135588-3	135588-4	135588-5
Your Reference	----------	FSW Control 22/09/15	WAF Control 22/09/15	Condensate 6.3% 22/09/15	Condensate 12.5% 22/09/15	Condensate 25% 22/09/15
Date Sampled	----------	22/09/2015	22/09/2015	22/09/2015	22/09/2015	22/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
$TRHC_6$ - C_9	µg/L	<10	<10	3,400	7,500	14,000
$TRHC_6$ - C_{10}	µg/L	<10	<10	3,400	7,700	14,000
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	<10	<10	480	1,800	2,700
Benzene	µg/L	<1	<1	1,400	2,800	5,500
Toluene	µg/L	<1	<1	1,100	2,300	4,400
Ethylbenzene	µg/L	<1	<1	23	51	90
m+p-xylene	µg/L	<2	<2	300	560	990
o-xylene	µg/L	<1	<1	93	180	330
Naphthalene	µg/L	<1	<1	28	63	110
Surrogate Dibromofluoromethane	%	103	103	101	99	99
Surrogate toluene-d8	%	87	87	94	97	98
Surrogate 4-BFB	%	88	87	102	102	102

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	135588-6	135588-7	135588-8	135588-9	135588-10
Your Reference	----------	Condensate 50% 22/09/15	Condensate 100% 22/09/15	Condensate weathered 6.3% 22/09/15	Condensate weathered 12.5% 22/09/15	Condensate weathered 25% 22/09/15
Date Sampled	----------	22/09/2015	22/09/2015	22/09/2015	22/09/2015	22/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	13/10/2015
$TRHC_6$ - C_9	µg/L	26,000	60,000	1,100	2,200	3,600
$TRHC_6$ - C_{10}	µg/L	26,000	60,000	1,300	2,500	4,000
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	4,000	11,000	450	850	1,000
Benzene	µg/L	11,000	26,000	35	64	140
Toluene	µg/L	8,200	19,000	450	870	1,500
Ethylbenzene	µg/L	200	290	26	47	87
m+p-xylene	µg/L	1,900	2,900	250	490	900
o-xylene	µg/L	660	960	89	180	330
Naphthalene	µg/L	220	210	48	82	140
Surrogate Dibromofluoromethane	%	98	98	99	97	96
Surrogate toluene-d8	%	100	100	101	103	107
Surrogate 4-BFB	%	102	101	109	108	108

vTRH(C6-C10)/BTEXN in Water			
Our Reference:	UNITS	135588-11	135588-12
Your Reference	----------	Condensate weathered 50% 22/09/15	Condensate weathered 100% 22/09/15
Date Sampled	----------	22/09/2015	22/09/2015
Type of sample		Water	Water
Date extracted	-	12/10/2015	12/10/2015
Date analysed	-	13/10/2015	13/10/2015
TRHC$_6$ - C$_9$	µg/L	7,900	18,000
TRHC$_6$ - C$_{10}$	µg/L	8,700	19,000
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	2,600	5,200
Benzene	µg/L	270	630
Toluene	µg/L	3,200	7,400
Ethylbenzene	µg/L	190	400
m+p-xylene	µg/L	1,800	4,000
o-xylene	µg/L	650	1,400
Naphthalene	µg/L	240	400
Surrogate Dibromofluoromethane	%	100	89
Surrogate toluene-d8	%	135	101
Surrogate 4-BFB	%	106	107

svTRH (C10-C40) in Water Our Reference: Your Reference	UNITS ----------	135588-1 FSW Control 22/09/15	135588-2 WAF Control 22/09/15	135588-3 Condensate 6.3% 22/09/15	135588-4 Condensate 12.5% 22/09/15	135588-5 Condensate 25% 22/09/15
Date Sampled	----------	22/09/2015	22/09/2015	22/09/2015	22/09/2015	22/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	12/10/2015	12/10/2015	13/10/2015	13/10/2015	13/10/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	240	460	780
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	220	600	910
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	140
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	230	480	780
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	200	420	670
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	170	540	830
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	73	87	106	120	118

svTRH (C10-C40) in Water Our Reference: Your Reference	UNITS ----------	135588-6 Condensate 50% 22/09/15	135588-7 Condensate 100% 22/09/15	135588-8 Condensate weathered 6.3% 22/09/15	135588-9 Condensate weathered 12.5% 22/09/15	135588-10 Condensate weathered 25% 22/09/15
Date Sampled	----------	22/09/2015	22/09/2015	22/09/2015	22/09/2015	22/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	13/10/2015	13/10/2015	13/10/2015	13/10/2015	13/10/2015
TRHC$_{10}$ - C$_{14}$	µg/L	1,400	3,000	160	270	490
TRHC$_{15}$ - C$_{28}$	µg/L	2,100	4,900	150	300	760
TRHC$_{29}$ - C$_{36}$	µg/L	270	490	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	1,500	3,000	120	220	400
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	1,300	2,800	76	140	260
TRH>C$_{16}$ - C$_{34}$	µg/L	1,900	4,400	150	280	750
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	170	<100	<100	<100
Surrogate o-Terphenyl	%	133	#	98	88	92

svTRH (C10-C40) in Water			
Our Reference:	UNITS	135588-11	135588-12
Your Reference	----------	Condensate weathered 50% 22/09/15	Condensate weathered 100% 22/09/15
Date Sampled	----------	22/09/2015	22/09/2015
Type of sample		Water	Water
Date extracted	-	12/10/2015	12/10/2015
Date analysed	-	13/10/2015	13/10/2015
TRHC$_{10}$ - C$_{14}$	µg/L	1,200	1,600
TRHC$_{15}$ - C$_{28}$	µg/L	2,200	2,700
TRHC$_{29}$ - C$_{36}$	µg/L	150	180
TRH>C$_{10}$ - C$_{16}$	µg/L	990	1,200
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	750	800
TRH>C$_{16}$ - C$_{34}$	µg/L	2,100	2,600
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100
Surrogate o-Terphenyl	%	#	#

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	135588-1 FSW Control 22/09/15 22/09/2015 Water	135588-2 WAF Control 22/09/15 22/09/2015 Water	135588-3 Condensate 6.3% 22/09/15 22/09/2015 Water	135588-4 Condensate 12.5% 22/09/15 22/09/2015 Water	135588-5 Condensate 25% 22/09/15 22/09/2015 Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Naphthalene	µg/L	<1	<1	18	34	65
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	1	3
Phenanthrene	µg/L	<1	<1	1	2	3
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	19	37	70
Surrogate p-Terphenyl-d14	%	82	103	96	92	90

PAHs in Water Our Reference: Your Reference	UNITS ----------	135588-6 Condensate 50% 22/09/15	135588-7 Condensate 100% 22/09/15	135588-8 Condensate weathered 6.3% 22/09/15	135588-9 Condensate weathered 12.5% 22/09/15	135588-10 Condensate weathered 25% 22/09/15
Date Sampled	----------	22/09/2015	22/09/2015	22/09/2015	22/09/2015	22/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Date analysed	-	12/10/2015	12/10/2015	12/10/2015	12/10/2015	12/10/2015
Naphthalene	µg/L	110	220	22	45	69
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	4	5	<1	<1	2
Phenanthrene	µg/L	4	5	<1	<1	1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	120	230	22	45	72
Surrogate p-Terphenyl-d14	%	92	74	93	91	83

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ---------- 	135588-11 Condensate weathered 50% 22/09/15 22/09/2015 Water	135588-12 Condensate weathered 100% 22/09/15 22/09/2015 Water
Date extracted	-	12/10/2015	12/10/2015
Date analysed	-	12/10/2015	12/10/2015
Naphthalene	µg/L	130	220
Acenaphthylene	µg/L	<1	<1
Acenaphthene	µg/L	<1	<1
Fluorene	µg/L	3	4
Phenanthrene	µg/L	2	2
Anthracene	µg/L	<1	<1
Fluoranthene	µg/L	<1	<1
Pyrene	µg/L	<1	<1
Benzo(a)anthracene	µg/L	<1	<1
Chrysene	µg/L	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2
Benzo(a)pyrene	µg/L	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5
Total +ve PAH's	µg/L	140	230
Surrogate p-Terphenyl-d14	%	77	62

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/10/2015	135588-1	12/10/2015 || 13/10/2015	LCS-W1	12/10/2015
Date analysed	-			12/10/2015	135588-1	12/10/2015 || 14/10/2015	LCS-W1	12/10/2015
TRHC$_6$ - C$_9$	µg/L	10	Org-016	<10	135588-1	<10 || <10	LCS-W1	108%
TRHC$_6$ - C$_{10}$	µg/L	10	Org-016	<10	135588-1	<10 || <10	LCS-W1	108%
Benzene	µg/L	1	Org-016	<1	135588-1	<1 || <1	LCS-W1	107%
Toluene	µg/L	1	Org-016	<1	135588-1	<1 || <1	LCS-W1	98%
Ethylbenzene	µg/L	1	Org-016	<1	135588-1	<1 || <1	LCS-W1	107%
m+p-xylene	µg/L	2	Org-016	<2	135588-1	<2 || <2	LCS-W1	113%
o-xylene	µg/L	1	Org-016	<1	135588-1	<1 || <1	LCS-W1	114%
Naphthalene	µg/L	1	Org-013	<1	135588-1	<1 || <1	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	101	135588-1	103 || 102 || RPD: 1	LCS-W1	102%
Surrogate toluene-d8	%		Org-016	88	135588-1	87 || 92 || RPD: 6	LCS-W1	90%
Surrogate 4-BFB	%		Org-016	90	135588-1	88 || 88 || RPD: 0	LCS-W1	104%

QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/10/2015	[NT]	[NT]	LCS-W3	12/10/2015
Date analysed	-			12/10/2015	[NT]	[NT]	LCS-W3	12/10/2015
TRHC$_{10}$ - C$_{14}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W3	100%
TRHC$_{15}$ - C$_{28}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W3	83%
TRHC$_{29}$ - C$_{36}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W3	83%
TRH>C$_{10}$ - C$_{16}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W3	100%
TRH>C$_{16}$ - C$_{34}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W3	83%
TRH>C$_{34}$ - C$_{40}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W3	83%
Surrogate o-Terphenyl	%		Org-003	84	[NT]	[NT]	LCS-W3	95%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			12/10/2015	[NT]	[NT]	LCS-W3	12/10/2015
Date analysed	-			12/10/2015	[NT]	[NT]	LCS-W3	12/10/2015
Naphthalene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	77%
Acenaphthylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	70%
Phenanthrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	78%

Client Reference: PR1244

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	77%
Pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	79%
Benzo(a)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	100%
Benzo(b,j+k) fluoranthene	µg/L	2	Org-012 subset	<2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W3	94%
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	95	[NT]	[NT]	LCS-W3	80%

Report Comments:

TRH_W(semi vol):# Percent recovery is not possible to report as the high concentration of analytes in the sample/s have caused interference.

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

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CERTIFICATE OF ANALYSIS 134814

Client:

Ecotox Services Australasia Pty Ltd
Unit 27, 2 Chaplin Dr
Lane Cove
NSW 2066

Attention: Tina

Sample log in details:

Your Reference:	**PR1244**		
No. of samples:	19 Waters		
Date samples received / completed instructions received	23/09/2015	/	23/09/2015

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	30/09/15	/	30/09/15
Date of Preliminary Report:	Not Issued		

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	134814-1	134814-2	134814-3	134814-4	134814-5
Your Reference	----------	FSW Control 10/9/2015	WAF Control 10/9/2015	Condensate 0.8% 10/9/2015	Condensate 1.6% 10/9/2015	Condensate 3.1% 10/9/2015
Date Sampled	----------	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	28/09/2015	28/09/2015	28/09/2015	28/09/2015	28/09/2015
Date analysed	-	29/09/2015	29/09/2015	29/09/2015	29/09/2015	29/09/2015
$TRHC_6$ - C_9	µg/L	<10	<10	350	720	1,500
$TRHC_6$ - C_{10}	µg/L	<10	<10	370	770	1,600
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	<10	<10	56	110	250
Benzene	µg/L	<1	<1	160	330	650
Toluene	µg/L	<1	<1	120	260	550
Ethylbenzene	µg/L	<1	<1	2	5	11
m+p-xylene	µg/L	<2	<2	23	49	100
o-xylene	µg/L	<1	<1	8	17	35
Naphthalene	µg/L	<1	<1	2	4	9
Surrogate Dibromofluoromethane	%	98	98	98	96	96
Surrogate toluene-d8	%	102	100	100	101	100
Surrogate 4-BFB	%	97	96	98	99	100

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	134814-6	134814-7	134814-8	134814-9	134814-10
Your Reference	----------	Condensate 6.3% 10/9/2015	Condensate 12.5% 10/9/2015	Condensate 25% 10/9/2015	Condensate 50% 10/9/2015	Condensate 100% 10/9/2015
Date Sampled	----------	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	28/09/2015	28/09/2015	28/09/2015	28/09/2015	28/09/2015
Date analysed	-	29/09/2015	29/09/2015	29/09/2015	29/09/2015	29/09/2015
$TRHC_6$ - C_9	µg/L	2,900	6,600	13,000	29,000	66,000
$TRHC_6$ - C_{10}	µg/L	3,000	6,800	13,000	29,000	66,000
$TRHC_6$ - C_{10} less BTEX (F1)	µg/L	340	1,200	2,000	4,800	9,800
Benzene	µg/L	1,300	2,700	5,400	12,000	28,000
Toluene	µg/L	1,100	2,200	4,400	9,600	22,000
Ethylbenzene	µg/L	23	47	81	180	430
m+p-xylene	µg/L	170	460	850	1,800	4,400
o-xylene	µg/L	71	150	280	600	1,400
Naphthalene	µg/L	19	21	30	50	110
Surrogate Dibromofluoromethane	%	97	97	99	98	98
Surrogate toluene-d8	%	99	100	99	98	97
Surrogate 4-BFB	%	101	99	95	98	96

vTRH(C6-C10)/BTEXN in Water						
Our Reference:	UNITS	134814-11	134814-12	134814-13	134814-14	134814-15
Your Reference	----------	FSW Control 11/9/2015	WAF Control 11/9/2015	Condensate 1.6% 11/9/2015	Condensate 3.1% 11/9/2015	Condensate 6.3% 11/9/2015
Date Sampled	----------	11/09/2015	11/09/2015	11/09/2015	11/09/2015	11/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	28/09/2015	28/09/2015	28/09/2015	28/09/2015	28/09/2015
Date analysed	-	29/09/2015	29/09/2015	29/09/2015	29/09/2015	29/09/2015
TRHC$_6$ - C$_9$	µg/L	<10	<10	650	1,400	3,000
TRHC$_6$ - C$_{10}$	µg/L	<10	<10	690	1,400	3,100
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	<10	<10	110	170	670
Benzene	µg/L	<1	<1	290	600	1,200
Toluene	µg/L	<1	<1	230	500	980
Ethylbenzene	µg/L	<1	<1	4	9	21
m+p-xylene	µg/L	<2	<2	43	89	160
o-xylene	µg/L	<1	<1	15	31	65
Naphthalene	µg/L	<1	<1	4	7	17
Surrogate Dibromofluoromethane	%	100	100	97	97	96
Surrogate toluene-d8	%	99	99	102	100	99
Surrogate 4-BFB	%	96	95	100	101	102

vTRH(C6-C10)/BTEXN in Water					
Our Reference:	UNITS	134814-16	134814-17	134814-18	134814-19
Your Reference	----------	Condensate 12.5% 11/9/2015	Condensate 25% 11/9/2015	Condensate 50% 11/9/2015	Condensate 100% 11/9/2015
Date Sampled	----------	11/09/2015	11/09/2015	11/09/2015	11/09/2015
Type of sample		Water	Water	Water	Water
Date extracted	-	28/09/2015	28/09/2015	28/09/2015	28/09/2015
Date analysed	-	29/09/2015	29/09/2015	29/09/2015	29/09/2015
TRHC$_6$ - C$_9$	µg/L	6,200	12,000	26,000	62,000
TRHC$_6$ - C$_{10}$	µg/L	6,400	12,000	26,000	62,000
TRHC$_6$ - C$_{10}$ less BTEX (F1)	µg/L	1,200	1,600	3,900	8,500
Benzene	µg/L	2,500	5,100	11,000	27,000
Toluene	µg/L	2,100	4,100	8,700	21,000
Ethylbenzene	µg/L	42	78	160	380
m+p-xylene	µg/L	410	820	1,700	3,900
o-xylene	µg/L	140	270	530	1,200
Naphthalene	µg/L	19	33	43	110
Surrogate Dibromofluoromethane	%	97	100	100	98
Surrogate toluene-d8	%	99	99	98	97
Surrogate 4-BFB	%	99	97	94	97

svTRH (C10-C40) in Water						
Our Reference:	UNITS	134814-1	134814-2	134814-3	134814-4	134814-5
Your Reference	----------	FSW Control 10/9/2015	WAF Control 10/9/2015	Condensate 0.8% 10/9/2015	Condensate 1.6% 10/9/2015	Condensate 3.1% 10/9/2015
Date Sampled	----------	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	24/09/2015	24/09/2015	24/09/2015	24/09/2015	24/09/2015
Date analysed	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015	25/09/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	<50	<50	53
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	<100	120
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	<50	<50	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	<100	<100	120
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	87	79	83	88	97

svTRH (C10-C40) in Water						
Our Reference:	UNITS	134814-6	134814-7	134814-8	134814-9	134814-10
Your Reference	----------	Condensate 6.3% 10/9/2015	Condensate 12.5% 10/9/2015	Condensate 25% 10/9/2015	Condensate 50% 10/9/2015	Condensate 100% 10/9/2015
Date Sampled	----------	10/09/2015	10/09/2015	10/09/2015	10/09/2015	10/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	24/09/2015	24/09/2015	24/09/2015	24/09/2015	24/09/2015
Date analysed	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015	25/09/2015
TRHC$_{10}$ - C$_{14}$	µg/L	120	240	490	880	1,900
TRHC$_{15}$ - C$_{28}$	µg/L	160	320	570	980	1,600
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	120
TRH>C$_{10}$ - C$_{16}$	µg/L	98	200	380	660	1,300
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	79	180	350	610	1,200
TRH>C$_{16}$ - C$_{34}$	µg/L	150	300	540	930	1,600
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	95	93	94	84	84

svTRH (C10-C40) in Water						
Our Reference:	UNITS	134814-11	134814-12	134814-13	134814-14	134814-15
Your Reference	----------	FSW Control 11/9/2015	WAF Control 11/9/2015	Condensate 1.6% 11/9/2015	Condensate 3.1% 11/9/2015	Condensate 6.3% 11/9/2015
Date Sampled	----------	11/09/2015	11/09/2015	11/09/2015	11/09/2015	11/09/2015
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	24/09/2015	24/09/2015	24/09/2015	24/09/2015	24/09/2015
Date analysed	-	29/09/2015	29/09/2015	29/09/2015	29/09/2015	29/09/2015
TRHC$_{10}$ - C$_{14}$	µg/L	<50	<50	<50	<50	78
TRHC$_{15}$ - C$_{28}$	µg/L	<100	<100	<100	<100	170
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	<100	<100
TRH>C$_{10}$ - C$_{16}$	µg/L	<50	<50	<50	<50	63
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	<50	<50	<50	<50	<50
TRH>C$_{16}$ - C$_{34}$	µg/L	<100	<100	<100	<100	170
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100	<100
Surrogate o-Terphenyl	%	102	98	91	100	83

svTRH (C10-C40) in Water					
Our Reference:	UNITS	134814-16	134814-17	134814-18	134814-19
Your Reference	----------	Condensate 12.5% 11/9/2015	Condensate 25% 11/9/2015	Condensate 50% 11/9/2015	Condensate 100% 11/9/2015
Date Sampled	----------	11/09/2015	11/09/2015	11/09/2015	11/09/2015
Type of sample		Water	Water	Water	Water
Date extracted	-	24/09/2015	24/09/2015	24/09/2015	24/09/2015
Date analysed	-	29/09/2015	29/09/2015	29/09/2015	29/09/2015
TRHC$_{10}$ - C$_{14}$	µg/L	190	410	960	1,900
TRHC$_{15}$ - C$_{28}$	µg/L	280	440	1,000	1,800
TRHC$_{29}$ - C$_{36}$	µg/L	<100	<100	<100	130
TRH>C$_{10}$ - C$_{16}$	µg/L	160	320	750	1,400
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	µg/L	140	290	710	1,300
TRH>C$_{16}$ - C$_{34}$	µg/L	260	410	950	1,700
TRH>C$_{34}$ - C$_{40}$	µg/L	<100	<100	<100	<100
Surrogate o-Terphenyl	%	99	99	128	101

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	134814-1 FSW Control 10/9/2015 10/09/2015 Water	134814-2 WAF Control 10/9/2015 10/09/2015 Water	134814-3 Condensate 0.8% 10/9/2015 10/09/2015 Water	134814-4 Condensate 1.6% 10/9/2015 10/09/2015 Water	134814-5 Condensate 3.1% 10/9/2015 10/09/2015 Water
Date extracted	-	24/09/2015	24/09/2015	24/09/2015	24/09/2015	24/09/2015
Date analysed	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015	25/09/2015
Naphthalene	µg/L	<1	<1	2	4	8
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	<1	<1
Phenanthrene	µg/L	<1	<1	<1	<1	<1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	2.1	4.3	8.2
Surrogate p-Terphenyl-d14	%	93	89	87	93	91

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	134814-6 Condensate 6.3% 10/9/2015 10/09/2015 Water	134814-7 Condensate 12.5% 10/9/2015 10/09/2015 Water	134814-8 Condensate 25% 10/9/2015 10/09/2015 Water	134814-9 Condensate 50% 10/9/2015 10/09/2015 Water	134814-10 Condensate 100% 10/9/2015 10/09/2015 Water
Date extracted	-	24/09/2015	24/09/2015	24/09/2015	24/09/2015	24/09/2015
Date analysed	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015	25/09/2015
Naphthalene	µg/L	16	29	58	110	220
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	1	2	4
Phenanthrene	µg/L	<1	<1	1	2	3
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	16	29	61	110	230
Surrogate p-Terphenyl-d14	%	98	89	90	87	94

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	134814-11 FSW Control 11/9/2015 11/09/2015 Water	134814-12 WAF Control 11/9/2015 11/09/2015 Water	134814-13 Condensate 1.6% 11/9/2015 11/09/2015 Water	134814-14 Condensate 3.1% 11/9/2015 11/09/2015 Water	134814-15 Condensate 6.3% 11/9/2015 11/09/2015 Water
Date extracted	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015	25/09/2015
Date analysed	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015	25/09/2015
Naphthalene	µg/L	<1	<1	4	7	14
Acenaphthylene	µg/L	<1	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1	<1
Fluorene	µg/L	<1	<1	<1	<1	<1
Phenanthrene	µg/L	<1	<1	<1	<1	<1
Anthracene	µg/L	<1	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5	<5
Total +ve PAH's	µg/L	NIL (+)VE	NIL (+)VE	3.6	7.1	14
Surrogate p-Terphenyl-d14	%	104	107	103	107	94

PAHs in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	134814-16 Condensate 12.5% 11/9/2015 11/09/2015 Water	134814-17 Condensate 25% 11/9/2015 11/09/2015 Water	134814-18 Condensate 50% 11/9/2015 11/09/2015 Water	134814-19 Condensate 100% 11/9/2015 11/09/2015 Water
Date extracted	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015
Date analysed	-	25/09/2015	25/09/2015	25/09/2015	25/09/2015
Naphthalene	µg/L	29	55	100	200
Acenaphthylene	µg/L	<1	<1	<1	<1
Acenaphthene	µg/L	<1	<1	<1	<1
Fluorene	µg/L	<1	1	3	3
Phenanthrene	µg/L	<1	<1	2	2
Anthracene	µg/L	<1	<1	<1	<1
Fluoranthene	µg/L	<1	<1	<1	<1
Pyrene	µg/L	<1	<1	<1	<1
Benzo(a)anthracene	µg/L	<1	<1	<1	<1
Chrysene	µg/L	<1	<1	<1	<1
Benzo(b,j+k)fluoranthene	µg/L	<2	<2	<2	<2
Benzo(a)pyrene	µg/L	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	<1	<1	<1	<1
Dibenzo(a,h)anthracene	µg/L	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	<1	<1	<1	<1
Benzo(a)pyrene TEQ	µg/L	<5	<5	<5	<5
Total +ve PAH's	µg/L	29	57	110	210
Surrogate p-Terphenyl-d14	%	104	106	115	100

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-013	Water samples are analysed directly by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-012 subset	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			28/09/2015	134814-1	28/09/2015 || 29/09/2015	LCS-W2	28/09/2015
Date analysed	-			29/09/2015	134814-1	29/09/2015 || 29/09/2015	LCS-W2	29/09/2015
TRHC$_6$ - C$_9$	µg/L	10	Org-016	<10	134814-1	<10 || <10	LCS-W2	101%
TRHC$_6$ - C$_{10}$	µg/L	10	Org-016	<10	134814-1	<10 || <10	LCS-W2	101%
Benzene	µg/L	1	Org-016	<1	134814-1	<1 || <1	LCS-W2	101%
Toluene	µg/L	1	Org-016	<1	134814-1	<1 || <1	LCS-W2	103%
Ethylbenzene	µg/L	1	Org-016	<1	134814-1	<1 || <1	LCS-W2	99%
m+p-xylene	µg/L	2	Org-016	<2	134814-1	<2 || <2	LCS-W2	100%
o-xylene	µg/L	1	Org-016	<1	134814-1	<1 || <1	LCS-W2	97%
Naphthalene	µg/L	1	Org-013	<1	134814-1	<1 || <1	[NR]	[NR]
Surrogate Dibromofluoromethane	%		Org-016	97	134814-1	98 || 103 || RPD: 5	LCS-W2	96%
Surrogate toluene-d8	%		Org-016	102	134814-1	102 || 95 || RPD: 7	LCS-W2	105%
Surrogate 4-BFB	%		Org-016	97	134814-1	97 || 89 || RPD: 9	LCS-W2	101%
QUALITY CONTROL svTRH (C10-C40) in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			25/09/2015	[NT]	[NT]	LCS-W2	24/09/2015
Date analysed	-			29/09/2015	[NT]	[NT]	LCS-W2	25/09/2015
TRHC$_{10}$ - C$_{14}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W2	90%
TRHC$_{15}$ - C$_{28}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	81%
TRHC$_{29}$ - C$_{36}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	83%
TRH>C$_{10}$ - C$_{16}$	µg/L	50	Org-003	<50	[NT]	[NT]	LCS-W2	90%
TRH>C$_{16}$ - C$_{34}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	81%
TRH>C$_{34}$ - C$_{40}$	µg/L	100	Org-003	<100	[NT]	[NT]	LCS-W2	83%
Surrogate o-Terphenyl	%		Org-003	90	[NT]	[NT]	LCS-W2	79%
QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			25/09/2015	[NT]	[NT]	LCS-W1	24/09/2015
Date analysed	-			25/09/2015	[NT]	[NT]	LCS-W1	25/09/2015
Naphthalene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	76%
Acenaphthylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluorene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	77%
Phenanthrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	80%

QUALITY CONTROL PAHs in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	80%
Pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	85%
Benzo(a)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Chrysene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	80%
Benzo(b,j+k) fluoranthene	µg/L	2	Org-012 subset	<2	[NT]	[NT]	[NR]	[NR]
Benzo(a)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	LCS-W1	85%
Indeno(1,2,3-c,d)pyrene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	µg/L	1	Org-012 subset	<1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012 subset	84	[NT]	[NT]	LCS-W1	69%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Water	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	134814-11	28/09/2015 || 29/09/2015
Date analysed	-	134814-11	29/09/2015 || 29/09/2015
$TRHC_6$ - C_9	µg/L	134814-11	<10 || <10
$TRHC_6$ - C_{10}	µg/L	134814-11	<10 || <10
Benzene	µg/L	134814-11	<1 || <1
Toluene	µg/L	134814-11	<1 || <1
Ethylbenzene	µg/L	134814-11	<1 || <1
m+p-xylene	µg/L	134814-11	<2 || <2
o-xylene	µg/L	134814-11	<1 || <1
Naphthalene	µg/L	134814-11	<1 || <1
Surrogate Dibromofluoromethane	%	134814-11	100 || 103 || RPD: 3
Surrogate toluene-d8	%	134814-11	99 || 95 || RPD: 4
Surrogate 4-BFB	%	134814-11	96 || 88 || RPD: 9

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Appendix C: Test Report for the Sea Urchin Fertilisation Test

Toxicity Test Report: TR1244/1

Accredited for compliance with ISO/IEC 17025

Client:	Jacobs Group (Australia) Pty Ltd	**ESA Job #:**	PR1244
	263 Adelaide Terrace	**Date Sampled:**	27 December 2014
	Perth WA 6001	**Date Received:**	27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	Sample Name:	Sample Description:
7323	Barossa Field Condensate	Condensate sample received at room temperature in apparent good condition.

Test Performed:	1-hr sea urchin fertilisation success test using *Heliocidaris tuberculata*
Test Protocol:	ESA SOP 104 (ESA 2014), based on USEPA (2002) and Simon and Laginestra (1996)
Test Temperature:	The test was performed at 20±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	Pre-weighed aliquot of condensate were added to filtered seawater (FSW) at a single loading rate of 1 part oil to 9 parts FSW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF control were tested concurrently with the sample. The test concentrations are expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations.
Source of Test Organisms:	Field collected from South Maroubra, NSW.
Test Initiated:	10 September 2015 at 1130h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	% Fertilised Eggs (Mean ± SD)	
FSW Control	78.8 ± 3.2	
WAF Control	90.0 ± 2.6	
0.6	84.3 ± 6.5	
1.2	82.3 ± 3.4	*
2.4	80.5 ± 5.2	*
4.8	80.5 ± 4.1	*
9.7	80.0 ± 2.2	*
19.3	34.8 ± 8.8	*
38.6	0.0 ± 0.0	
77.2	0.0 ± 0.0	

EC10 = 14.6g/L**
EC50 = 18.6 (8.97-19.12)g/L
NOEC = 0.6g/L
LOEC = 1.2g/L

Sample 7323*: Barossa Field Condensate*

Concentration (µg/L)	% Fertilised Eggs (Mean ± SD)	
FSW Control	78.8 ± 3.2	
WAF Control	90.0 ± 2.6	
350	84.3 ± 6.5	
720	82.3 ± 3.4	*
1673	80.5 ± 5.2	*
3180	80.5 ± 4.1	*
7160	80.0 ± 2.2	*
14060	34.8 ± 8.8	*
30860	0.0 ± 0.0	
69620	0.0 ± 0.0	

EC10 = 9206.2 (7702.42-10203.00)µg/L
EC50 = 13202.7 (12495.20-13763.40)µg/L
NOEC = 350µg/L
LOEC = 720µg/L

*Significantly lower percentage fertilised eggs compared with the WAF Control (Dunnett's Test, 1-tailed, P=0.05)
**95% Confidence Limits not reliable

Toxicity Test Report: TR1244/1

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % fertilised eggs	≥70.0%	78.8%	Yes
Reference Toxicant within cusum chart limits	23.7-105.6µg Cu/L	26.7µg Cu/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 9 November 2015

Results are based on the samples in the condition as received by ESA.

NATA Accredited Laboratory Number: 14709

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Citations:

ESA (2014) ESA SOP 104 - *Sea Urchin Fertilisation Success Test*. Issue No. 13. Ecotox Services Australasia, Sydney NSW.

Simon, J. and Laginestra, E.(1997) Bioassay for testing sublethal toxicity in effluents, using gametes of sea urchin *Heliocidaris tuberculata*. National Pulp Mills Research Program Technical Report No. 20. CSIRO, Canberra ACT

USEPA (2002) Short-term methods for measuring the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. Third Edition. United States Environmental Protection Agency, Office of Water, Washington DC, EPA-821-R-02-014.

Appendix D: Test Report for the Sea Urchin Larval Development Test

Toxicity Test Report: TR1244/2

Accredited for compliance with ISO/IEC 17025

Client:	Jacobs Group (Australia) Pty Ltd 263 Adelaide Terrace Perth WA 6001	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1244 27 December 2014 27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	**Sample Name:**	**Sample Description:**
7323	Barossa Field Condensate	Condensate sample received at room temperature in apparent good condition.

Test Performed:	72-hr sea urchin larval development test using *Heliocidaris tuberculata*
Test Protocol:	ESA SOP 105 (ESA 2014), based on APHA (1998), Simon and Laginestra (1996) and Doyle *et al*. (2003)
Test Temperature:	The test was performed at 20±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	Pre-weighed aliquot of condensate were added to filtered seawater (FSW) at a single loading rate of 1 part oil to 9 parts FSW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF control were tested concurrently with the sample. The test concentrations are expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations.
Source of Test Organisms:	Field collected from South Maroubra, NSW.
Test Initiated:	10 September 2015 at 1245h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	**% Normal larvae (Mean ± SD)**	
FSW Control	80.8 ± 5.0	
WAF Control	87.8 ± 2.2	
1.2	83.0 ± 3.2	
2.4	83.0 ± 5.4	
4.8	84.3 ± 6.7	
9.7	83.8 ± 4.8	
19.3	81.0 ± 4.2	
38.6	1.5 ± 1.3	*
77.2	0.0 ± 0.0	

EC10 = 21.0 (18.90-22.76)g/L
EC50 = 26.5 (24.67-28.01)g/L
NOEC = 19.3g/L
LOEC = 38.6g/L

Sample 7323*: Barossa Field Condensate*

Concentration (µg/L)	**% Normal larvae (Mean ± SD)**	
FSW Control	80.8 ± 5.0	
WAF Control	87.8 ± 2.2	
720	83.0 ± 3.2	
1673	83.0 ± 5.4	
3180	84.3 ± 6.7	
7160	83.8 ± 4.8	
14060	81.0 ± 4.2	
30860	1.5 ± 1.3	*
69620	0.0 ± 0.0	

EC10 = 15481.6 (13727.10-16947.80)µg/L
EC50 = 20104.40 (18575.70-21450.10)µg/L
NOEC = 14060µg/L
LOEC = 30860µg/L

*Significantly lower percentage of normally developed larvae compared with the WAF Control (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR1244/2

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % normal larvae	≥70.0%	80.8%	Yes
Reference Toxicant within cusum chart limits	10.5-23.1µg Cu/L	12.2µg Cu/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 9 November 2015

Results are based on the samples in the condition as received by ESA.

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Citations:

APHA (1998) Method 8810 D. Echinoderm Embryo Development Test. In Standard Methods for the Examination of Water and Wastewater, 20th Ed. American Public Health Association, American Water Works Association and the Water Environment Federation, USA.

Doyle, C.J., Pablo, F., Lim, R.P. and Hyne, R.V. (2003) Assessment of metal toxicity in sediment pore water from Lake Macquarie, Australia. *Arch. Environ. Contam. Toxicology*, 44(3): 343-350.

ESA (2014) *ESA SOP 105 - Sea Urchin Larval Development Test*. Issue No. 10. Ecotox Services Australasia, Sydney NSW.

Simon, J. and Laginestra, E.(1997) Bioassay for testing sublethal toxicity in effluents, using gametes of sea urchin *Heliocidaris tuberculata*. National Pulp Mills Research Program Technical Report No. 20. CSIRO, Canberra, ACT.

Appendix E: Test Report for the Milky Oyster Larval Development Test

Toxicity Test Report: TR1244/3

Accredited for compliance with ISO/IEC 17025

Client:	Jacobs Group (Australia) Pty Ltd	**ESA Job #:**	PR1244
	263 Adelaide Terrace	**Date Sampled:**	27 December 2014
	Perth WA 6001	**Date Received:**	27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	**Sample Name:**	**Sample Description:**
7323	Barossa Field Condensate	Condensate sample received at room temperature in apparent good condition.

Test Performed:	48-hr larval development test using the milky oyster *Saccostrea echinata*
Test Protocol:	ESA SOP 106 (ESA 2014), based on APHA (1998) and Krassoi (1995)
Test Temperature:	The test was performed at 29±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	Pre-weighed aliquot of condensate were added to filtered seawater (FSW) at a single loading rate of 1 part oil to 9 parts FSW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF control were tested concurrently with the sample. The test concentrations are expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations
Source of Test Organisms:	Field collected from Mackay, QLD.
Test Initiated:	10 September 2015 at 1800h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	**% Normal larvae (Mean ± SD)**	
FSW Control	74.5 ± 4.8	
WAF Control	72.5 ± 3.1	
1.2	70.8 ± 3.6	
2.4	72.5 ± 3.1	
4.8	72.3 ± 4.2	
9.7	73.5 ± 2.1	
19.3	62.0 ± 2.2	*
38.6	0.0 ± 0.0	
77.2	0.0 ± 0.0	

IC10 = 15.7(11.78-18.35)g/L
EC50 = 24.7 (24.11-25.32)g/L
NOEC = 9.7g/L
LOEC = 19.3g/L

Sample 7323*: Barossa Field Condensate*

Concentration (µg/L)	**% Normal larvae (Mean ± SD)**	
FSW Control	74.5 ± 4.8	
WAF Control	72.5 ± 3.1	
720	70.8 ± 3.6	
1673	72.5 ± 3.1	
3180	72.3 ± 4.2	
7160	73.5 ± 2.1	
14060	62.0 ± 2.2	*
30860	0.0 ± 0.0	
69620	0.0 ± 0.0	

IC10 = 11478.4 (9026.54-13230.50)µg/L
EC50 = 18747.2 (18266.80-19240.30)µg/L
NOEC = 7160µg/L
LOEC = 14060µg/L

*Significantly lower percentage of normal larvae compared with the WAF Control (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR1244/3

QA/QC Parameter	Criterion	This Test	Criterion met?
FSW Control mean % normal	≥70%	74.5%	Yes
Reference Toxicant within cusum chart limits	10.2-20.0µg Cu/L	14.5µg Cu/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 9 November 2015

Results are based on the samples in the condition as received by ESA.

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Citations:

APHA (1998) Standard Methods for the Examination of Water and Wastewater. 20th Ed. American Public Health Association, American Water Works Association and the Water Environment Federation, Washington, DC.

ESA (2014) SOP 106 – *Bivalve Larval Development Test*. Issue No. 14. Ecotox Services Australasia, Sydney, NSW.

Krassoi, R (1995) Salinity adjustment of effluents for use with marine bioassays: effects on the larvae of the doughboy scallop Chlamys asperrimus and the Sydney rock oyster *Saccostrea commercialis*. *Australasian Journal of Ecotoxicology*, 1: 143-148.

Appendix F: Test Report for the Micro-Algal Growth Inhibition Test

Toxicity Test Report: TR1244/4

Accredited for compliance with ISO/IEC 17025

Client:	Jacobs Group (Australia) Pty Ltd	**ESA Job #:**	PR1244
	263 Adelaide Terrace	**Date Sampled:**	27 December 2014
	Perth WA 6001	**Date Received:**	27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	Sample Name:	Sample Description:
7323	Barossa Field Condensate	Condensate sample received at room temperature in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	72-hr marine algal growth test using *Isochrysis aff. galbana*
Test Protocol:	ESA SOP 110 (ESA 2014), based on Stauber *et al*. (1994)
Test Temperature:	The test was performed at 29±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	Pre-weighed aliquot of condensate were added to filtered seawater (FSW) at a single loading rate of 1 part oil to 9 parts FSW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF control were tested concurrently with the sample. The test concentrations are expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations.
Source of Test Organisms:	In-house culture, originally sourced from CSIRO Microalgae Supply Service, TAS
Test Initiated:	11 September 2015 at 1110h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	Cell Yield (Mean number of cells/mL x10^4 ± SD)	
FSW Control	20.2 ± 3.2	
WAF Control	17.8 ± 1.0	
1.2	18.9 ± 4.3	
2.4	21.4 ± 7.3	
4.8	20.8 ± 6.2	
9.7	13.6 ± 5.1	
19.3	1.1 ± 0.5	*
38.6	0.0 ± 0.0	
77.2	0.0 ± 0.0	

IC10 = 6.39 (2.18-10.68)g/L
IC50 = 12.6 (7.45-15.09)g/L
NOEC = 9.7g/L
LOEC = 19.3g/L

Sample 7323*: Barossa Field Condensate*

Concentration (µg/L)	Cell Yield (Mean number of cells/mL x10^4 ± SD)	
FSW Control	20.2 ± 3.2	
WAF Control	17.8 ± 1.0	
650	18.9 ± 4.3	
1400	21.4 ± 7.3	
3248	20.8 ± 6.2	
6670	13.6 ± 5.1	
12850	1.1 ± 0.5	*
27960	0.0 ± 0.0	
65830	0.0 ± 0.0	

IC10 = 4355.2 (1641.13-7401.38)µg/L
IC50 = 8529.3 (5094.77-10126.00)µg/L
NOEC = 6670µg/L
LOEC = 12850µg/L

*Significantly lower cell yield compared with the WAF Control (Steel's Many-One Rank Test, 1-tailed, P=0.05)

Toxicity Test Report: TR1244/4

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean cell density	≥16.0x10^4 cells/mL	21.2x10^4 cells/mL	Yes
Control coefficient of variation	<20%	16.0%	Yes
Reference Toxicant within cusum chart limits	15.1-46.7µg Cu/L	19.0µg Cu/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 9 November 2015

Results are based on the samples in the condition as received by ESA.

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Citations:

ESA (2014) SOP 110 – *Marine Algal Growth Test*. Issue No. 11. Ecotox Services Australasia, Sydney NSW

Stauber, J.L., Tsai, J., Vaughan, G.T., Peterson, S.M. and Brockbank, C.I. (1994) Algae as indicators of toxicity of the effluent from bleached eucalypt kraft pulp mills. National Pulp Mills Research Program, Technical Report No. 3. CSIRO, Canberra, ACT

Appendix G: Test Report for the Macro-Algal Growth Test

Toxicity Test Report: TR1244/5

Client:	Jacobs Group (Australia) Pty Ltd 263 Adelaide Terrace Perth WA 6001	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1244 27 December 2014 27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	Sample Name:	Sample Description:
7323	Barossa Field Condensate	Condensate sample received at room temperature in apparent good condition.

Test Performed:	14-day macroalgal growth test using *Ecklonia radiata*
Test Protocol:	ESA SOP 116 (ESA 2010), based on Bidwell *et al*. (1998) and Burridge *et al.* (1999)
Test Temperature:	The test was performed at 18±1°C.
Deviations from Protocol:	Test extended from 72 hours to 14 days to encompass growth endpoint.
Comments on Solution Preparation:	Pre-weighed aliquot of condensate were added to filtered seawater (FSW) at a single loading rate of 1 part oil to 9 parts FSW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF control were tested concurrently with the sample. The test concentrations are expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations.
Source of Test Organisms:	Field collected from Mercury Passage, TAS
Test Initiated:	10 September 2015 at 1400h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	Gametophyte Length, µm (Mean ± SD)	
FSW Control	23.65 ± 1.12	
WAF Control	24.90 ± 2.80	
1.2	22.93 ± 1.35	
2.4	22.60 ± 3.28	
4.8	21.18 ± 1.14	*
9.7	18.63 ± 1.04	*
19.3	15.00 ± 0.85	*
38.6	13.78 ± 1.51	*
77.2	11.83 ± 1.11	*

14-day IC10 = 2.7g/L**
14-day IC50 = 64.8g/L**
NOEC = 2.4g/L
LOEC = 4.8g/L

Sample 7323: B*arossa Field Condensate*

Concentration (µg/L)	Gametophyte Length, µm (Mean ± SD)	
FSW Control	23.65 ± 1.12	
WAF Control	24.90 ± 2.80	
720	22.93 ± 1.35	
1673	22.60 ± 3.28	
3180	21.18 ± 1.14	*
7160	18.63 ± 1.04	*
14060	15.00 ± 0.85	*
30860	13.78 ± 1.51	*
69620	11.83 ± 1.11	*

14-day IC10 = 1873.9µg/L**
14-day IC50 = 57196.9µg/L**
NOEC = 1673µg/L
LOEC = 3180µg/L

*Significantly lower gametophyte length compared with the WAF Control (Dunnett's Test, 1-tailed, P=0.05)
**95% confidence limits are not reliable

Toxicity Test Report: TR1244/5

QA/QC Parameter	Criterion	This Test	Criterion met?
FSW Control mean % germination @ 72hrs	≥70%	90.3%	Yes
72-hr germination reference Toxicant within cusum chart limits	86.0-1262.1µg Cu/L	408.5µg Cu/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 9 November 2015

Results are based on the samples in the condition as received by ESA. This document shall not be reproduced except in full.

Citations:

Bidwell, J. R., Wheeler, K. W., & Burridge, T. R. (1998). Toxicant effects on the zoospore stage of the marine maroalga Ecklonia radiata (Phaeophyta:Laminariales). *Marine Ecology Progress Series.Vol 163* , 259-265.

Burridge, T. R., Karistanios, M., & Bidwell, J. (1999). The use of aquatic macrophyte ecotoxicological assays inmonitoring coastal effluent discharges in southern Australia. *Marine Pollution Bulletin. Vol 39* , 1-12.

ESA (2010) *SOP 116 – Macroalgal Germination Success Test.* Issue No. 11. Ecotox Services Australasia, Sydney NSW

Appendix H: Test Report for the Sea Anemone Development Test

Toxicity Test Report: TR1244/6

Client:	Jacobs Group (Australia) Pty Ltd 263 Adelaide Terrace Perth WA 6001	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1244 27 December 2014 27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	**Sample Name:**	**Sample Description:**
7323	Barossa Field Condensate	Condensate sample received at room temperature in apparent good condition.

Test Performed:	8-day Sea anemone pedal lacerate development test using *Aiptasia pulchella*
Test Protocol:	ESA SOP 128 (ESA 2014), based on Howe *et al.* (2014)
Test Temperature:	The test was performed at 20±1°C.
Deviations from Protocol:	Three replicate were used for the sample concentrations.
Comments on Solution Preparation:	Pre-weighed aliquot of condensate were added to filtered seawater (FSW) at a single loading rate of 1 part oil to 9 parts FSW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF control were tested concurrently with the sample. The test concentrations are expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations.
Source of Test Organisms:	In house cultures
Test Initiated:	27 October 2015 at 1130h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	**% Normal (Mean ± SD)**
FSW Control	100 ± 0.0
WAF Control	95.0 ± 10.0
4.8	93.3 ± 11.6
9.7	86.7 ± 11.6
19.3	80.0 ± 20.0
38.6	73.3 ± 11.6
77.2	0.0 ± 0.0

8-day IC10 = 11.2g/L*
8-day EC50 = 40.1 (31.78-50.60)g/L
NOEC = 38.6g/L
LOEC = 77.2g/L

Sample 7323*: Barossa Field Condensate*

Concentration (µg/L)	**% Normal (Mean ± SD)**
FSW Control	100 ± 0.0
WAF Control	95.0 ± 10.0
2492	93.3 ± 11.6
7660	86.7 ± 11.6
15840	80.0 ± 20.0
28040	73.3 ± 11.6
63990	0.0 ± 0.0

8-day IC10 = 8862.4µg/L*
8-day EC50 = 30720.0 (23961.00-39385.50)µg/L
NOEC = 28040µg/L
LOEC = 63990µg/L

*95% confidence limits are not reliable

QA/QC Parameter	**Criterion**	**This Test**	**Criterion met?**
Control mean % normal pedal lacerates	≥90.0%	100%	Yes
Reference Toxicant within cusum chart limits	n/a	11.5µg Cu/L	n/a

Toxicity Test Report: TR1244/6

Test Report Authorised by: Dr Rick Krassoi, Director on 7 December 2015

Results are based on the samples in the condition as received by ESA. This document shall not be reproduced except in full.

Citations:

Cary, L.R. (1911) A study of pedal laceration in actinians. The Biological Bulletin 20, 81-107.

ESA (2014) ESA SOP 128 – *Sea Anemone Pedal Lacerate Development Test*. Issue No. 1. Ecotox Services Australasia, Sydney NSW.

Howe, Pelli L., Reichelt-Brushett, Amanda J. and Clark, Malcolm W (2014) Development of a chronic, early life-stage sub-lethal toxicity test and recovery assessment for the tropical zooxanthellate sea anemone Aiptasia pulchella. Ecotoxicology and Environmental Safety 100: 138-147.

Stauber, Jennifer L, Julie Tsai, Gary T Vaughan, Sharon M Peterson, and Christopher I Brockbank. Algae as indicators of toxicity of the effluent from bleached eucalypt kraft pulp mills. Technical Report Series No. 3. Fyshwick: National Pulp Mills Research Program, 1994.

Appendix I: Test Report for the Copepodid Development Test

Toxicity Test Report: TR1244/7

Client:	Jacobs Group (Australia) Pty Ltd 263 Adelaide Terrace Perth WA 6001	**ESA Job #:**	PR1244
		Date Sampled:	27 December 2014
		Date Received:	27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	**Sample Name:**	**Sample Description:**
7323 B	arossa Field Condensate	Condensate sample received at room temperature in apparent good condition.

Test Performed:	5-day copepodid development toxicity test using the copepod *Parvocalanus crassirostris*
Test Protocol:	Based on ESA SOP 124 (2014)
Test Temperature:	The test was performed at 27±1°C.
Deviations from Protocol:	Test extended to 5 days. Copepod eggs added to test solutions at test initiation, and copepodid development counted at test termination. Test run at 28±1°C. Fed Isochrysis at a rate of 16,000 cells/copepod daily.
Comments on Solution Preparation:	Pre-weighed aliquot of condensate were added to filtered seawater (FSW) at a single loading rate of 1 part oil to 9 parts FSW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF control were tested concurrently with the sample. The test concentrations are expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations.
Source of Test Organisms:	In house culture
Test Initiated:	22 September 2015 at 1400h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)		**% Normal (Mean ± SD)**
FSW Control		70.0 ± 10.7
WAF Control		60.0 ± 16.3
4.	8	40.0 ± 28.3
9.	7	50.0 ± 11.6
19.3		0.0 ± 0.0
38.6		0.0 ± 0.0
77.2		0.0 ± 0.0

IC10 = 1.0g/L*^
EC50 = 12.2 (10.84-13.73)g/L
NOEC = 9.7g/L
LOEC = 19.3g/L

Sample 7323*: Barossa Field Condensate*

Concentration (µg/L)		**% Normal (Mean ± SD)**
FSW Control		70.0 ± 10.7
WAF Control		60.0 ± 16.3
38	60	40.0 ± 28.3
85	60	50.0 ± 11.6
15	830	0.0 ± 0.0
29	770	0.0 ± 0.0
68	390	0.0 ± 0.0

IC10 = 27.2µg/L*^
EC50 = 10506.9 (9451.82-11679.80)µg/L
NOEC = 8560µg/L
LOEC = 15830µg/L

%95% confidence limits are not reliable
^ Based on extrapolated data

QA/QC Parameter	**Criterion**	**This Test**	**Criterion met?**
Control mean % Normal	≥70.0%	70.0%	Yes
Reference Toxicant within cusum chart limits	n/a*	2.8µg Cu/L	n/a

*Reference toxicant cusum chart limits are not available due to limited testing

Toxicity Test Report: TR1244/7

Test Report Authorised by: Dr Rick Krassoi, Director on 12 November 2015

Results are based on the samples in the condition as received by ESA.

NATA Accredited Laboratory Number: 14709

This document shall not be reproduced except in full.

Citations:

ESA (2014) *SOP 124 – Acute toxicity test using the copepod Gladioferens imparipes*. Issue No. 3. Ecotox Services Australasia, Sydney, New South Wales.

Appendix J: Test Report for the Fish Imbalance and Growth Test

Toxicity Test Report: TR1244/8

Client:	Jacobs Group (Australia) Pty Ltd 263 Adelaide Terrace Perth WA 6001	**ESA Job #:**	PR1244
		Date Sampled:	27 December 2014
		Date Received:	27 August 2015
Attention:	Celeste Wilson	**Sampled By:**	Client
Client Ref:	Not Supplied	**ESA Quote #:**	PL1244_q03

Lab ID No.:	**Sample Name:**	**Sample Description:**
7323 B	arossa Field Condensate	Condensate sample receive d at room tempera ture in apparent goo d condition.

Test Performed:	7-day fish imbalance and biomass toxicity test using barramundi *Lates calcarifer*
Test Protocol:	ESA SOP 122 (ESA 2012), based on USEPA (2002)
Test Temperature:	The test was performed at 25±2°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	Pre-weighed aliquot of c ondensate were added to filtere d s eawater (FSW) at a single loa ding rate of 1 part oil t o 9 p arts F SW. The samples were mixed for 24 hours using a magnetic stirrer so that the peak of a vortex is achieved. Following mixing, the solutions were left to settle for 1 hour, after which time the water-accommodated fractions (WAF) were siphoned off. The WAF was serially diluted with FSW to prepare the remaining test concentrations. A FSW control and a WAF c ontrol were tested concurrently w ith th e sample. T he test con centrations ar e expressed as loading rates and total recoverable hydrocarbon (TRH) concentrations.
Source of Test Organisms:	Hatchery reared, SA
Test Initiated:	22 September 2015 at 1230h

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	**% Unaffected (Mean ± SD)**	
FSW Control	100 ± 0.0	
WAF Control	100 ± 0.0	
4.8	100 ± 0.0	
9.7	100 ± 0.0	
19.3	90.0 ± 11.6	
38.6	20.0 ± 0.0	*
77.2	0.0 ± 0.0	

7 day EC10 (unaffected) = 19.4 (13.58-23.28)g/L
7 day EC50 (unaffected) = 29.3 (24.71-34.66)g/L
NOEC = 19.3g/L
LOEC = 38.6g/L

Sample 7323*: Barossa Field Condensate*

Loading Rate (g/L)	**Biomass, mg (Mean ± SD)**	
FSW Control	8.3 ± 1.3	
WAF Control	8.0 ± 0.8	
4.8	7.7 ± 0.4	
9.7	8.3 ± 0.3	
19.3	7.7 ± 1.2	
38.6	1.4 ± 0.2	**
77.2	0.0 ± 0.0	

7 day IC10 (biomass) = 20.9 (8.44-22.09)g/L
7 day IC50 (biomass) = 30.6 (27.79-31.44)g/L
NOEC = 19.3g/L
LOEC = 38.6g/L

*Significantly lower percentage of unaffected larval fish compared with the WAF Control (Steel's Many-One Rank Test, 1-tailed, P=0.05)
**Significantly lower fish biomass compared with the WAF Control (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR1244/8

Sample 7323*: Barossa Field Condensate* Concentration (µg/L)	% Unaffected (Mean ± SD)	
FSW Control	100 ± 0.0	
WAF Control	100 ± 0.0	
3860	100 ± 0.0	
8560	100 ± 0.0	
1 5830	90 .0 ± 11.6	
2 9770	20 .0 ± 0.0	*
6 8390	0.0 ± 0.0	

7 day EC10 (unaffected) = 15875.5 (11275.40-18756.60)µg/L
7 day EC50 (unaffected) = 23182.2 (19851.60-27226.80)µg/L
NOEC = 15830µg/L
LOEC = 29770µg/L

Sample 7323*: Barossa Field Condensate* Concentration (µg/L)	Biomass, mg (Mean ± SD)		
FSW Control	8.3 ± 1.3		
WAF Control	8.0 ± 0.8		
3 860	7.7 ± 0.4		
8 560	8.3 ± 0.3		
15830	7.7 ± 1.2		
29770	1.4 ± 0. 2	**	
68390	0.0 ± 0.0		

7 day IC10 (biomass) = 17016.3 (7373.18-18757.60)µg/L
7 day IC50 (biomass) = 24006.3 (21800.80-24621.00)µg/L
NOEC = 15830µg/L
LOEC = 29770µg/L

*Significantly lower percentage of unaffected larval fish compared with the WAF Control (Steel's Many-One Rank Test, 1-tailed, P=0.05)
**Significantly lower fish biomass compared with the WAF Control (Dunnett's Test, 1-tailed, P=0.05)

Sample 7323*: Weathered Barossa Field Condensate* Loading Rate (g/L)	% Unaffected (Mean ± SD)
FSW Control	100 ± 0.0
WAF Control	100 ± 0.0
5. 0	100 ± 0.0
9. 9	100 ± 0.0
19.9	100 ± 0.0
39.8	100 ± 0.0
79.5	60 .0 ± 49.0

7 day EC10 (unaffected) = 69.1g/L*
7 day EC50 (unaffected) = >79.5g/L
NOEC = 79.5g/L
LOEC = >79.5g/L

Sample 7323*: Weathered Barossa Field Condensate* Loading Rate (g/L)	Biomass, mg (Mean ± SD)	
FSW Control	8.3 ± 1.3	
WAF Control	8.0 ± 0.8	
5.0	8.7 ± 0.6	
9.9	8.0 ± 1.0	
19 .9	8.1 ± 0.3	
39 .8	8.6 ± 0.7	
79 .5	5.0 ± 3.8	

7 day IC10 (biomass) = 48.6g/L*
7 day IC50 (biomass) = >79.5g/L
NOEC = 79.5g/L
LOEC = >79.5g/L

*95% confidence limits are not available

Sample 7323*: Weathered Barossa Field Condensate* Concentration (µg/L)	% Unaffected (Mean ± SD)
FSW Control	100 ± 0.0
WAF Control	100 ± 0.0
1410	100 ± 0.0
2770	100 ± 0.0
4850	100 ± 0.0
1 1450	100 ± 0.0
2 2480	60 .0 ± 49.0

7 day EC10 (unaffected) = 19596.3µg/L*
7 day EC50 (unaffected) = >22480.0µg/L
NOEC = 22480µg/L
LOEC = >22480µg/L

Sample 7323*: Weathered Barossa Field Condensate* Concentration (µg/L)	Biomass, mg (Mean ± SD)	
FSW Control	8.3 ± 1.3	
WAF Control	8.0 ± 0.8	
1 410	8.7 ± 0.6	
2 770	8.0 ± 1.0	
4 850	8.1 ± 0.3	
11450	8.6 ± 0.7	
22480	5.0 ± 3.8	

7 day IC10 (biomass) = 13908.1µg/L*
7 day IC50 (biomass) = >22480.0µg/L
NOEC = 22480µg/L
LOEC = >22480µg/L

*95% confidence limits are not available

Toxicity Test Report: TR1244/8

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % unaffected	≥80.0%	100% Y	es
Control mean growth	≥20% of initial weight	52.6% Ye	s
Reference Toxicant within cusum chart limits	n/a	17.3mg NH_4^+/L n/a	

Test Report Authorised by: Dr Rick Krassoi, Director on 9 November 2015

Results are based on the samples in the condition as received by ESA. This document shall not be reproduced except in full.

Citations:

ESA (2012) SOP 122 – *7-day Fish Imbalance and Growth Test*. Issue No 2. Ecotox Services Australasia, Sydney, NSW

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USEPA (2002) Short-term methods for estimating the chronic toxicity of effluents and receiving waters to marine and estuarine organisms. Third edition EPA-821-R-02-014. United States Environmental Protection Agency, Office of Research and Development, Washington FC, USA

Appendix K: Statistical Analyses of the Sea Urchin Fertilisation Test

Sea Urchin Fertilisation Test-Proportion Fertilised

Start Date:	10/09/2015 11:30	Test ID:	PR1244/01	Sample ID:	Borossa Field Condensate
End Date:	10/09/2015 12:50	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 104	Test Species:	HT-Heliocidaris tuberculata
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4
FSW Control	0.7600	0.7600	0.8200	0.8100
WAF Control	0.9300	0.8900	0.8700	0.9100
0.6	0.7500	0.9000	0.8500	0.8700
1.2	0.8700	0.8100	0.7900	0.8200
2.4	0.7800	0.8700	0.7500	0.8200
4.8	0.8100	0.8500	0.8100	0.7500
9.7	0.8000	0.7800	0.7900	0.8300
19.3	0.4100	0.2300	0.4200	0.3300
38.6	0.0000	0.0000	0.0000	0.0000
77.2	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.7875	0.8750	1.0925	1.0588	1.1326	3.593	4					
WAF Control	0.9000	1.0000	1.2510	1.2019	1.3030	3.477	4	*			40	400
0.6	0.8425	0.9361	1.1678	1.0472	1.2490	7.389	4	1.847	2.451	0.1104	63	400
*1.2	0.8225	0.9139	1.1373	1.0948	1.2019	4.034	4	2.525	2.451	0.1104	71	400
*2.4	0.8050	0.8944	1.1161	1.0472	1.2019	6.013	4	2.996	2.451	0.1104	78	400
*4.8	0.8050	0.8944	1.1150	1.0472	1.1731	4.637	4	3.021	2.451	0.1104	78	400
*9.7	0.8000	0.8889	1.1076	1.0826	1.1458	2.473	4	3.185	2.451	0.1104	80	400
*19.3	0.3475	0.3861	0.6280	0.5002	0.7051	15.109	4	13.837	2.451	0.1104	261	400
38.6	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400
77.2	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400

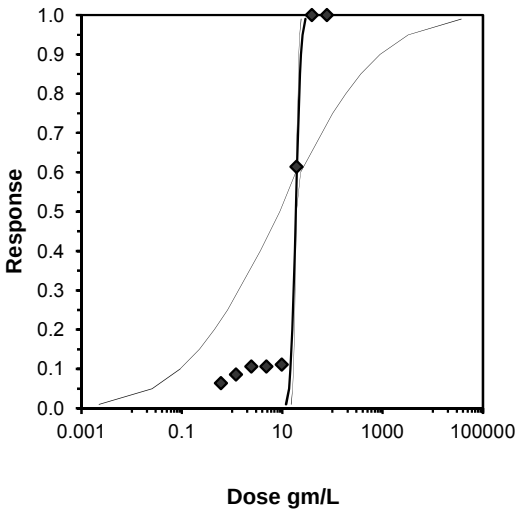
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.956873	0.924	-0.47569	0.016491
Bartlett's Test indicates equal variances (p = 0.50)	5.347583	16.81189		
The control means are significantly different (p = 1.65E-03)	5.407685	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	0.6	1.2	0.848528		0.075077	0.083314	0.16506	0.004053	1.7E-10	6, 21
Treatments vs WAF Control										

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	12.13036	5.86011	0.644542	23.61617	0.1	6.328178	12.59159	0.39	1.268647	0.082438	47
Intercept	-10.3891	7.536889	-25.1614	4.383164							
TSCR	0.170772	0.00769	0.155699	0.185845							

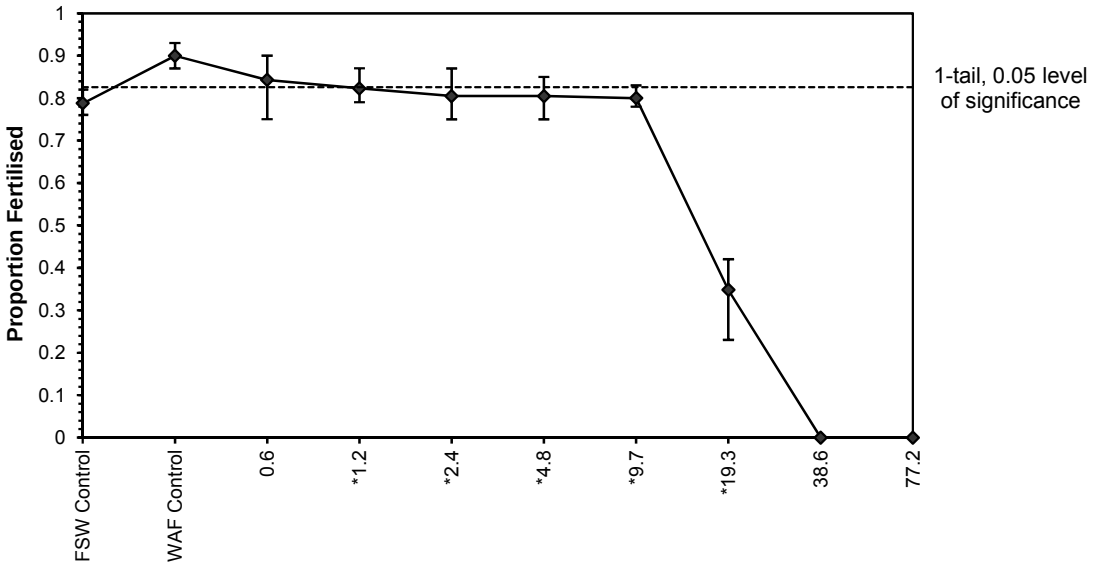
Point	Probits	gm/L	95% Fiducial Limits	
EC01	2.674	11.93624	0.002224	15.10118
EC05	3.355	13.58465	0.025375	16.14361
EC10	3.718	14.55454	0.092886	16.73032
EC15	3.964	15.24774	0.222909	17.13974
EC20	4.158	15.82214	0.446931	17.47387
EC25	4.326	16.33214	0.811669	17.76765
EC40	4.747	17.69136	3.64624	18.55218
EC50	5.000	18.56294	8.966176	19.11728
EC60	5.253	19.47745	18.64012	23.30117
EC75	5.674	21.09843	20.12496	101.2331
EC80	5.842	21.77851	20.48029	183.6966
EC85	6.036	22.59893	20.88954	368.1345
EC90	6.282	23.67527	21.40736	883.1808
EC95	6.645	25.36558	22.19035	3232.15
EC99	7.326	28.8686	23.72618	36865.22



Sea Urchin Fertilisation Test-Proportion Fertilised

Start Date:	10/09/2015 11:30	Test ID:	PR1244/01	Sample ID:	Borossa Field Condensate
End Date:	10/09/2015 12:50	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 104	Test Species:	HT-Heliocidaris tuberculata
Comments:	Loading Rate				

Dose-Response Plot



Sea Urchin Fertilisation Test-Proportion Fertilised

Start Date:	10/09/2015 11:30	Test ID:	PR1244/01	Sample ID:	Borossa Field Condensate
End Date:	10/09/2015 12:50	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 104	Test Species:	HT-Heliocidaris tuberculata
Comments:	Loading Rate				

		Auxiliary Data Summary					
Conc-gm/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
FSW Control	% Fertilised	78.75	76.00	82.00	3.20	2.27	4
WAF Control		90.00	87.00	93.00	2.58	1.79	4
0.6		84.25	75.00	90.00	6.50	3.03	4
1.2		82.25	79.00	87.00	3.40	2.24	4
2.4		80.50	75.00	87.00	5.20	2.83	4
4.8		80.50	75.00	85.00	4.12	2.52	4
9.7		80.00	78.00	83.00	2.16	1.84	4
19.3		34.75	23.00	42.00	8.81	8.54	4
38.6		0.00	0.00	0.00	0.00		4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
0.6		8.10	8.10	8.10	0.00	0.00	1
1.2		8.10	8.10	8.10	0.00	0.00	1
2.4		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.00	8.00	8.00	0.00	0.00	1
19.3		7.90	7.90	7.90	0.00	0.00	1
38.6		7.70	7.70	7.70	0.00	0.00	1
77.2		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
0.6		35.40	35.40	35.40	0.00	0.00	1
1.2		35.40	35.40	35.40	0.00	0.00	1
2.4		35.40	35.40	35.40	0.00	0.00	1
4.8		35.40	35.40	35.40	0.00	0.00	1
9.7		35.50	35.50	35.50	0.00	0.00	1
19.3		35.50	35.50	35.50	0.00	0.00	1
38.6		35.60	35.60	35.60	0.00	0.00	1
77.2		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
0.6		100.00	100.00	100.00	0.00	0.00	1
1.2		99.60	99.60	99.60	0.00	0.00	1
2.4		91.80	91.80	91.80	0.00	0.00	1
4.8		96.10	96.10	96.10	0.00	0.00	1
9.7		98.70	98.70	98.70	0.00	0.00	1
19.3		90.10	90.10	90.10	0.00	0.00	1
38.6		90.20	90.20	90.20	0.00	0.00	1
77.2		87.20	87.20	87.20	0.00	0.00	1

Sea Urchin Fertilisation Test-Proportion Fertilised

Start Date:	10/09/2015 11:30	Test ID:	PR1244/01b	Sample ID:	Borossa Field Condensate
End Date:	10/09/2015 12:50	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 104	Test Species:	HT-Heliocidaris tuberculata
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	0.7600	0.7600	0.8200	0.8100
WAF Control	0.9300	0.8900	0.8700	0.9100
350	0.7500	0.9000	0.8500	0.8700
720	0.8700	0.8100	0.7900	0.8200
1673	0.7800	0.8700	0.7500	0.8200
3180	0.8100	0.8500	0.8100	0.7500
7160	0.8000	0.7800	0.7900	0.8300
14060	0.4100	0.2300	0.4200	0.3300
30860	0.0000	0.0000	0.0000	0.0000
69620	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root					1-Tailed			Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.7875	0.8750	1.0925	1.0588	1.1326	3.593	4					
WAF Control	0.9000	1.0000	1.2510	1.2019	1.3030	3.477	4	*			40	400
350	0.8425	0.9361	1.1678	1.0472	1.2490	7.389	4	1.847	2.451	0.1104	63	400
*720	0.8225	0.9139	1.1373	1.0948	1.2019	4.034	4	2.525	2.451	0.1104	71	400
*1673	0.8050	0.8944	1.1161	1.0472	1.2019	6.013	4	2.996	2.451	0.1104	78	400
*3180	0.8050	0.8944	1.1150	1.0472	1.1731	4.637	4	3.021	2.451	0.1104	78	400
*7160	0.8000	0.8889	1.1076	1.0826	1.1458	2.473	4	3.185	2.451	0.1104	80	400
*14060	0.3475	0.3861	0.6280	0.5002	0.7051	15.109	4	13.837	2.451	0.1104	261	400
30860	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400
69620	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400

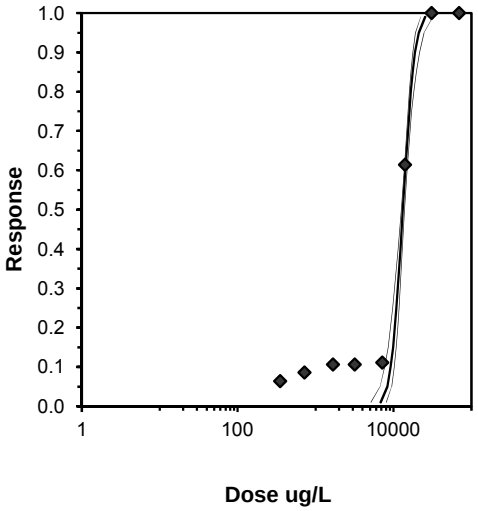
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.956873	0.924	-0.47569	0.016491
Bartlett's Test indicates equal variances (p = 0.50)	5.347583	16.81189		
The control means are significantly different (p = 1.65E-03)	5.407685	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	350	720	501.996		0.075077	0.083314	0.16506	0.004053	1.7E-10	6, 21
Treatments vs WAF Control										

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	8.184476	1.175402	5.880688	10.48826	0.1	6.111686	12.59159	0.41	4.120661	0.122183	15
Intercept	-28.7255	4.881007	-38.2922	-19.1587							
TSCR	0.168365	0.007944	0.152795	0.183936							

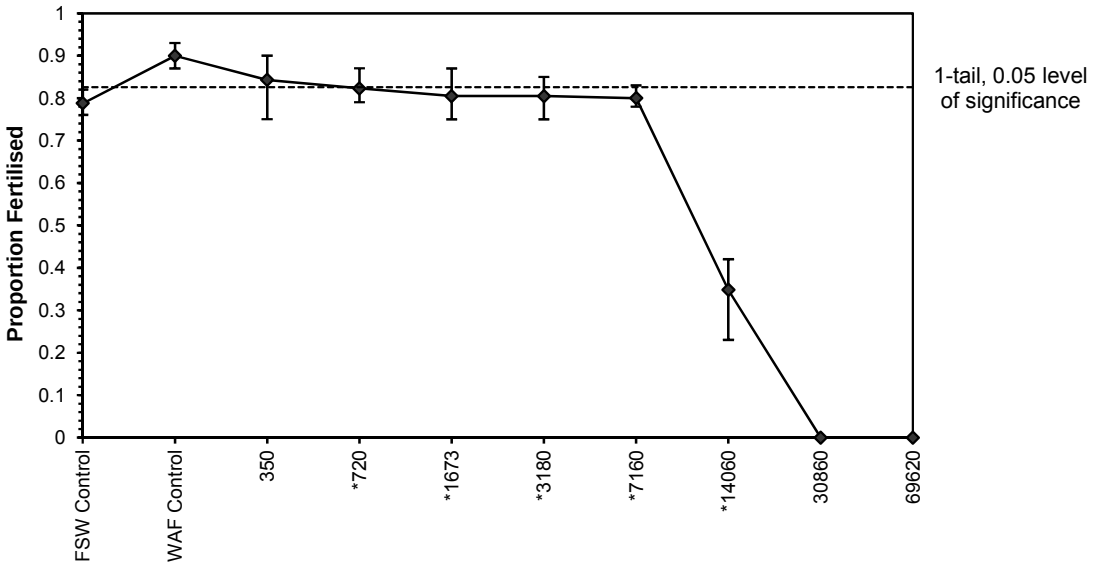
Point	Probits	ug/L	95% Fiducial Limits	
EC01	2.674	6861.551	5129.257	8091.332
EC05	3.355	8311.683	6688.936	9409.815
EC10	3.718	9206.152	7702.422	10203.02
EC15	3.964	9863.415	8468.76	10779.25
EC20	4.158	10419.09	9128.97	11263.89
EC25	4.326	10920.7	9732.943	11700.96
EC40	4.747	12294.38	11406.6	12914.51
EC50	5.000	13202.66	12495.25	13763.39
EC60	5.253	14178.03	13586.08	14777.9
EC75	5.674	15961.44	15266.99	17010.68
EC80	5.842	16729.88	15906.41	18082.49
EC85	6.036	17672.39	16656.57	19451.22
EC90	6.282	18934.09	17624.56	21353.38
EC95	6.645	20971.7	19133.71	24558.6
EC99	7.326	25403.9	22273.69	31994.42



Sea Urchin Fertilisation Test-Proportion Fertilised

Start Date:	10/09/2015 11:30	Test ID:	PR1244/01b	Sample ID:	Borossa Field Condensate
End Date:	10/09/2015 12:50	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 104	Test Species:	HT-Heliocidaris tuberculata
Comments:	TRH				

Dose-Response Plot



Sea Urchin Fertilisation Test-Proportion Fertilised

Start Date:	10/09/2015 11:30	Test ID:	PR1244/01b	Sample ID:	Borossa Field Condensate
End Date:	10/09/2015 12:50	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 104	Test Species:	HT-Heliocidaris tuberculata
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Fertilised	78.75	76.00	82.00	3.20	2.27	4
WAF Control		90.00	87.00	93.00	2.58	1.79	4
350		84.25	75.00	90.00	6.50	3.03	4
720		82.25	79.00	87.00	3.40	2.24	4
1673		80.50	75.00	87.00	5.20	2.83	4
3180		80.50	75.00	85.00	4.12	2.52	4
7160		80.00	78.00	83.00	2.16	1.84	4
14060		34.75	23.00	42.00	8.81	8.54	4
30860		0.00	0.00	0.00	0.00		4
69620		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
350		8.10	8.10	8.10	0.00	0.00	1
720		8.10	8.10	8.10	0.00	0.00	1
1673		8.10	8.10	8.10	0.00	0.00	1
3180		8.10	8.10	8.10	0.00	0.00	1
7160		8.00	8.00	8.00	0.00	0.00	1
14060		7.90	7.90	7.90	0.00	0.00	1
30860		7.70	7.70	7.70	0.00	0.00	1
69620		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
350		35.40	35.40	35.40	0.00	0.00	1
720		35.40	35.40	35.40	0.00	0.00	1
1673		35.40	35.40	35.40	0.00	0.00	1
3180		35.40	35.40	35.40	0.00	0.00	1
7160		35.50	35.50	35.50	0.00	0.00	1
14060		35.50	35.50	35.50	0.00	0.00	1
30860		35.60	35.60	35.60	0.00	0.00	1
69620		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
350		100.00	100.00	100.00	0.00	0.00	1
720		99.60	99.60	99.60	0.00	0.00	1
1673		91.80	91.80	91.80	0.00	0.00	1
3180		96.10	96.10	96.10	0.00	0.00	1
7160		98.70	98.70	98.70	0.00	0.00	1
14060		90.10	90.10	90.10	0.00	0.00	1
30860		90.20	90.20	90.20	0.00	0.00	1
69620		87.20	87.20	87.20	0.00	0.00	1

Appendix L: Statistical Analyses of the Sea Urchin Larval Development Test

Sea Urchin Larval Development Test-Proportion Normal

Start Date:	10/09/2015 12:45	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	13/09/2015 12:45	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 105	Test Species:	HT-Heliocidaris tuberculata
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4
FSW Control	0.8600	0.8400	0.7600	0.7700
WAF Control	0.9000	0.8700	0.8500	0.8900
1.2	0.8500	0.8600	0.8200	0.7900
2.4	0.7800	0.7900	0.8600	0.8900
4.8	0.9100	0.7500	0.8500	0.8600
9.7	0.8900	0.8600	0.7800	0.8200
19.3	0.8400	0.8400	0.8100	0.7500
38.6	0.0200	0.0300	0.0000	0.0100
77.2	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.8075	0.9202	1.1190	1.0588	1.1873	5.710	4					
WAF Control	0.8775	1.0000	1.2142	1.1731	1.2490	2.772	4	*			49	400
1.2	0.8300	0.9459	1.1470	1.0948	1.1873	3.644	4	1.552	2.451	0.1062	68	400
2.4	0.8300	0.9459	1.1493	1.0826	1.2327	6.320	4	1.497	2.451	0.1062	68	400
4.8	0.8425	0.9601	1.1684	1.0472	1.2661	7.752	4	1.056	2.451	0.1062	63	400
9.7	0.8375	0.9544	1.1588	1.0826	1.2327	5.630	4	1.278	2.451	0.1062	65	400
19.3	0.8100	0.9231	1.1214	1.0472	1.1593	4.713	4	2.142	2.451	0.1062	76	400
*38.6	0.0150	0.0171	0.1165	0.0500	0.1741	46.067	4	25.329	2.451	0.1062	394	400
77.2	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400

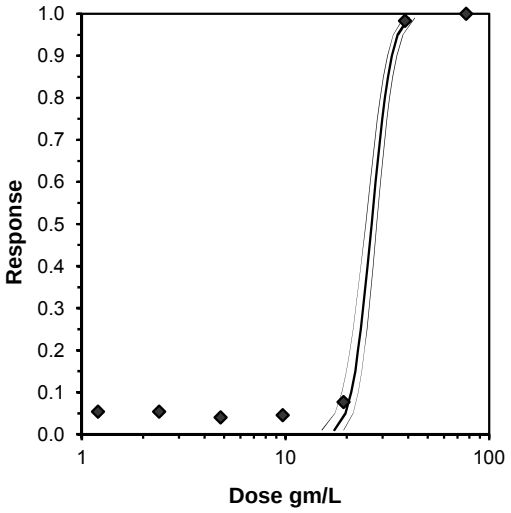
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.9702	0.924	-0.29751	-0.48312
Bartlett's Test indicates equal variances (p = 0.76)	3.405559	16.81189		
The control means are significantly different (p = 0.04)	2.636326	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	19.3	38.6	27.29432		0.077486	0.088239	0.62519	0.003756	1.4E-16	6, 21
Treatments vs WAF Control										

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	12.80885	1.109446	10.63434	14.98337	0.1225	1.216596	11.0705	0.94	1.422494	0.078071	8
Intercept	-13.2205	1.676767	-16.507	-9.93405							
TSCR	0.1565	0.008124	0.140576	0.172424							

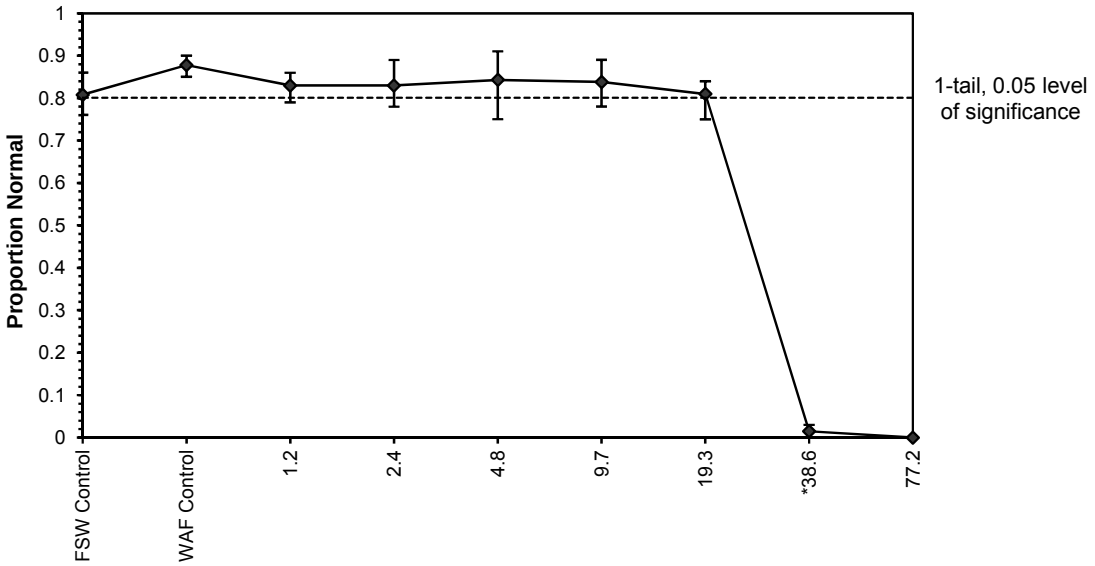
Point	Probits	gm/L	95% Fiducial Limits	
EC01	2.674	17.41299	15.13301	19.30053
EC05	3.355	19.68241	17.49698	21.48321
EC10	3.718	21.01075	18.89652	22.75572
EC15	3.964	21.95726	19.89879	23.66218
EC20	4.158	22.73984	20.7296	24.41245
EC25	4.326	23.43341	21.46688	25.07866
EC40	4.747	25.27636	23.42552	26.85922
EC50	5.000	26.45414	24.67237	28.00939
EC60	5.253	27.68679	25.96848	29.22808
EC75	5.674	29.86425	28.22241	31.43128
EC80	5.842	30.77512	29.14738	32.37631
EC85	6.036	31.87198	30.24463	33.53511
EC90	6.282	33.30777	31.65174	35.08805
EC95	6.645	35.55568	33.78822	37.6012
EC99	7.326	40.18962	37.97549	43.05577



Sea Urchin Larval Development Test-Proportion Normal

Start Date:	10/09/2015 12:45	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	13/09/2015 12:45	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 105	Test Species:	HT-Heliocidaris tuberculata
Comments:	Loading Rate				

Dose-Response Plot



Sea Urchin Larval Development Test-Proportion Normal

Start Date:	10/09/2015 12:45	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	13/09/2015 12:45	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 105	Test Species:	HT-Heliocidaris tuberculata
Comments:	Loading Rate				

		Auxiliary Data Summary					
Conc-gm/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
FSW Control	% Normal	80.75	76.00	86.00	4.99	2.77	4
WAF Control		87.75	85.00	90.00	2.22	1.70	4
1.2		83.00	79.00	86.00	3.16	2.14	4
2.4		83.00	78.00	89.00	5.35	2.79	4
4.8		84.25	75.00	91.00	6.70	3.07	4
9.7		83.75	78.00	89.00	4.79	2.61	4
19.3		81.00	75.00	84.00	4.24	2.54	4
38.6		1.50	0.00	3.00	1.29	75.75	4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
1.2		8.10	8.10	8.10	0.00	0.00	1
2.4		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.00	8.00	8.00	0.00	0.00	1
19.3		7.90	7.90	7.90	0.00	0.00	1
38.6		7.70	7.70	7.70	0.00	0.00	1
77.2		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
1.2		35.40	35.40	35.40	0.00	0.00	1
2.4		35.40	35.40	35.40	0.00	0.00	1
4.8		35.40	35.40	35.40	0.00	0.00	1
9.7		35.50	35.50	35.50	0.00	0.00	1
19.3		35.50	35.50	35.50	0.00	0.00	1
38.6		35.60	35.60	35.60	0.00	0.00	1
77.2		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
1.2		99.60	99.60	99.60	0.00	0.00	1
2.4		91.80	91.80	91.80	0.00	0.00	1
4.8		96.10	96.10	96.10	0.00	0.00	1
9.7		98.70	98.70	98.70	0.00	0.00	1
19.3		90.10	90.10	90.10	0.00	0.00	1
38.6		90.20	90.20	90.20	0.00	0.00	1
77.2		87.20	87.20	87.20	0.00	0.00	1

Sea Urchin Larval Development Test-Proportion Normal

Start Date:	10/09/2015 12:45	Test ID:	PR1244/02b	Sample ID:	Borossa Field Condensate
End Date:	13/09/2015 12:45	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 105	Test Species:	HT-Heliocidaris tuberculata
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	0.8600	0.8400	0.7600	0.7700
WAF Control	0.9000	0.8700	0.8500	0.8900
720	0.8500	0.8600	0.8200	0.7900
1673	0.7800	0.7900	0.8600	0.8900
3180	0.9100	0.7500	0.8500	0.8600
7160	0.8900	0.8600	0.7800	0.8200
14060	0.8400	0.8400	0.8100	0.7500
30860	0.0200	0.0300	0.0000	0.0100
69620	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.8075	0.9202	1.1190	1.0588	1.1873	5.710	4					
WAF Control	0.8775	1.0000	1.2142	1.1731	1.2490	2.772	4	*			49	400
720	0.8300	0.9459	1.1470	1.0948	1.1873	3.644	4	1.552	2.451	0.1062	68	400
1673	0.8300	0.9459	1.1493	1.0826	1.2327	6.320	4	1.497	2.451	0.1062	68	400
3180	0.8425	0.9601	1.1684	1.0472	1.2661	7.752	4	1.056	2.451	0.1062	63	400
7160	0.8375	0.9544	1.1588	1.0826	1.2327	5.630	4	1.278	2.451	0.1062	65	400
14060	0.8100	0.9231	1.1214	1.0472	1.1593	4.713	4	2.142	2.451	0.1062	76	400
*30860	0.0150	0.0171	0.1165	0.0500	0.1741	46.067	4	25.329	2.451	0.1062	394	400
69620	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400

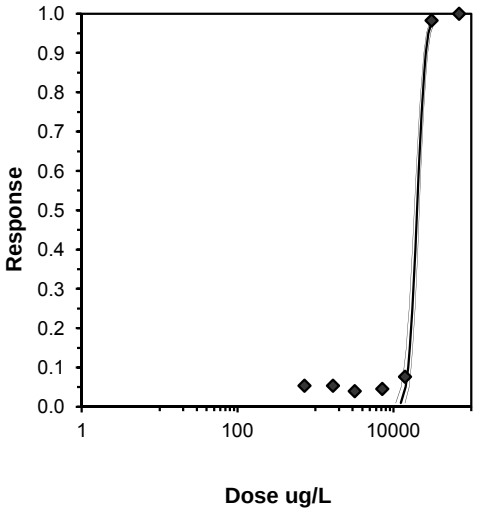
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.9702	0.924	-0.29751	-0.48312
Bartlett's Test indicates equal variances (p = 0.76)	3.405559	16.81189		
The control means are significantly different (p = 0.04)	2.636326	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	14060	30860	20830.06		0.077486	0.088239	0.62519	0.003756	1.4E-16	6, 21
Treatments vs WAF Control										

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	11.29387	0.978228	9.376539	13.21119	0.1225	1.216603	11.0705	0.94	4.30329	0.088544	8
Intercept	-43.6008	4.30439	-52.0374	-35.1642							
TSCR	0.1565	0.008124	0.140576	0.172424							

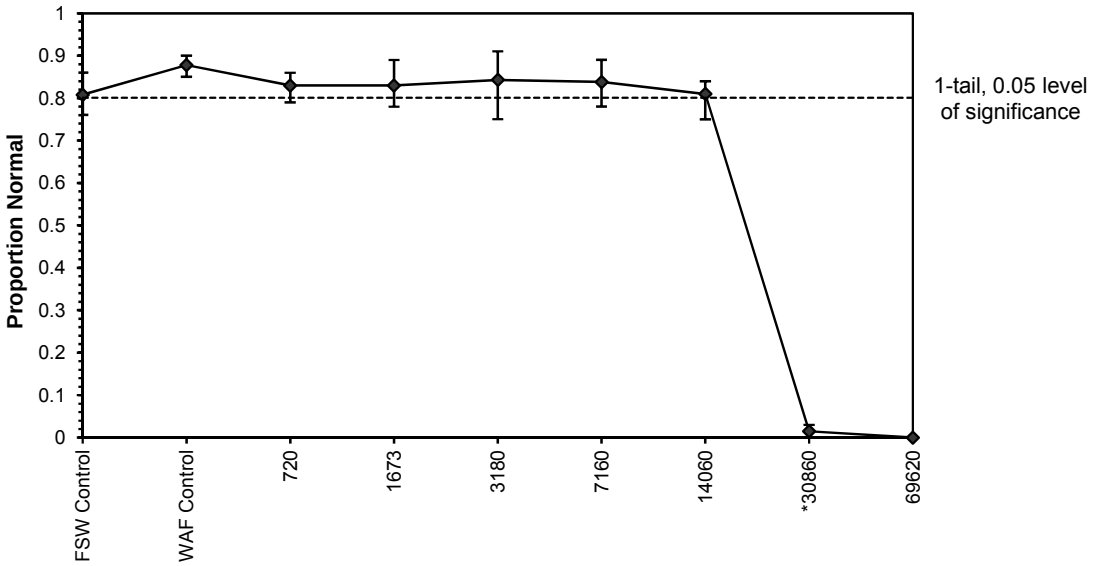
Point	Probits	ug/L	95% Fiducial Limits	
EC01	2.674	12511.43	10670.46	14060.43
EC05	3.355	14376.36	12579.9	15877.06
EC10	3.718	15481.64	13727.1	16947.82
EC15	3.964	16274.99	14555.74	17715.52
EC20	4.158	16934.41	15246.91	18353.93
EC25	4.326	17521.39	15863.37	18923.02
EC40	4.747	19092.29	17514.7	20453.87
EC50	5.000	20104.36	18575.71	21450.06
EC60	5.253	21170.08	19686.28	22511.6
EC75	5.674	23068.11	21635.17	24445.67
EC80	5.842	23867.7	22441.11	25280.93
EC85	6.036	24834.76	23401.61	26309.6
EC90	6.282	26107.39	24640.21	27695.61
EC95	6.645	28114.58	26534.89	29955.98
EC99	7.326	32305.29	30294.34	34930.5



Sea Urchin Larval Development Test-Proportion Normal

Start Date:	10/09/2015 12:45	Test ID:	PR1244/02b	Sample ID:	Borossa Field Condensate
End Date:	13/09/2015 12:45	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 105	Test Species:	HT-Heliocidaris tuberculata
Comments:	TRH				

Dose-Response Plot



Sea Urchin Larval Development Test-Proportion Normal

Start Date:	10/09/2015 12:45	Test ID:	PR1244/02b	Sample ID:	Borossa Field Condensate
End Date:	13/09/2015 12:45	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 105	Test Species:	HT-Heliocidaris tuberculata
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Normal	80.75	76.00	86.00	4.99	2.77	4
WAF Control		87.75	85.00	90.00	2.22	1.70	4
720		83.00	79.00	86.00	3.16	2.14	4
1673		83.00	78.00	89.00	5.35	2.79	4
3180		84.25	75.00	91.00	6.70	3.07	4
7160		83.75	78.00	89.00	4.79	2.61	4
14060		81.00	75.00	84.00	4.24	2.54	4
30860		1.50	0.00	3.00	1.29	75.75	4
69620		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
720		8.10	8.10	8.10	0.00	0.00	1
1673		8.10	8.10	8.10	0.00	0.00	1
3180		8.10	8.10	8.10	0.00	0.00	1
7160		8.00	8.00	8.00	0.00	0.00	1
14060		7.90	7.90	7.90	0.00	0.00	1
30860		7.70	7.70	7.70	0.00	0.00	1
69620		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
720		35.40	35.40	35.40	0.00	0.00	1
1673		35.40	35.40	35.40	0.00	0.00	1
3180		35.40	35.40	35.40	0.00	0.00	1
7160		35.50	35.50	35.50	0.00	0.00	1
14060		35.50	35.50	35.50	0.00	0.00	1
30860		35.60	35.60	35.60	0.00	0.00	1
69620		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
720		99.60	99.60	99.60	0.00	0.00	1
1673		91.80	91.80	91.80	0.00	0.00	1
3180		96.10	96.10	96.10	0.00	0.00	1
7160		98.70	98.70	98.70	0.00	0.00	1
14060		90.10	90.10	90.10	0.00	0.00	1
30860		90.20	90.20	90.20	0.00	0.00	1
69620		87.20	87.20	87.20	0.00	0.00	1

Appendix M: Statistical Analyses of the Milky Oyster Larval Development Test

Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4
FSW Control	0.7200	0.7900	0.7800	0.6900
WAF Control	0.6800	0.7300	0.7400	0.7500
1.2	0.7600	0.7000	0.6800	0.6900
2.4	0.6900	0.7400	0.7100	0.7600
4.8	0.7800	0.7200	0.6800	0.7100
9.7	0.7100	0.7600	0.7400	0.7300
19.3	0.6300	0.5900	0.6400	0.6200
38.6	0.0000	0.0000	0.0000	0.0000
77.2	0.0000	0.0000	0.0000	0.0000

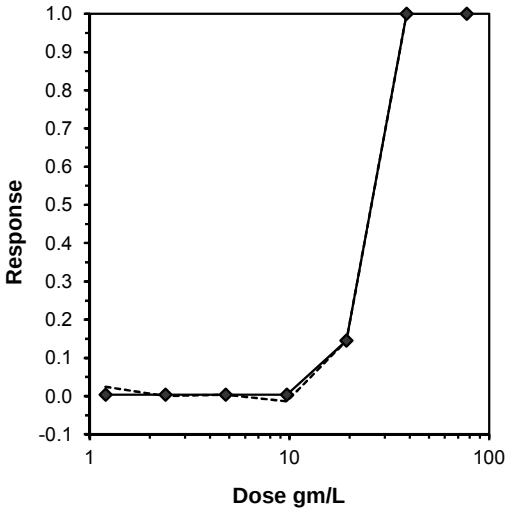
			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.7450	1.0276	1.0427	0.9803	1.0948	5.272	4					
WAF Control	0.7250	1.0000	1.0192	0.9695	1.0472	3.376	4	*			110	400
1.2	0.7075	0.9759	1.0000	0.9695	1.0588	4.023	4	0.779	2.410	0.0596	117	400
2.4	0.7250	1.0000	1.0192	0.9803	1.0588	3.421	4	-0.001	2.410	0.0596	110	400
4.8	0.7225	0.9966	1.0169	0.9695	1.0826	4.679	4	0.095	2.410	0.0596	111	400
9.7	0.7350	1.0138	1.0303	1.0021	1.0588	2.291	4	-0.447	2.410	0.0596	106	400
*19.3	0.6200	0.8552	0.9067	0.8759	0.9273	2.448	4	4.553	2.410	0.0596	152	400
38.6	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400
77.2	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.974316	0.916	0.369425	-0.29632
Bartlett's Test indicates equal variances (p = 0.82)	2.211731	15.08627		
The control means are not significantly different (p = 0.50)	0.724702	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	9.7	19.3	13.68247		0.054646	0.075334	0.008512	0.001222	8.8E-04	5, 18
Treatments vs WAF Control										

Trimmed Spearman-Karber

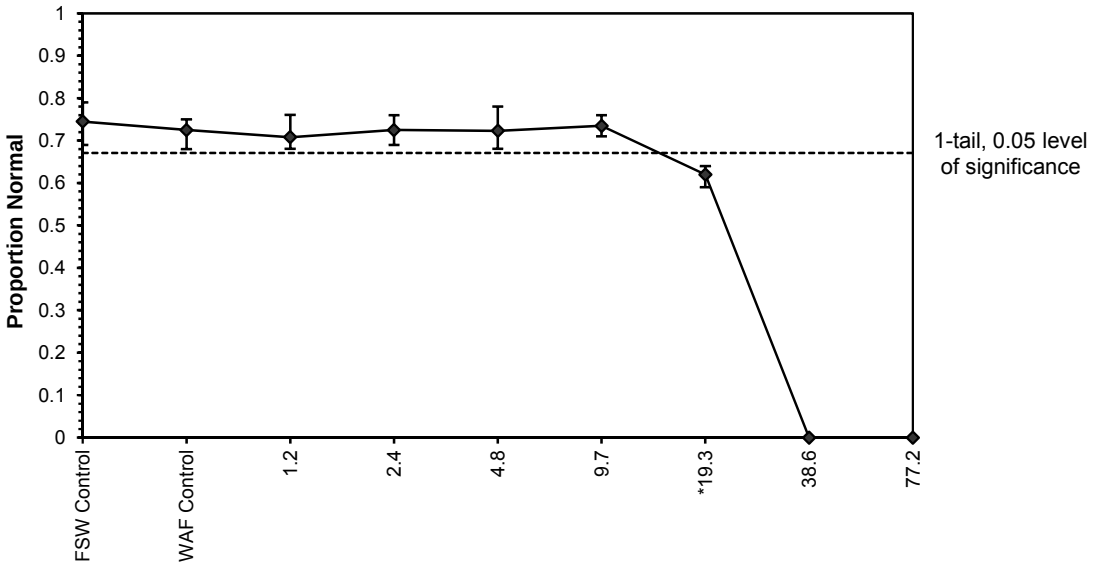
Trim Level	EC50	95% CL	
0.0%			
5.0%	25.222	24.515	25.950
10.0%	25.608	24.672	26.579
20.0%	25.738	25.313	26.171
Auto-0.3%	24.709	24.110	25.323



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	Loading Rate				

Dose-Response Plot



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	Loading Rate				

		Auxiliary Data Summary					
Conc-gm/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
FSW Control	% Normal	74.50	69.00	79.00	4.80	2.94	4
WAF Control		72.50	68.00	75.00	3.11	2.43	4
1.2		70.75	68.00	76.00	3.59	2.68	4
2.4		72.50	69.00	76.00	3.11	2.43	4
4.8		72.25	68.00	78.00	4.19	2.83	4
9.7		73.50	71.00	76.00	2.08	1.96	4
19.3		62.00	59.00	64.00	2.16	2.37	4
38.6		0.00	0.00	0.00	0.00		4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
1.2		8.10	8.10	8.10	0.00	0.00	1
2.4		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.00	8.00	8.00	0.00	0.00	1
19.3		7.90	7.90	7.90	0.00	0.00	1
38.6		7.70	7.70	7.70	0.00	0.00	1
77.2		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
1.2		35.40	35.40	35.40	0.00	0.00	1
2.4		35.40	35.40	35.40	0.00	0.00	1
4.8		35.40	35.40	35.40	0.00	0.00	1
9.7		35.50	35.50	35.50	0.00	0.00	1
19.3		35.50	35.50	35.50	0.00	0.00	1
38.6		35.60	35.60	35.60	0.00	0.00	1
77.2		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
1.2		99.60	99.60	99.60	0.00	0.00	1
2.4		91.80	91.80	91.80	0.00	0.00	1
4.8		96.10	96.10	96.10	0.00	0.00	1
9.7		98.70	98.70	98.70	0.00	0.00	1
19.3		90.10	90.10	90.10	0.00	0.00	1
38.6		90.20	90.20	90.20	0.00	0.00	1
77.2		87.20	87.20	87.20	0.00	0.00	1

Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4
FSW Control	0.7200	0.7900	0.7800	0.6900
WAF Control	0.6800	0.7300	0.7400	0.7500
1.2	0.7600	0.7000	0.6800	0.6900
2.4	0.6900	0.7400	0.7100	0.7600
4.8	0.7800	0.7200	0.6800	0.7100
9.7	0.7100	0.7600	0.7400	0.7300
19.3	0.6300	0.5900	0.6400	0.6200
38.6	0.0000	0.0000	0.0000	0.0000
77.2	0.0000	0.0000	0.0000	0.0000

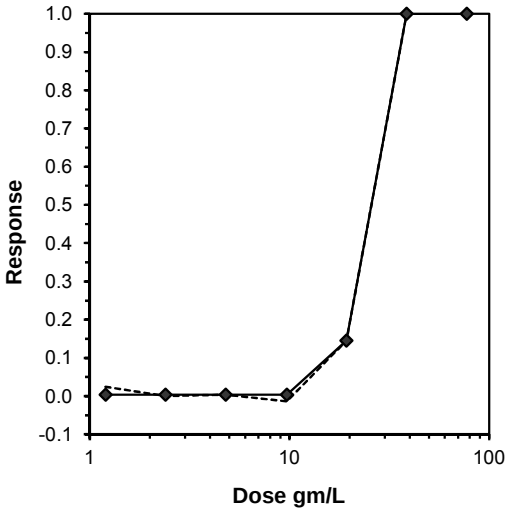
			Transform: Arcsin Square Root					1-Tailed			Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	0.7450	1.0276	1.0427	0.9803	1.0948	5.272	4					
WAF Control	0.7250	1.0000	1.0192	0.9695	1.0472	3.376	4	*			0.7250	1.0000
1.2	0.7075	0.9759	1.0000	0.9695	1.0588	4.023	4	0.779	2.410	0.0596	0.7225	0.9966
2.4	0.7250	1.0000	1.0192	0.9803	1.0588	3.421	4	-0.001	2.410	0.0596	0.7225	0.9966
4.8	0.7225	0.9966	1.0169	0.9695	1.0826	4.679	4	0.095	2.410	0.0596	0.7225	0.9966
9.7	0.7350	1.0138	1.0303	1.0021	1.0588	2.291	4	-0.447	2.410	0.0596	0.7225	0.9966
*19.3	0.6200	0.8552	0.9067	0.8759	0.9273	2.448	4	4.553	2.410	0.0596	0.6200	0.8552
38.6	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				0.0000	0.0000
77.2	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.974316	0.916	0.369425	-0.29632
Bartlett's Test indicates equal variances (p = 0.82)	2.211731	15.08627		
The control means are not significantly different (p = 0.50)	0.724702	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	9.7	19.3	13.68247		0.054646	0.075334	0.008512	0.001222	8.8E-04	5, 18
Treatments vs WAF Control										

Log-Logit Interpolation (200 Resamples)

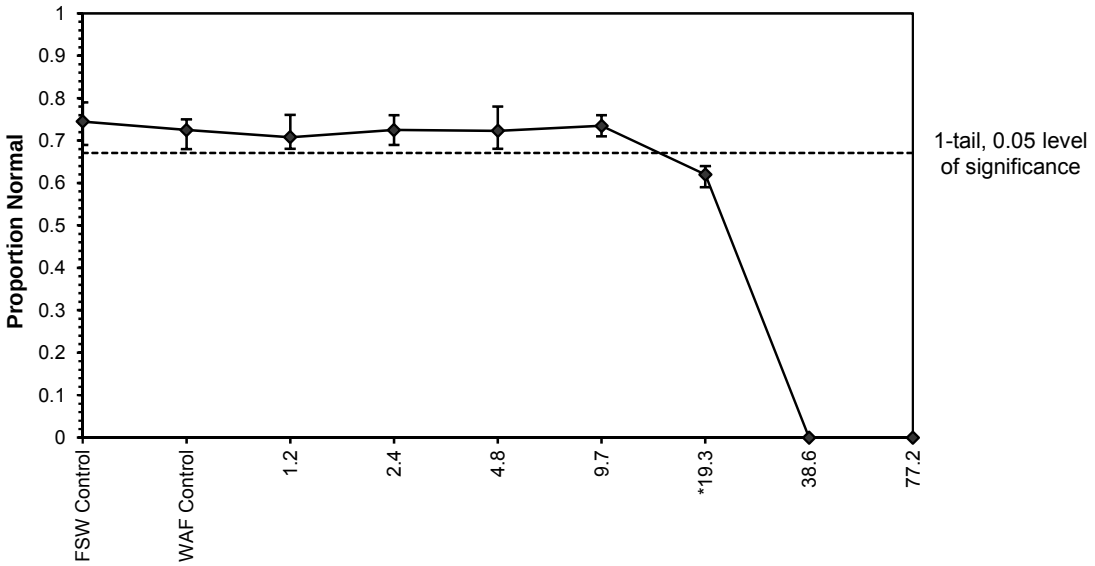
Point	gm/L	SD	95% CL(Exp)		Skew
IC05	12.371	1.054	9.095	13.474	-5.6672
IC10	15.745	1.017	11.783	18.345	-0.1579
IC15	19.322	0.819	14.886	19.494	-1.6728
IC20	19.535	0.082	19.253	19.698	-1.9600
IC25	19.744	0.071	19.470	19.901	-0.5760
IC40	20.378	0.066	20.122	20.523	-0.5922
IC50	20.829	0.064	20.582	20.970	-0.5981



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	Loading Rate				

Dose-Response Plot



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	Loading Rate				

		Auxiliary Data Summary					
Conc-gm/L	**Parameter**	**Mean**	**Min**	**Max**	**SD**	**CV%**	**N**
FSW Control	% Normal	74.50	69.00	79.00	4.80	2.94	4
WAF Control		72.50	68.00	75.00	3.11	2.43	4
1.2		70.75	68.00	76.00	3.59	2.68	4
2.4		72.50	69.00	76.00	3.11	2.43	4
4.8		72.25	68.00	78.00	4.19	2.83	4
9.7		73.50	71.00	76.00	2.08	1.96	4
19.3		62.00	59.00	64.00	2.16	2.37	4
38.6		0.00	0.00	0.00	0.00		4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
1.2		8.10	8.10	8.10	0.00	0.00	1
2.4		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.00	8.00	8.00	0.00	0.00	1
19.3		7.90	7.90	7.90	0.00	0.00	1
38.6		7.70	7.70	7.70	0.00	0.00	1
77.2		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
1.2		35.40	35.40	35.40	0.00	0.00	1
2.4		35.40	35.40	35.40	0.00	0.00	1
4.8		35.40	35.40	35.40	0.00	0.00	1
9.7		35.50	35.50	35.50	0.00	0.00	1
19.3		35.50	35.50	35.50	0.00	0.00	1
38.6		35.60	35.60	35.60	0.00	0.00	1
77.2		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
1.2		99.60	99.60	99.60	0.00	0.00	1
2.4		91.80	91.80	91.80	0.00	0.00	1
4.8		96.10	96.10	96.10	0.00	0.00	1
9.7		98.70	98.70	98.70	0.00	0.00	1
19.3		90.10	90.10	90.10	0.00	0.00	1
38.6		90.20	90.20	90.20	0.00	0.00	1
77.2		87.20	87.20	87.20	0.00	0.00	1

Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04b	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	0.7200	0.7900	0.7800	0.6900
WAF Control	0.6800	0.7300	0.7400	0.7500
720	0.7600	0.7000	0.6800	0.6900
1673	0.6900	0.7400	0.7100	0.7600
3180	0.7800	0.7200	0.6800	0.7100
7160	0.7100	0.7600	0.7400	0.7300
14060	0.6300	0.5900	0.6400	0.6200
30860	0.0000	0.0000	0.0000	0.0000
69620	0.0000	0.0000	0.0000	0.0000

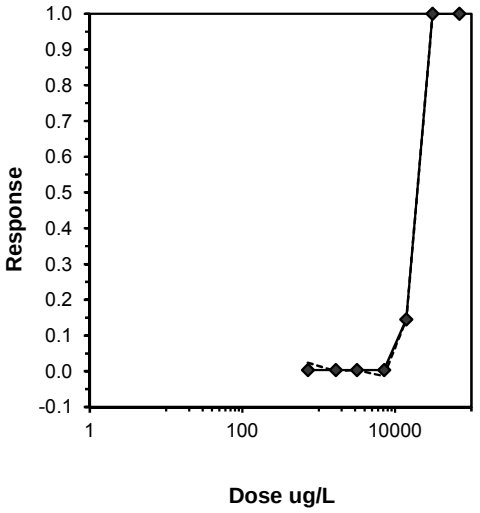
			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.7450	1.0276	1.0427	0.9803	1.0948	5.272	4					
WAF Control	0.7250	1.0000	1.0192	0.9695	1.0472	3.376	4	*			110	400
720	0.7075	0.9759	1.0000	0.9695	1.0588	4.023	4	0.779	2.410	0.0596	117	400
1673	0.7250	1.0000	1.0192	0.9803	1.0588	3.421	4	-0.001	2.410	0.0596	110	400
3180	0.7225	0.9966	1.0169	0.9695	1.0826	4.679	4	0.095	2.410	0.0596	111	400
7160	0.7350	1.0138	1.0303	1.0021	1.0588	2.291	4	-0.447	2.410	0.0596	106	400
*14060	0.6200	0.8552	0.9067	0.8759	0.9273	2.448	4	4.553	2.410	0.0596	152	400
30860	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400
69620	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				400	400

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.974316	0.916	0.369425	-0.29632
Bartlett's Test indicates equal variances (p = 0.82)	2.211731	15.08627		
The control means are not significantly different (p = 0.50)	0.724702	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	7160	14060	10033.42		0.054646	0.075334	0.008512	0.001222	8.8E-04	5, 18
Treatments vs WAF Control										

Trimmed Spearman-Karber

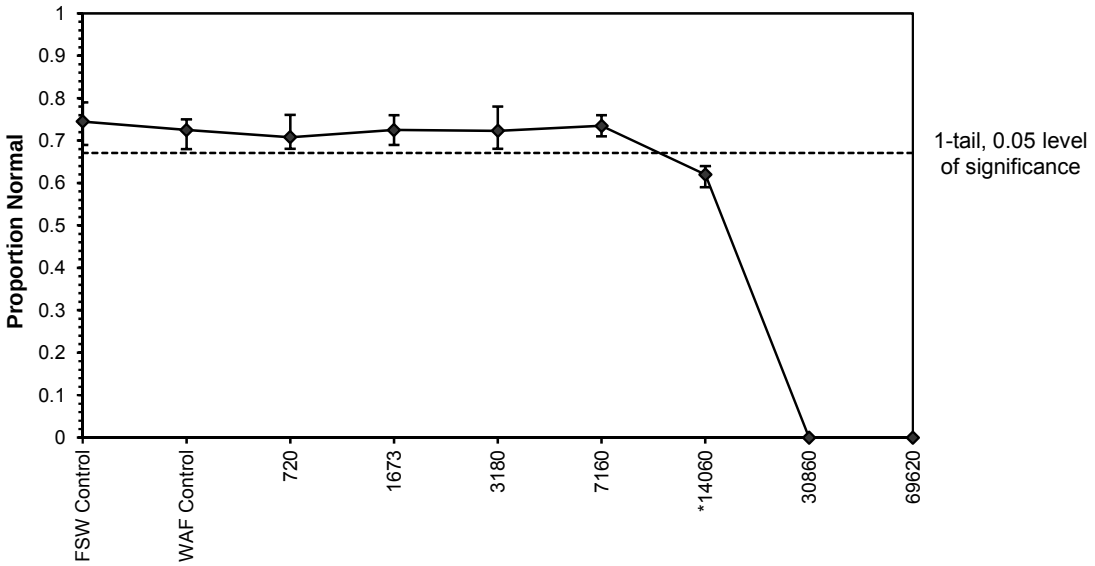
Trim Level	EC50	95% CL	
0.0%			
5.0%	19116.99	18552.77	19698.36
10.0%	19394.51	18656.02	20162.23
20.0%	19488.61	19123.45	19860.75
Auto-0.3%	18747.24	18266.79	19240.34



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04b	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	TRH				

Dose-Response Plot



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04b	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Normal	74.50	69.00	79.00	4.80	2.94	4
WAF Control		72.50	68.00	75.00	3.11	2.43	4
720		70.75	68.00	76.00	3.59	2.68	4
1673		72.50	69.00	76.00	3.11	2.43	4
3180		72.25	68.00	78.00	4.19	2.83	4
7160		73.50	71.00	76.00	2.08	1.96	4
14060		62.00	59.00	64.00	2.16	2.37	4
30860		0.00	0.00	0.00	0.00		4
69620		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
720		8.10	8.10	8.10	0.00	0.00	1
1673		8.10	8.10	8.10	0.00	0.00	1
3180		8.10	8.10	8.10	0.00	0.00	1
7160		8.00	8.00	8.00	0.00	0.00	1
14060		7.90	7.90	7.90	0.00	0.00	1
30860		7.70	7.70	7.70	0.00	0.00	1
69620		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
720		35.40	35.40	35.40	0.00	0.00	1
1673		35.40	35.40	35.40	0.00	0.00	1
3180		35.40	35.40	35.40	0.00	0.00	1
7160		35.50	35.50	35.50	0.00	0.00	1
14060		35.50	35.50	35.50	0.00	0.00	1
30860		35.60	35.60	35.60	0.00	0.00	1
69620		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
720		99.60	99.60	99.60	0.00	0.00	1
1673		91.80	91.80	91.80	0.00	0.00	1
3180		96.10	96.10	96.10	0.00	0.00	1
7160		98.70	98.70	98.70	0.00	0.00	1
14060		90.10	90.10	90.10	0.00	0.00	1
30860		90.20	90.20	90.20	0.00	0.00	1
69620		87.20	87.20	87.20	0.00	0.00	1

Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04b	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	0.7200	0.7900	0.7800	0.6900
WAF Control	0.6800	0.7300	0.7400	0.7500
720	0.7600	0.7000	0.6800	0.6900
1673	0.6900	0.7400	0.7100	0.7600
3180	0.7800	0.7200	0.6800	0.7100
7160	0.7100	0.7600	0.7400	0.7300
14060	0.6300	0.5900	0.6400	0.6200
30860	0.0000	0.0000	0.0000	0.0000
69620	0.0000	0.0000	0.0000	0.0000

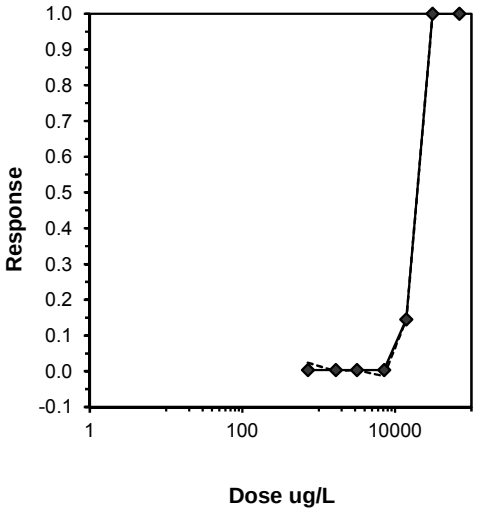
			Transform: Arcsin Square Root					1-Tailed			Isotonic	
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	0.7450	1.0276	1.0427	0.9803	1.0948	5.272	4					
WAF Control	0.7250	1.0000	1.0192	0.9695	1.0472	3.376	4	*			0.7250	1.0000
720	0.7075	0.9759	1.0000	0.9695	1.0588	4.023	4	0.779	2.410	0.0596	0.7225	0.9966
1673	0.7250	1.0000	1.0192	0.9803	1.0588	3.421	4	-0.001	2.410	0.0596	0.7225	0.9966
3180	0.7225	0.9966	1.0169	0.9695	1.0826	4.679	4	0.095	2.410	0.0596	0.7225	0.9966
7160	0.7350	1.0138	1.0303	1.0021	1.0588	2.291	4	-0.447	2.410	0.0596	0.7225	0.9966
*14060	0.6200	0.8552	0.9067	0.8759	0.9273	2.448	4	4.553	2.410	0.0596	0.6200	0.8552
30860	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				0.0000	0.0000
69620	0.0000	0.0000	0.0500	0.0500	0.0500	0.000	4				0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.974316	0.916	0.369425	-0.29632
Bartlett's Test indicates equal variances (p = 0.82)	2.211731	15.08627		
The control means are not significantly different (p = 0.50)	0.724702	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	7160	14060	10033.42		0.054646	0.075334	0.008512	0.001222	8.8E-04	5, 18
Treatments vs WAF Control										

Log-Logit Interpolation (200 Resamples)

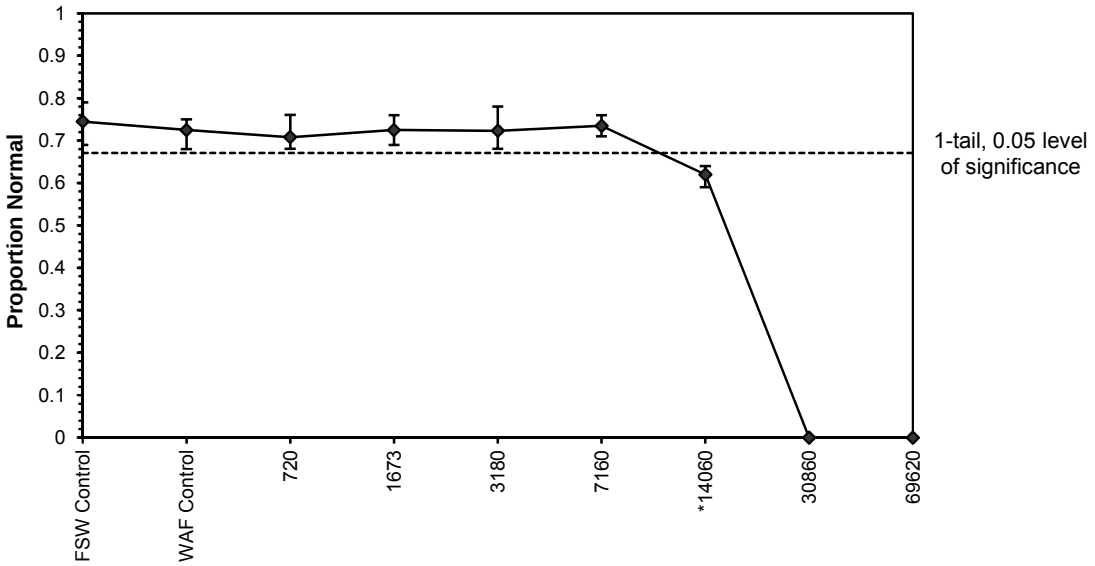
Point	ug/L	SD	95% CL(Exp)		Skew
IC05	9055.039	550.0583	6722.156	9886.09	-0.4671
IC10	11478.4	746.7707	9026.542	13230.49	0.0761
IC15	14078.12	576.9736	11380.46	14211.57	-1.1160
IC20	14251.33	59.23795	14048.25	14383.92	-0.1525
IC25	14422.52	57.71578	14222.15	14551.48	-0.1687
IC40	14942.4	54.40733	14753.36	15064.09	-0.2065
IC50	15313.95	52.80835	15128.32	15435.3	-0.2244



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04b	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	TRH				

Dose-Response Plot



Bivalve Larval Development Test-Proportion Normal

Start Date:	10/09/2015 18:00	Test ID:	PR1244/04b	Sample ID:	Borossa Field Condensate
End Date:	12/09/2015 16:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 106	Test Species:	SE-Saccostrea echinata
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Normal	74.50	69.00	79.00	4.80	2.94	4
WAF Control		72.50	68.00	75.00	3.11	2.43	4
720		70.75	68.00	76.00	3.59	2.68	4
1673		72.50	69.00	76.00	3.11	2.43	4
3180		72.25	68.00	78.00	4.19	2.83	4
7160		73.50	71.00	76.00	2.08	1.96	4
14060		62.00	59.00	64.00	2.16	2.37	4
30860		0.00	0.00	0.00	0.00		4
69620		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
720		8.10	8.10	8.10	0.00	0.00	1
1673		8.10	8.10	8.10	0.00	0.00	1
3180		8.10	8.10	8.10	0.00	0.00	1
7160		8.00	8.00	8.00	0.00	0.00	1
14060		7.90	7.90	7.90	0.00	0.00	1
30860		7.70	7.70	7.70	0.00	0.00	1
69620		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
720		35.40	35.40	35.40	0.00	0.00	1
1673		35.40	35.40	35.40	0.00	0.00	1
3180		35.40	35.40	35.40	0.00	0.00	1
7160		35.50	35.50	35.50	0.00	0.00	1
14060		35.50	35.50	35.50	0.00	0.00	1
30860		35.60	35.60	35.60	0.00	0.00	1
69620		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO %	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
720		99.60	99.60	99.60	0.00	0.00	1
1673		91.80	91.80	91.80	0.00	0.00	1
3180		96.10	96.10	96.10	0.00	0.00	1
7160		98.70	98.70	98.70	0.00	0.00	1
14060		90.10	90.10	90.10	0.00	0.00	1
30860		90.20	90.20	90.20	0.00	0.00	1
69620		87.20	87.20	87.20	0.00	0.00	1

Appendix N: Statistical Analyses of Micro-Algal Growth Inhibition Test

Marine Algal Growth Test-Cell Yield

Start Date:	11/09/2015 11:10	Test ID:	PR1244/05	Sample ID:	Borossa Field Condensate
End Date:	14/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 110	Test Species:	IG-isochrysis aff galbana
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4	5	6	7	8
FSW Control	24.809	22.609	15.409	21.609	17.009	22.609	18.409	18.809
WAF Control	18.209	17.609	16.409	18.809				
1.2	19.009	22.609	12.809	21.009				
2.4	32.209	16.409	18.209	18.809				
4.8	16.409	16.209	29.409	21.009				
9.7	14.009	6.409	18.009	16.009				
19.3	0.409	1.409	1.609	1.009				
38.6	0.000	0.000	0.000	0.000				
77.2	0.000	0.000	0.000	0.000				

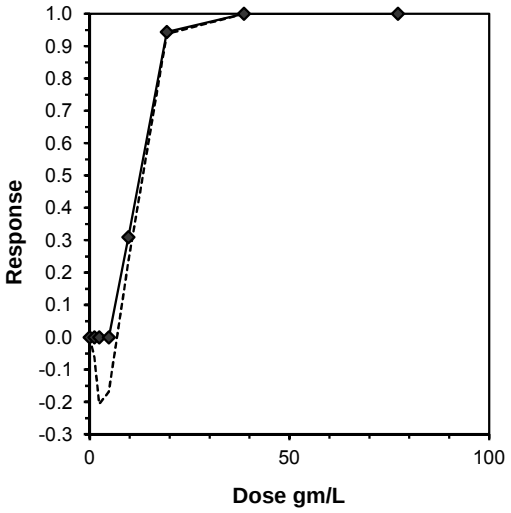
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
FSW Control	20.159	1.1351	20.159	15.409	24.809	16.030	8				
WAF Control	17.759	1.0000	17.759	16.409	18.809	5.770	4	*		19.697	1.0000
1.2	18.859	1.0619	18.859	12.809	22.609	22.768	4	22.00	10.00	19.697	1.0000
2.4	21.409	1.2055	21.409	16.409	32.209	33.966	4	20.50	10.00	19.697	1.0000
4.8	20.759	1.1689	20.759	16.209	29.409	29.761	4	18.50	10.00	19.697	1.0000
9.7	13.609	0.7663	13.609	6.409	18.009	37.256	4	12.00	10.00	13.609	0.6909
*19.3	1.109	0.0624	1.109	0.409	1.609	47.713	4	10.00	10.00	1.109	0.0563
38.6	0.000	0.0000	0.000	0.000	0.000	0.000	4			0.000	0.0000
77.2	0.000	0.0000	0.000	0.000	0.000	0.000	4			0.000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.940018	0.916	0.707398	1.092201
Bartlett's Test indicates unequal variances (p = 5.62E-03)	16.46936	15.08627		
The control means are not significantly different (p = 0.19)	1.419305	2.228139		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	9.7	19.3	13.68247	
Treatments vs WAF Control				

Linear Interpolation (200 Resamples)

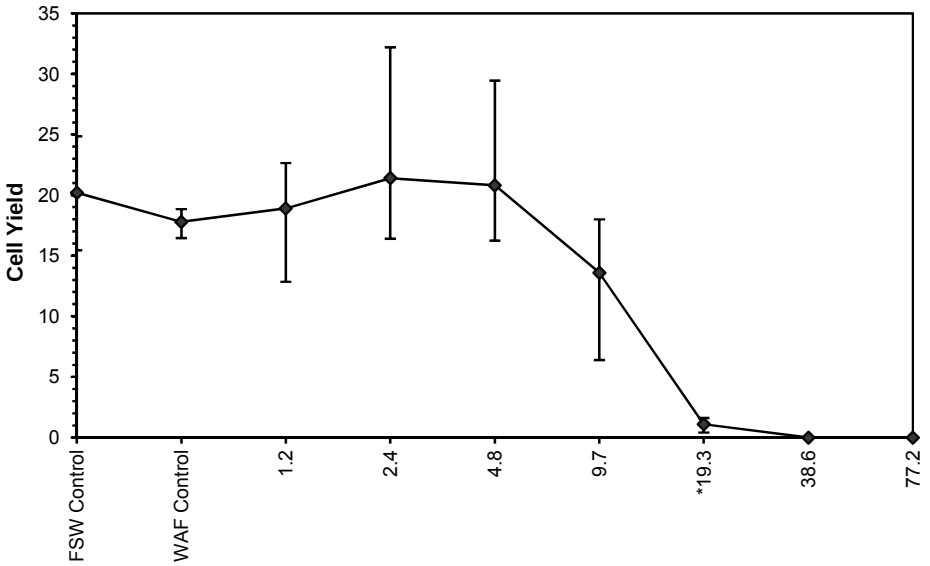
Point	gm/L	SD	95% CL(Exp)		Skew
IC05	5.593	1.260	0.093	7.552	-0.6336
IC10	6.385	1.313	2.183	10.675	0.1652
IC15	7.178	1.381	3.325	11.694	0.4336
IC20	7.971	1.427	4.320	12.176	0.2373
IC25	8.764	1.374	5.558	12.659	0.1009
IC40	11.076	1.350	6.896	14.139	-0.3797
IC50	12.588	1.286	7.448	15.094	-0.8271



Marine Algal Growth Test-Cell Yield

Start Date:	11/09/2015 11:10	Test ID:	PR1244/05	Sample ID:	Borossa Field Condensate
End Date:	14/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 110	Test Species:	IG-isochrysis aff galbana
Comments:	Loading Rate				

Dose-Response Plot



Marine Algal Growth Test-Cell Yield

Start Date:	11/09/2015 11:10	Test ID:	PR1244/05	Sample ID:	Borossa Field Condensate
End Date:	14/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 110	Test Species:	IG-isochrysis aff galbana
Comments:	Loading Rate				

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	Cell Yield	20.16	15.41	24.81	3.23	8.92	8
WAF Control		17.76	16.41	18.81	1.02	5.70	4
1.2		18.86	12.81	22.61	4.29	10.99	4
2.4		21.41	16.41	32.21	7.27	12.60	4
4.8		20.76	16.21	29.41	6.18	11.97	4
9.7		13.61	6.41	18.01	5.07	16.55	4
19.3		1.11	0.41	1.61	0.53	65.59	4
38.6		0.00	0.00	0.00	0.00		4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
1.2		8.10	8.10	8.10	0.00	0.00	1
2.4		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.10	8.10	8.10	0.00	0.00	1
19.3		8.00	8.00	8.00	0.00	0.00	1
38.6		7.80	7.80	7.80	0.00	0.00	1
77.2		7.60	7.60	7.60	0.00	0.00	1
FSW Control	Salinity ppt	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.90	35.90	35.90	0.00	0.00	1
1.2		35.60	35.60	35.60	0.00	0.00	1
2.4		35.40	35.40	35.40	0.00	0.00	1
4.8		35.30	35.30	35.30	0.00	0.00	1
9.7		35.30	35.30	35.30	0.00	0.00	1
19.3		35.60	35.60	35.60	0.00	0.00	1
38.6		35.40	35.40	35.40	0.00	0.00	1
77.2		35.40	35.40	35.40	0.00	0.00	1

Marine Algal Growth Test-Cell Yield

Start Date:	11/09/2015 11:10	Test ID:	PR1244/05b	Sample ID:	Borossa Field Condensate
End Date:	14/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 110	Test Species:	IG-isochrysis aff galbana
Comments:	TRH				

Conc-ug/L	1	2	3	4	5	6	7	8
FSW Control	24.809	22.609	15.409	21.609	17.009	22.609	18.409	18.809
WAF Control	18.209	17.609	16.409	18.809				
650	19.009	22.609	12.809	21.009				
1400	32.209	16.409	18.209	18.809				
3248	16.409	16.209	29.409	21.009				
6670	14.009	6.409	18.009	16.009				
12850	0.409	1.409	1.609	1.009				
27960	0.000	0.000	0.000	0.000				
65830	0.000	0.000	0.000	0.000				

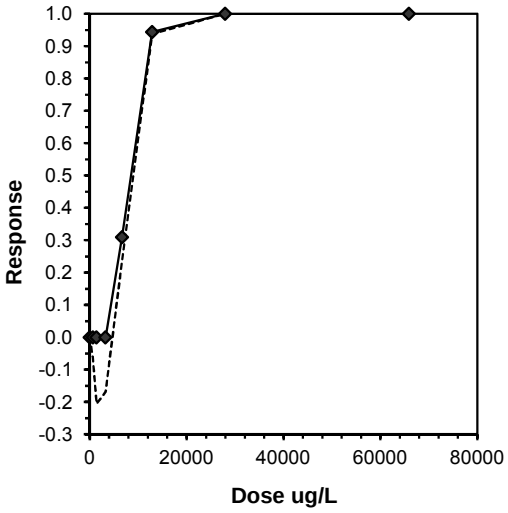
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
FSW Control	20.159	1.1351	20.159	15.409	24.809	16.030	8				
WAF Control	17.759	1.0000	17.759	16.409	18.809	5.770	4	*		19.697	1.0000
650	18.859	1.0619	18.859	12.809	22.609	22.768	4	22.00	10.00	19.697	1.0000
1400	21.409	1.2055	21.409	16.409	32.209	33.966	4	20.50	10.00	19.697	1.0000
3248	20.759	1.1689	20.759	16.209	29.409	29.761	4	18.50	10.00	19.697	1.0000
6670	13.609	0.7663	13.609	6.409	18.009	37.256	4	12.00	10.00	13.609	0.6909
*12850	1.109	0.0624	1.109	0.409	1.609	47.713	4	10.00	10.00	1.109	0.0563
27960	0.000	0.0000	0.000	0.000	0.000	0.000	4			0.000	0.0000
65830	0.000	0.0000	0.000	0.000	0.000	0.000	4			0.000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.940018	0.916	0.707398	1.092201
Bartlett's Test indicates unequal variances (p = 5.62E-03)	16.46936	15.08627		
The control means are not significantly different (p = 0.19)	1.419305	2.228139		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	6670	12850	9257.943	
Treatments vs WAF Control				

Linear Interpolation (200 Resamples)

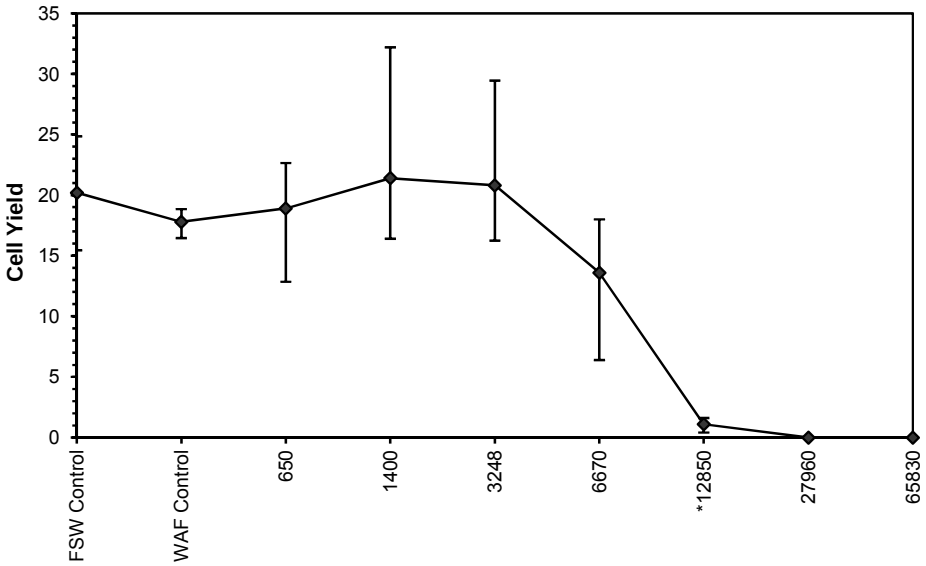
Point	ug/L	SD	95% CL(Exp)		Skew
IC05	3801.606	785.5934	207.0058	5212.784	-0.7487
IC10	4355.211	856.1277	1641.129	7401.379	0.2877
IC15	4908.817	918.0294	2434.842	8021.064	0.5678
IC20	5462.423	938.173	3189.309	8299.437	0.4571
IC25	6016.028	930.5002	3814.942	8577.81	0.2738
IC40	7555.524	913.1011	4589.661	9476.525	-0.1698
IC50	8529.32	856.3443	5094.774	10125.96	-0.5333



Marine Algal Growth Test-Cell Yield

Start Date:	11/09/2015 11:10	Test ID:	PR1244/05b	Sample ID:	Borossa Field Condensate
End Date:	14/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 110	Test Species:	IG-isochrysis aff galbana
Comments:	TRH				

Dose-Response Plot



Marine Algal Growth Test-Cell Yield

Start Date:	11/09/2015 11:10	Test ID:	PR1244/05b	Sample ID:	Borossa Field Condensate
End Date:	14/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 110	Test Species:	IG-isochrysis aff galbana
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	Cell Yield	20.16	15.41	24.81	3.23	8.92	8
WAF Control		17.76	16.41	18.81	1.02	5.70	4
650		18.86	12.81	22.61	4.29	10.99	4
1400		21.41	16.41	32.21	7.27	12.60	4
3248		20.76	16.21	29.41	6.18	11.97	4
6670		13.61	6.41	18.01	5.07	16.55	4
12850		1.11	0.41	1.61	0.53	65.59	4
27960		0.00	0.00	0.00	0.00		4
65830		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
650		8.10	8.10	8.10	0.00	0.00	1
1400		8.10	8.10	8.10	0.00	0.00	1
3248		8.10	8.10	8.10	0.00	0.00	1
6670		8.10	8.10	8.10	0.00	0.00	1
12850		8.00	8.00	8.00	0.00	0.00	1
27960		7.80	7.80	7.80	0.00	0.00	1
65830		7.60	7.60	7.60	0.00	0.00	1
FSW Control	Salinity ppt	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.90	35.90	35.90	0.00	0.00	1
650		35.60	35.60	35.60	0.00	0.00	1
1400		35.40	35.40	35.40	0.00	0.00	1
3248		35.30	35.30	35.30	0.00	0.00	1
6670		35.30	35.30	35.30	0.00	0.00	1
12850		35.60	35.60	35.60	0.00	0.00	1
27960		35.40	35.40	35.40	0.00	0.00	1
65830		35.40	35.40	35.40	0.00	0.00	1

Appendix O: Statistical Analyses of Macro-Algal Growth Test

Macroalgal Growth Test-Gametophyte Length

Start Date:	10/09/2015 14:00	Test ID:	PR1244/15	Sample ID:	Borossa Field Condensate
End Date:	24/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 116	Test Species:	ER-Ecklonia radiata
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4
FSW Control	23.400	22.900	23.000	25.300
WAF Control	28.200	21.900	23.400	26.100
1.2	23.600	22.600	21.200	24.300
2.4	26.200	22.400	23.500	18.300
4.8	20.400	22.100	22.200	20.000
9.7	17.200	18.500	19.500	19.300
19.3	15.800	15.300	15.100	13.800
38.6	12.400	12.900	14.000	15.800
77.2	13.100	10.800	12.400	11.000

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	23.650	0.9498	23.650	22.900	25.300	4.740	4					
WAF Control	24.900	1.0000	24.900	21.900	28.200	11.259	4	*			24.900	1.0000
1.2	22.925	0.9207	22.925	21.200	24.300	5.867	4	1.519	2.480	3.224	22.925	0.9207
2.4	22.600	0.9076	22.600	18.300	26.200	14.519	4	1.769	2.480	3.224	22.600	0.9076
*4.8	21.175	0.8504	21.175	20.000	22.200	5.376	4	2.865	2.480	3.224	21.175	0.8504
*9.7	18.625	0.7480	18.625	17.200	19.500	5.603	4	4.826	2.480	3.224	18.625	0.7480
*19.3	15.000	0.6024	15.000	13.800	15.800	5.683	4	7.615	2.480	3.224	15.000	0.6024
*38.6	13.775	0.5532	13.775	12.400	15.800	10.936	4	8.557	2.480	3.224	13.775	0.5532
*77.2	11.825	0.4749	11.825	10.800	13.100	9.376	4	10.057	2.480	3.224	11.825	0.4749

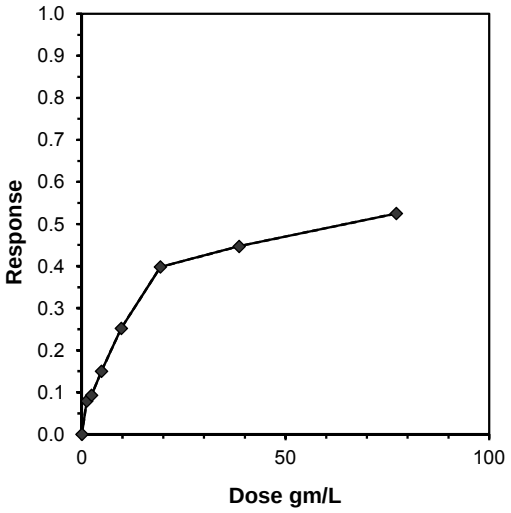
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.969423	0.93	-0.20116	1.06828
Bartlett's Test indicates equal variances (p = 0.20)	9.76692	18.47531		
The control means are not significantly different (p = 0.44)	0.827984	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	2.4	4.8	3.394113		3.224348	0.129492	92.94603	3.380729	5.5E-10	7, 24
Treatments vs WAF Control										

Linear Interpolation (200 Resamples)

Point	gm/L	SD	95% CL(Exp)		Skew
IC05*	0.756	1.099	0.175	5.754	1.4236
IC10	2.720	1.551	0.000	7.717	0.6850
IC15	4.819	1.913	0.000	10.477	0.1349
IC20	7.212	2.030	0.601	13.586	0.0468
IC25	9.604	2.128	3.717	16.457	0.1881
IC40	20.245	7.848	11.624	55.512	1.4840
IC50	64.828				

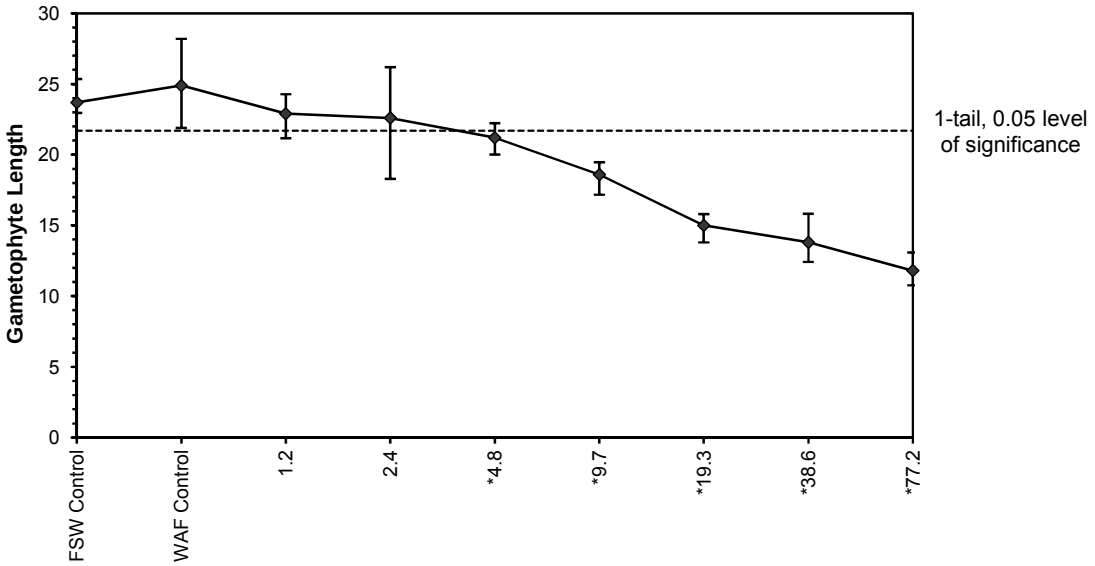
* indicates IC estimate less than the lowest concentration



Macroalgal Growth Test-Gametophyte Length

Start Date:	10/09/2015 14:00	Test ID:	PR1244/15	Sample ID:	Borossa Field Condensate
End Date:	24/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 116	Test Species:	ER-Ecklonia radiata
Comments:	Loading Rate				

Dose-Response Plot



Macroalgal Growth Test-Gametophyte Length

Start Date:	10/09/2015 14:00	Test ID:	PR1244/15	Sample ID:	Borossa Field Condensate
End Date:	24/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 116	Test Species:	ER-Ecklonia radiata
Comments:	Loading Rate				

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	Length um	23.65	22.90	25.30	1.12	4.48	4
WAF Control		24.90	21.90	28.20	2.80	6.72	4
1.2		22.93	21.20	24.30	1.35	5.06	4
2.4		22.60	18.30	26.20	3.28	8.02	4
4.8		21.18	20.00	22.20	1.14	5.04	4
9.7		18.63	17.20	19.50	1.04	5.49	4
19.3		15.00	13.80	15.80	0.85	6.16	4
38.6		13.78	12.40	15.80	1.51	8.91	4
77.2		11.83	10.80	13.10	1.11	8.90	4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
1.2		8.10	8.10	8.10	0.00	0.00	1
2.4		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.00	8.00	8.00	0.00	0.00	1
19.3		7.90	7.90	7.90	0.00	0.00	1
38.6		7.70	7.70	7.70	0.00	0.00	1
77.2		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
1.2		35.40	35.40	35.40	0.00	0.00	1
2.4		35.40	35.40	35.40	0.00	0.00	1
4.8		35.40	35.40	35.40	0.00	0.00	1
9.7		35.50	35.50	35.50	0.00	0.00	1
19.3		35.50	35.50	35.50	0.00	0.00	1
38.6		35.60	35.60	35.60	0.00	0.00	1
77.2		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO % sat	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
1.2		99.60	99.60	99.60	0.00	0.00	1
2.4		91.80	91.80	91.80	0.00	0.00	1
4.8		96.10	96.10	96.10	0.00	0.00	1
9.7		98.70	98.70	98.70	0.00	0.00	1
19.3		90.10	90.10	90.10	0.00	0.00	1
38.6		90.20	90.20	90.20	0.00	0.00	1
77.2		87.20	87.20	87.20	0.00	0.00	1

Macroalgal Growth Test-Gametophyte Length

Start Date:	10/09/2015 14:00	Test ID:	PR1244/15b	Sample ID:	Borossa Field Condensate
End Date:	24/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 116	Test Species:	ER-Ecklonia radiata
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	23.400	22.900	23.000	25.300
WAF Control	28.200	21.900	23.400	26.100
720	23.600	22.600	21.200	24.300
1673	26.200	22.400	23.500	18.300
3180	20.400	22.100	22.200	20.000
7160	17.200	18.500	19.500	19.300
14060	15.800	15.300	15.100	13.800
30860	12.400	12.900	14.000	15.800
69620	13.100	10.800	12.400	11.000

			Transform: Untransformed					1-Tailed			Isotonic	
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	23.650	0.9498	23.650	22.900	25.300	4.740	4					
WAF Control	24.900	1.0000	24.900	21.900	28.200	11.259	4	*			24.900	1.0000
720	22.925	0.9207	22.925	21.200	24.300	5.867	4	1.519	2.480	3.224	22.925	0.9207
1673	22.600	0.9076	22.600	18.300	26.200	14.519	4	1.769	2.480	3.224	22.600	0.9076
*3180	21.175	0.8504	21.175	20.000	22.200	5.376	4	2.865	2.480	3.224	21.175	0.8504
*7160	18.625	0.7480	18.625	17.200	19.500	5.603	4	4.826	2.480	3.224	18.625	0.7480
*14060	15.000	0.6024	15.000	13.800	15.800	5.683	4	7.615	2.480	3.224	15.000	0.6024
*30860	13.775	0.5532	13.775	12.400	15.800	10.936	4	8.557	2.480	3.224	13.775	0.5532
*69620	11.825	0.4749	11.825	10.800	13.100	9.376	4	10.057	2.480	3.224	11.825	0.4749

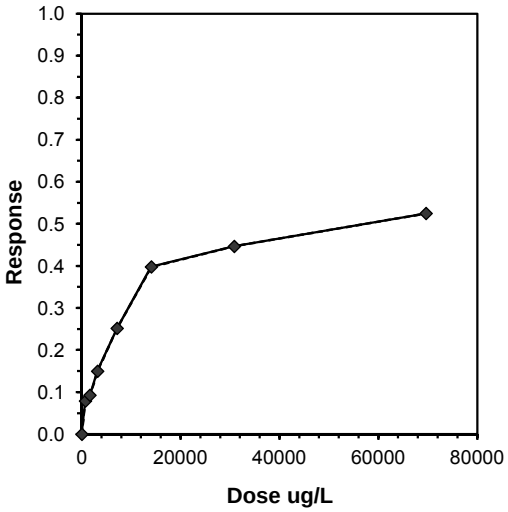
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.969423	0.93	-0.20116	1.06828
Bartlett's Test indicates equal variances (p = 0.20)	9.76692	18.47531		
The control means are not significantly different (p = 0.44)	0.827984	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	1673	3180	2306.543		3.224348	0.129492	92.94603	3.380729	5.5E-10	7, 24
Treatments vs WAF Control										

Linear Interpolation (200 Resamples)

Point	ug/L	SD	95% CL(Exp)		Skew
IC05*	453.8734	743.0149	88.53384	3725.254	1.1789
IC10	1873.933	1097.594	0	5705.609	0.4406
IC15	3195.608	1427.685	0	7450.03	0.1707
IC20	5138.784	1630.032	0	9230.277	-0.0001
IC25	7081.961	1574.98	2817.731	11498.48	0.1329
IC40	14882.86	7355.097	9376.753	48927.62	1.1696
IC50	57196.92				

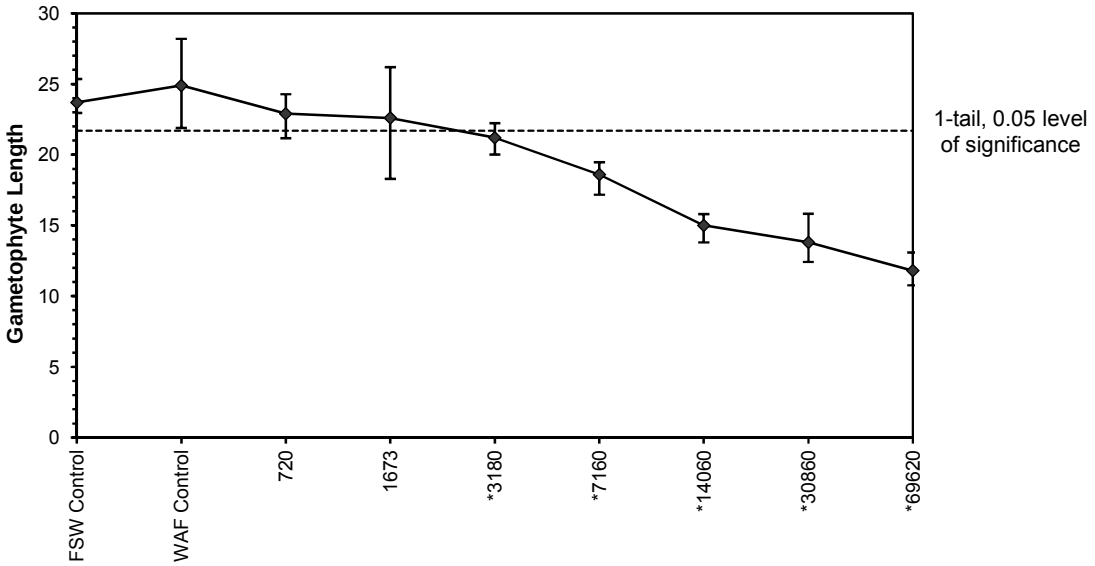
* indicates IC estimate less than the lowest concentration



Macroalgal Growth Test-Gametophyte Length

Start Date:	10/09/2015 14:00	Test ID:	PR1244/15b	Sample ID:	Borossa Field Condensate
End Date:	24/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 116	Test Species:	ER-Ecklonia radiata
Comments:	TRH				

Dose-Response Plot



Macroalgal Growth Test-Gametophyte Length

Start Date:	10/09/2015 14:00	Test ID:	PR1244/15b	Sample ID:	Borossa Field Condensate
End Date:	24/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 116	Test Species:	ER-Ecklonia radiata
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	Length um	23.65	22.90	25.30	1.12	4.48	4
WAF Control		24.90	21.90	28.20	2.80	6.72	4
720		22.93	21.20	24.30	1.35	5.06	4
1673		22.60	18.30	26.20	3.28	8.02	4
3180		21.18	20.00	22.20	1.14	5.04	4
7160		18.63	17.20	19.50	1.04	5.49	4
14060		15.00	13.80	15.80	0.85	6.16	4
30860		13.78	12.40	15.80	1.51	8.91	4
69620		11.83	10.80	13.10	1.11	8.90	4
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
720		8.10	8.10	8.10	0.00	0.00	1
1673		8.10	8.10	8.10	0.00	0.00	1
3180		8.10	8.10	8.10	0.00	0.00	1
7160		8.00	8.00	8.00	0.00	0.00	1
14060		7.90	7.90	7.90	0.00	0.00	1
30860		7.70	7.70	7.70	0.00	0.00	1
69620		7.40	7.40	7.40	0.00	0.00	1
FSW Control	Salinity ppt	35.40	35.40	35.40	0.00	0.00	1
WAF Control		35.60	35.60	35.60	0.00	0.00	1
720		35.40	35.40	35.40	0.00	0.00	1
1673		35.40	35.40	35.40	0.00	0.00	1
3180		35.40	35.40	35.40	0.00	0.00	1
7160		35.50	35.50	35.50	0.00	0.00	1
14060		35.50	35.50	35.50	0.00	0.00	1
30860		35.60	35.60	35.60	0.00	0.00	1
69620		35.80	35.80	35.80	0.00	0.00	1
FSW Control	DO % sat	100.20	100.20	100.20	0.00	0.00	1
WAF Control		100.90	100.90	100.90	0.00	0.00	1
720		99.60	99.60	99.60	0.00	0.00	1
1673		91.80	91.80	91.80	0.00	0.00	1
3180		96.10	96.10	96.10	0.00	0.00	1
7160		98.70	98.70	98.70	0.00	0.00	1
14060		90.10	90.10	90.10	0.00	0.00	1
30860		90.20	90.20	90.20	0.00	0.00	1
69620		87.20	87.20	87.20	0.00	0.00	1

Appendix P: Statistical Analyses of Sea Anemone Development Test

Anemone Larval Toxicity Test-% Normal

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31	Sample ID:	Barossa Field Condensate
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:					

Conc-g/L	1	2	3	4
FSW Control	1.0000	1.0000	1.0000	1.0000
WAF Control	1.0000	1.0000	0.8000	1.0000
4.8	0.8000	1.0000	1.0000	
9.7	0.8000	0.8000	1.0000	
19.3	0.6000	0.8000	1.0000	
38.6	0.8000	0.6000	0.8000	
77.2	0.0000	0.0000	0.0000	

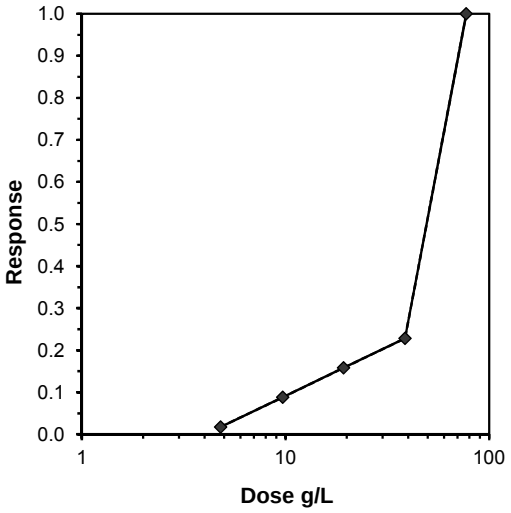
			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4					
WAF Control	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	*			1	20
4.8	0.9333	0.9825	1.2659	1.1071	1.3453	10.861	3	0.170	2.593	0.3023	1	15
9.7	0.8667	0.9123	1.1865	1.1071	1.3453	11.587	3	0.851	2.593	0.3023	2	15
19.3	0.8000	0.8421	1.1128	0.8861	1.3453	20.637	3	1.483	2.593	0.3023	3	15
38.6	0.7333	0.7719	1.0335	0.8861	1.1071	12.350	3	2.164	2.593	0.3023	4	15
77.2	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	3				15	15

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.931661	0.887	-0.22409	-0.77909
Bartlett's Test indicates equal variances (p = 0.88)	1.183699	13.2767		
The control means are not significantly different (p = 0.36)	1	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	38.6	77.2	54.58864		0.227972	0.247547	0.036184	0.023292	0.254275	4, 11
Treatments vs WAF Control										

Trimmed Spearman-Karber

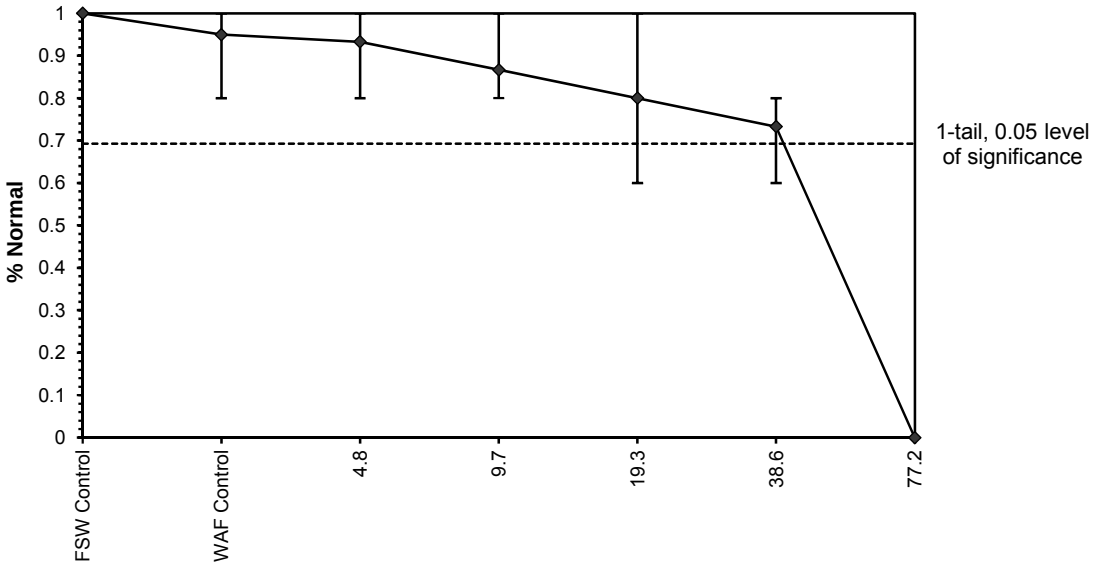
Trim Level	EC50	95% CL	
0.0%			
5.0%	42.079	33.018	53.627
10.0%	44.949	35.034	57.670
20.0%	48.986	36.746	65.302
Auto-1.8%	40.101	31.780	50.600



Anemone Larval Toxicity Test-% Normal

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31	Sample ID:	Barossa Field Condensate
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:					

Dose-Response Plot



Anemone Larval Toxicity Test-% Normal

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31	Sample ID:	Barossa Field Condensate
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:					

Auxiliary Data Summary

Conc-g/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Normal	100.00	100.00	100.00	0.00	0.00	4
WAF Control		95.00	80.00	100.00	10.00	3.33	4
4.8		93.33	80.00	100.00	11.55	3.64	3
9.7		86.67	80.00	100.00	11.55	3.92	3
19.3		80.00	60.00	100.00	20.00	5.59	3
38.6		73.33	60.00	80.00	11.55	4.63	3
77.2		0.00	0.00	0.00	0.00		3
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.10	8.10	8.10	0.00	0.00	1
19.3		8.00	8.00	8.00	0.00	0.00	1
38.6		7.90	7.90	7.90	0.00	0.00	1
77.2		7.60	7.60	7.60	0.00	0.00	1
FSW Control	Salinity ppt	35.10	35.10	35.10	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
4.8		34.90	34.90	34.90	0.00	0.00	1
9.7		34.90	34.90	34.90	0.00	0.00	1
19.3		35.00	35.00	35.00	0.00	0.00	1
38.6		35.00	35.00	35.00	0.00	0.00	1
77.2		35.10	35.10	35.10	0.00	0.00	1
FSW Control	DO %	102.10	102.10	102.10	0.00	0.00	1
WAF Control		101.60	101.60	101.60	0.00	0.00	1
4.8		103.90	103.90	103.90	0.00	0.00	1
9.7		105.10	105.10	105.10	0.00	0.00	1
19.3		105.20	105.20	105.20	0.00	0.00	1
38.6		104.50	104.50	104.50	0.00	0.00	1
77.2		110.40	110.40	110.40	0.00	0.00	1

Anemone Larval Toxicity Test-% Unaffected

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31b	Sample ID:	BAROSSA FIELD CONDENSATE
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:	TRH Concentration				

Conc-ug/L	1	2	3	4
FSW Control	1.0000	1.0000	1.0000	1.0000
WAF Control	1.0000	1.0000	0.8000	1.0000
2492	0.8000	1.0000	1.0000	
7660	0.8000	0.8000	1.0000	
15840	0.6000	0.8000	1.0000	
28040	0.8000	0.6000	0.8000	
63990	0.0000	0.0000	0.0000	

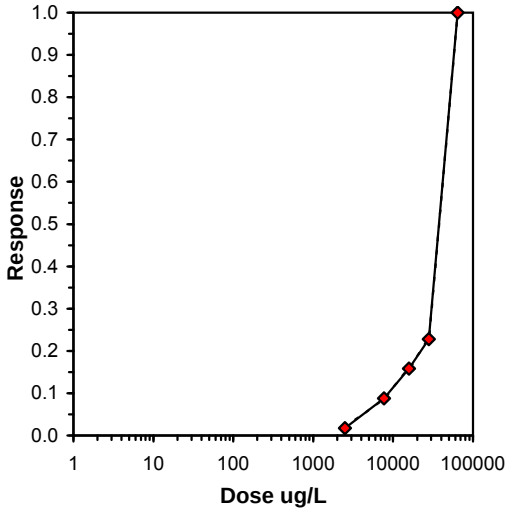
			Transform: Arcsin Square Root					1-Tailed			Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4					
WAF Control	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	*			1	20
2492	0.9333	0.9825	1.2659	1.1071	1.3453	10.861	3	0.170	2.593	0.3023	1	15
7660	0.8667	0.9123	1.1865	1.1071	1.3453	11.587	3	0.851	2.593	0.3023	2	15
15840	0.8000	0.8421	1.1128	0.8861	1.3453	20.637	3	1.483	2.593	0.3023	3	15
28040	0.7333	0.7719	1.0335	0.8861	1.1071	12.350	3	2.164	2.593	0.3023	4	15
63990	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	3				15	15

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.931661	0.887	-0.22409	-0.77909
Bartlett's Test indicates equal variances (p = 0.88)	1.183699	13.2767		
The control means are not significantly different (p = 0.36)	1	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	28040	63990	42358.94		0.227972	0.247547	0.036184	0.023292	0.254275	4, 11
Treatments vs WAF Control										

Trimmed Spearman-Karber

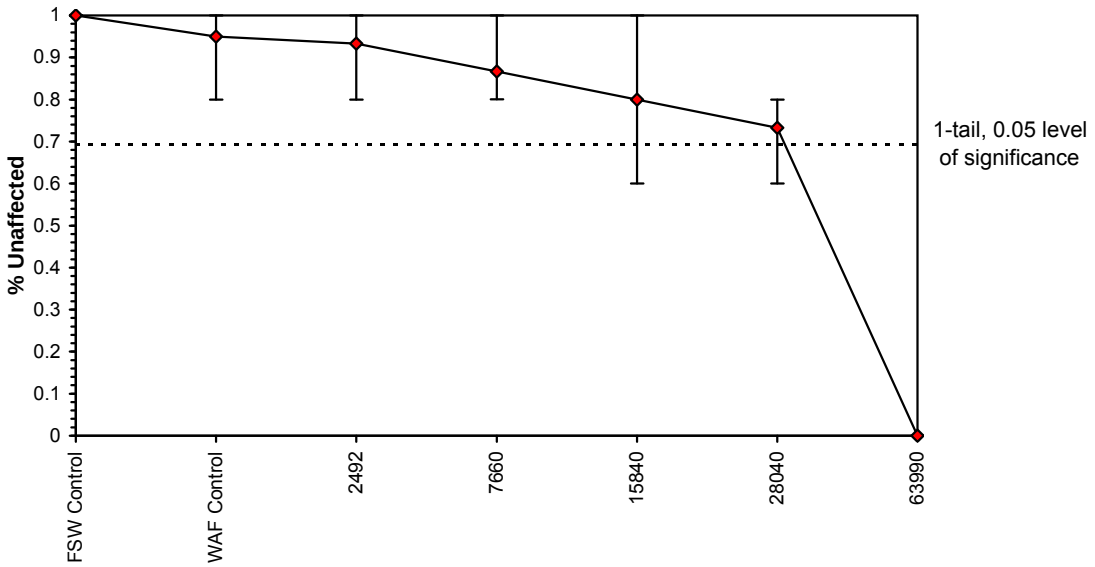
Trim Level	EC50	95% CL	
0.0%			
5.0%	32491.19	25241.84	41822.52
10.0%	34715.36	27194.92	44315.51
20.0%	37324.45	28220.84	49364.76
Auto-1.8%	30719.95	23960.98	39385.52



Anemone Larval Toxicity Test-% Unaffected

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31b	Sample ID:	BAROSSA FIELD CONDENSATE
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:	TRH Concentration				

Dose-Response Plot



Anemone Larval Toxicity Test-% Unaffected

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31b	Sample ID:	BAROSSA FIELD CONDENSATE
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:	TRH Concentration				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Normal	100.00	100.00	100.00	0.00	0.00	4
WAF Control		95.00	80.00	100.00	10.00	3.33	4
2492		93.33	80.00	100.00	11.55	3.64	3
7660		86.67	80.00	100.00	11.55	3.92	3
15840		80.00	60.00	100.00	20.00	5.59	3
28040		73.33	60.00	80.00	11.55	4.63	3
63990		0.00	0.00	0.00	0.00		3
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
2492		8.10	8.10	8.10	0.00	0.00	1
7660		8.10	8.10	8.10	0.00	0.00	1
15840		8.00	8.00	8.00	0.00	0.00	1
28040		7.90	7.90	7.90	0.00	0.00	1
63990		7.60	7.60	7.60	0.00	0.00	1
FSW Control	Salinity ppt	35.10	35.10	35.10	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
2492		34.90	34.90	34.90	0.00	0.00	1
7660		34.90	34.90	34.90	0.00	0.00	1
15840		35.00	35.00	35.00	0.00	0.00	1
28040		35.00	35.00	35.00	0.00	0.00	1
63990		35.10	35.10	35.10	0.00	0.00	1
FSW Control	DO %	102.10	102.10	102.10	0.00	0.00	1
WAF Control		101.60	101.60	101.60	0.00	0.00	1
2492		103.90	103.90	103.90	0.00	0.00	1
7660		105.10	105.10	105.10	0.00	0.00	1
15840		105.20	105.20	105.20	0.00	0.00	1
28040		104.50	104.50	104.50	0.00	0.00	1
63990		110.40	110.40	110.40	0.00	0.00	1

Anemone Larval Toxicity Test-% Normal

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31	Sample ID:	Barossa Field Condensate
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:					

Conc-g/L	1	2	3	4
FSW Control	1.0000	1.0000	1.0000	1.0000
WAF Control	1.0000	1.0000	0.8000	1.0000
4.8	0.8000	1.0000	1.0000	
9.7	0.8000	0.8000	1.0000	
19.3	0.6000	0.8000	1.0000	
38.6	0.8000	0.6000	0.8000	
77.2	0.0000	0.0000	0.0000	

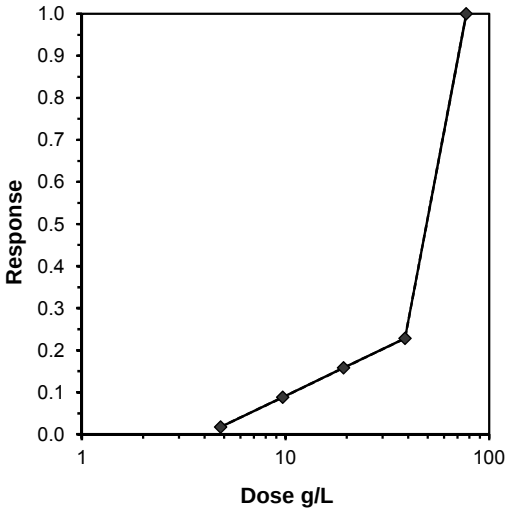
			Transform: Arcsin Square Root					1-Tailed			Isotonic	
Conc-g/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4					
WAF Control	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	*			0.9500	1.0000
4.8	0.9333	0.9825	1.2659	1.1071	1.3453	10.861	3	0.170	2.593	0.3023	0.9333	0.9825
9.7	0.8667	0.9123	1.1865	1.1071	1.3453	11.587	3	0.851	2.593	0.3023	0.8667	0.9123
19.3	0.8000	0.8421	1.1128	0.8861	1.3453	20.637	3	1.483	2.593	0.3023	0.8000	0.8421
38.6	0.7333	0.7719	1.0335	0.8861	1.1071	12.350	3	2.164	2.593	0.3023	0.7333	0.7719
77.2	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	3				0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.931661	0.887	-0.22409	-0.77909
Bartlett's Test indicates equal variances (p = 0.88)	1.183699	13.2767		
The control means are not significantly different (p = 0.36)	1	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	38.6	77.2	54.58864		0.227972	0.247547	0.036184	0.023292	0.254275	4, 11
Treatments vs WAF Control										

Log-Logit Interpolation (200 Resamples)

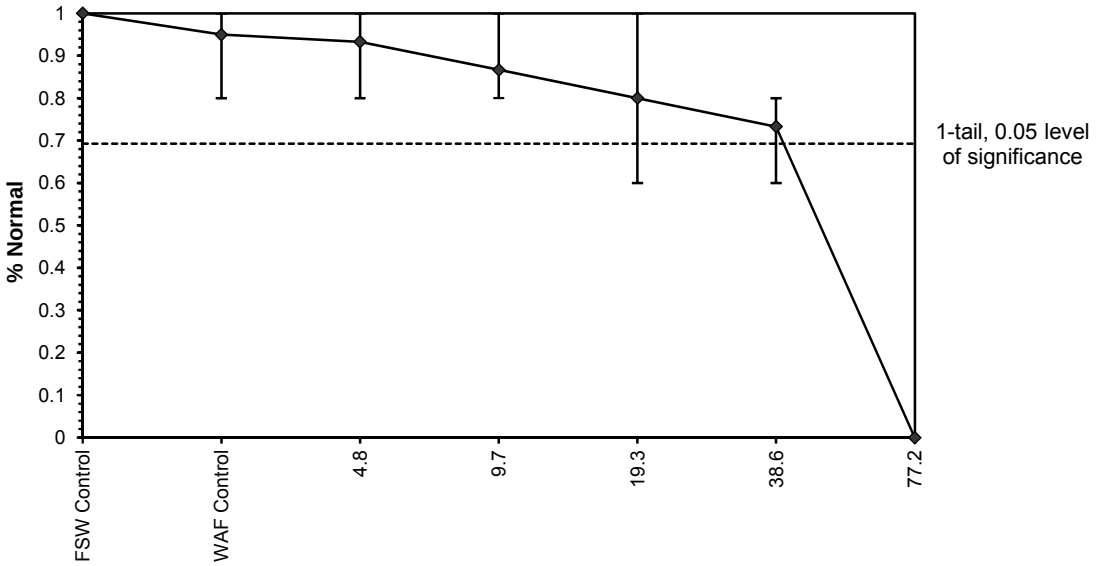
Point	g/L	SD	95% CL(Exp)		Skew
IC05	7.069	4.665	0.000	29.205	1.5128
IC10	11.167	7.033	0.284	38.143	1.0232
IC15	18.066	8.803	1.959	48.486	0.5551
IC20	29.791	10.145	1.565	44.843	-0.1692
IC25	38.875	8.426	3.066	40.413	-1.1606
IC40	40.571	0.665	38.281	42.074	-0.1870
IC50	41.642	0.649	39.342	43.120	-0.1869



Anemone Larval Toxicity Test-% Normal

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31	Sample ID:	Barossa Field Condensate
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:					

Dose-Response Plot



Anemone Larval Toxicity Test-% Normal

Start Date:	27/10/2015 11:30	Test ID:	PR1244/31	Sample ID:	Barossa Field Condensate
End Date:	4/11/2015 10:30	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 128	Test Species:	AI-Aiptasia pulchella
Comments:					

Auxiliary Data Summary

Conc-g/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Normal	100.00	100.00	100.00	0.00	0.00	4
WAF Control		95.00	80.00	100.00	10.00	3.33	4
4.8		93.33	80.00	100.00	11.55	3.64	3
9.7		86.67	80.00	100.00	11.55	3.92	3
19.3		80.00	60.00	100.00	20.00	5.59	3
38.6		73.33	60.00	80.00	11.55	4.63	3
77.2		0.00	0.00	0.00	0.00		3
FSW Control	pH	8.10	8.10	8.10	0.00	0.00	1
WAF Control		8.10	8.10	8.10	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.10	8.10	8.10	0.00	0.00	1
19.3		8.00	8.00	8.00	0.00	0.00	1
38.6		7.90	7.90	7.90	0.00	0.00	1
77.2		7.60	7.60	7.60	0.00	0.00	1
FSW Control	Salinity ppt	35.10	35.10	35.10	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
4.8		34.90	34.90	34.90	0.00	0.00	1
9.7		34.90	34.90	34.90	0.00	0.00	1
19.3		35.00	35.00	35.00	0.00	0.00	1
38.6		35.00	35.00	35.00	0.00	0.00	1
77.2		35.10	35.10	35.10	0.00	0.00	1
FSW Control	DO %	102.10	102.10	102.10	0.00	0.00	1
WAF Control		101.60	101.60	101.60	0.00	0.00	1
4.8		103.90	103.90	103.90	0.00	0.00	1
9.7		105.10	105.10	105.10	0.00	0.00	1
19.3		105.20	105.20	105.20	0.00	0.00	1
38.6		104.50	104.50	104.50	0.00	0.00	1
77.2		110.40	110.40	110.40	0.00	0.00	1

Appendix Q: Statistical Analyses of Copepodid Development Test

Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Conc-gm/L	1	2	3	4	5	6	7	8
FSW Control	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000
WAF Control	0.8000	0.4000	0.6000	0.6000				
4.8	0.4000	0.6000	0.6000	0.0000				
9.7	0.6000	0.6000	0.4000	0.4000				
19.3	0.0000	0.0000	0.0000	0.0000				
38.6	0.0000	0.0000	0.0000	0.0000				
77.2	0.0000	0.0000	0.0000	0.0000				

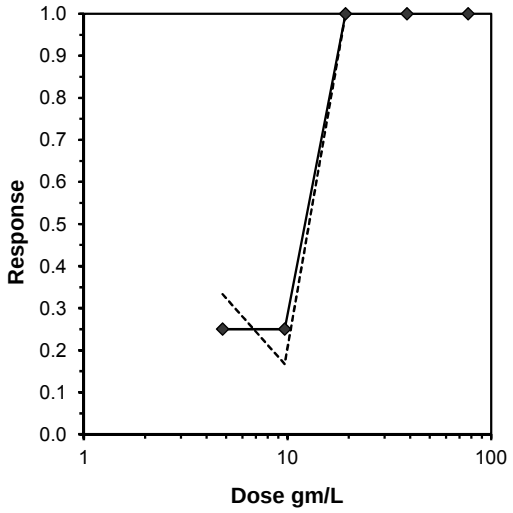
			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.7000	1.1667	0.9966	0.8861	1.1071	11.857	8					
WAF Control	0.6000	1.0000	0.8910	0.6847	1.1071	19.366	4	*			8	20
4.8	0.4000	0.6667	0.6706	0.2255	0.8861	46.456	4	1.441	2.180	0.3334	12	20
9.7	0.5000	0.8333	0.7854	0.6847	0.8861	14.802	4	0.691	2.180	0.3334	10	20
19.3	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20
38.6	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20
77.2	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.909212	0.859	-0.97373	1.125224
Bartlett's Test indicates equal variances (p = 0.28)	2.518146	9.21034		
The control means are not significantly different (p = 0.24)	1.260902	2.228139		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	9.7	19.3	13.68247		0.324825	0.537057	0.048608	0.046781	0.392639	2, 9
Treatments vs WAF Control										

Trimmed Spearman-Karber

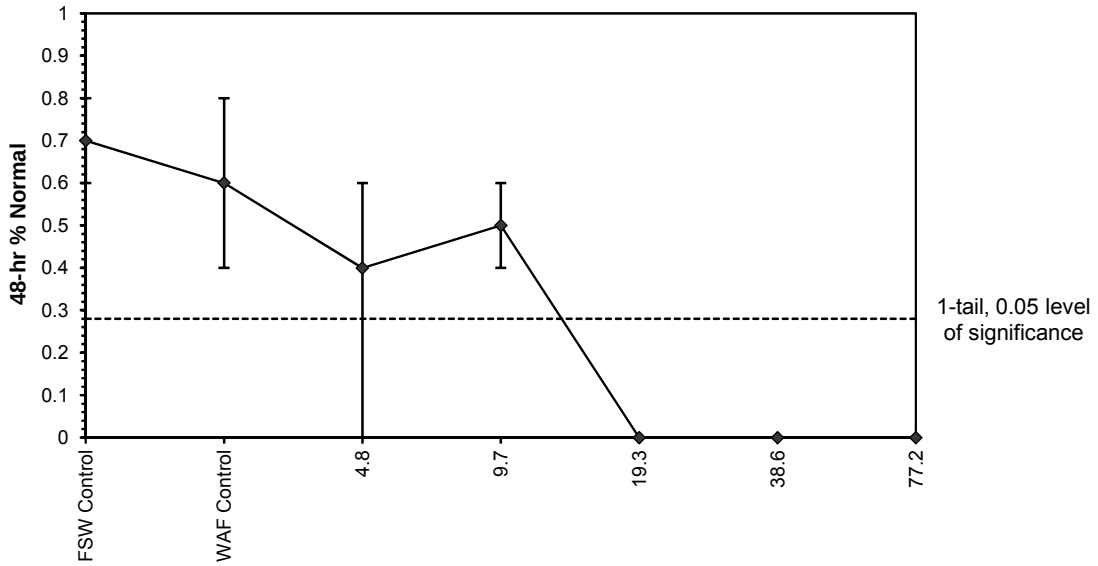
Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-25.0%	12.200	10.838	13.734



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Dose-Response Plot



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% normal	70.00	60.00	80.00	10.69	4.67	8
WAF Control		60.00	40.00	80.00	16.33	6.74	4
4.8		40.00	0.00	60.00	28.28	13.30	4
9.7		50.00	40.00	60.00	11.55	6.80	4
19.3		0.00	0.00	0.00	0.00		4
38.6		0.00	0.00	0.00	0.00		4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.10	8.10	8.10	0.00	0.00	1
19.3		8.00	8.00	8.00	0.00	0.00	1
38.6		7.80	7.80	7.80	0.00	0.00	1
77.2		7.30	7.30	7.30	0.00	0.00	1
FSW Control	DO %	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
4.8		96.30	96.30	96.30	0.00	0.00	1
9.7		95.70	95.70	95.70	0.00	0.00	1
19.3		96.70	96.70	96.70	0.00	0.00	1
38.6		95.60	95.60	95.60	0.00	0.00	1
77.2		85.10	85.10	85.10	0.00	0.00	1
FSW Control	Salinity ppt	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
4.8		35.10	35.10	35.10	0.00	0.00	1
9.7		35.10	35.10	35.10	0.00	0.00	1
19.3		35.20	35.20	35.20	0.00	0.00	1
38.6		35.30	35.30	35.30	0.00	0.00	1
77.2		35.30	35.30	35.30	0.00	0.00	1

Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Conc-gm/L	1	2	3	4	5	6	7	8
FSW Control	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000
WAF Control	0.8000	0.4000	0.6000	0.6000				
4.8	0.4000	0.6000	0.6000	0.0000				
9.7	0.6000	0.6000	0.4000	0.4000				
19.3	0.0000	0.0000	0.0000	0.0000				
38.6	0.0000	0.0000	0.0000	0.0000				
77.2	0.0000	0.0000	0.0000	0.0000				

			Transform: Arcsin Square Root					1-Tailed			Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	0.7000	1.1667	0.9966	0.8861	1.1071	11.857	8					
WAF Control	0.6000	1.0000	0.8910	0.6847	1.1071	19.366	4	*			0.6000	1.0000
4.8	0.4000	0.6667	0.6706	0.2255	0.8861	46.456	4	1.441	2.180	0.3334	0.4500	0.7500
9.7	0.5000	0.8333	0.7854	0.6847	0.8861	14.802	4	0.691	2.180	0.3334	0.4500	0.7500
19.3	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				0.0000	0.0000
38.6	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				0.0000	0.0000
77.2	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				0.0000	0.0000

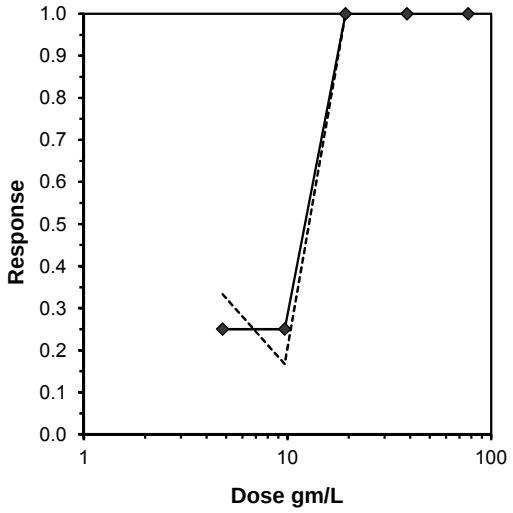
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.909212	0.859	-0.97373	1.125224
Bartlett's Test indicates equal variances (p = 0.28)	2.518146	9.21034		
The control means are not significantly different (p = 0.24)	1.260902	2.228139		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	9.7	19.3	13.68247		0.324825	0.537057	0.048608	0.046781	0.392639	2, 9
Treatments vs WAF Control										

Log-Logit Interpolation (200 Resamples)

Point	gm/L	SD	95% CL(Exp)		Skew
IC05*	0.431	3.000	0.067	14.446	1.9198
IC10*	1.036	3.573	0.073	14.258	1.1432
IC15*	1.886	3.723	0.004	13.948	0.6563
IC20*	3.088	3.708	0.000	13.465	0.2468
IC25	9.700	3.615	0.000	10.280	-0.2825
IC40	9.989	2.233	0.000	10.530	-2.2276
IC50	10.203	1.300	0.965	10.723	-4.2905

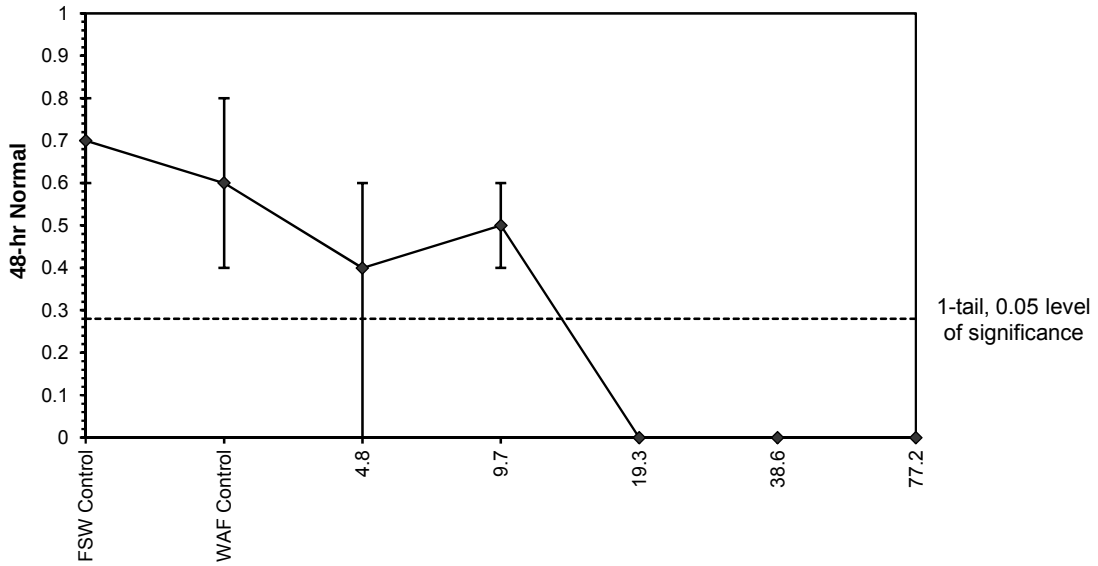
* indicates IC estimate less than the lowest concentration



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Dose-Response Plot



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% normal	70.00	60.00	80.00	10.69	4.67	8
WAF Control		60.00	40.00	80.00	16.33	6.74	4
4.8		40.00	0.00	60.00	28.28	13.30	4
9.7		50.00	40.00	60.00	11.55	6.80	4
19.3		0.00	0.00	0.00	0.00		4
38.6		0.00	0.00	0.00	0.00		4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.10	8.10	8.10	0.00	0.00	1
19.3		8.00	8.00	8.00	0.00	0.00	1
38.6		7.80	7.80	7.80	0.00	0.00	1
77.2		7.30	7.30	7.30	0.00	0.00	1
FSW Control	DO %	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
4.8		96.30	96.30	96.30	0.00	0.00	1
9.7		95.70	95.70	95.70	0.00	0.00	1
19.3		96.70	96.70	96.70	0.00	0.00	1
38.6		95.60	95.60	95.60	0.00	0.00	1
77.2		85.10	85.10	85.10	0.00	0.00	1
FSW Control	Salinity ppt	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
4.8		35.10	35.10	35.10	0.00	0.00	1
9.7		35.10	35.10	35.10	0.00	0.00	1
19.3		35.20	35.20	35.20	0.00	0.00	1
38.6		35.30	35.30	35.30	0.00	0.00	1
77.2		35.30	35.30	35.30	0.00	0.00	1

Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Conc-gm/L	1	2	3	4	5	6	7	8
FSW Control	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000
WAF Control	0.8000	0.4000	0.6000	0.6000				
3860	0.4000	0.6000	0.6000	0.0000				
8560	0.6000	0.6000	0.4000	0.4000				
15830	0.0000	0.0000	0.0000	0.0000				
29770	0.0000	0.0000	0.0000	0.0000				
68390	0.0000	0.0000	0.0000	0.0000				

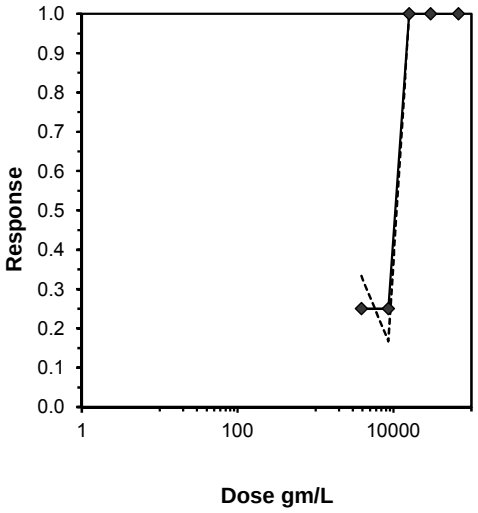
			Transform: Arcsin Square Root						1-Tailed		Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Resp	Number
FSW Control	0.7000	1.1667	0.9966	0.8861	1.1071	11.857	8					
WAF Control	0.6000	1.0000	0.8910	0.6847	1.1071	19.366	4	*			8	20
3860	0.4000	0.6667	0.6706	0.2255	0.8861	46.456	4	1.441	2.180	0.3334	12	20
8560	0.5000	0.8333	0.7854	0.6847	0.8861	14.802	4	0.691	2.180	0.3334	10	20
15830	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20
29770	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20
68390	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.909212	0.859	-0.97373	1.125224
Bartlett's Test indicates equal variances (p = 0.28)	2.518146	9.21034		
The control means are not significantly different (p = 0.24)	1.260902	2.228139		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	8560	15830	11640.65		0.324825	0.537057	0.048608	0.046781	0.392639	2, 9
Treatments vs WAF Control										

Trimmed Spearman-Karber

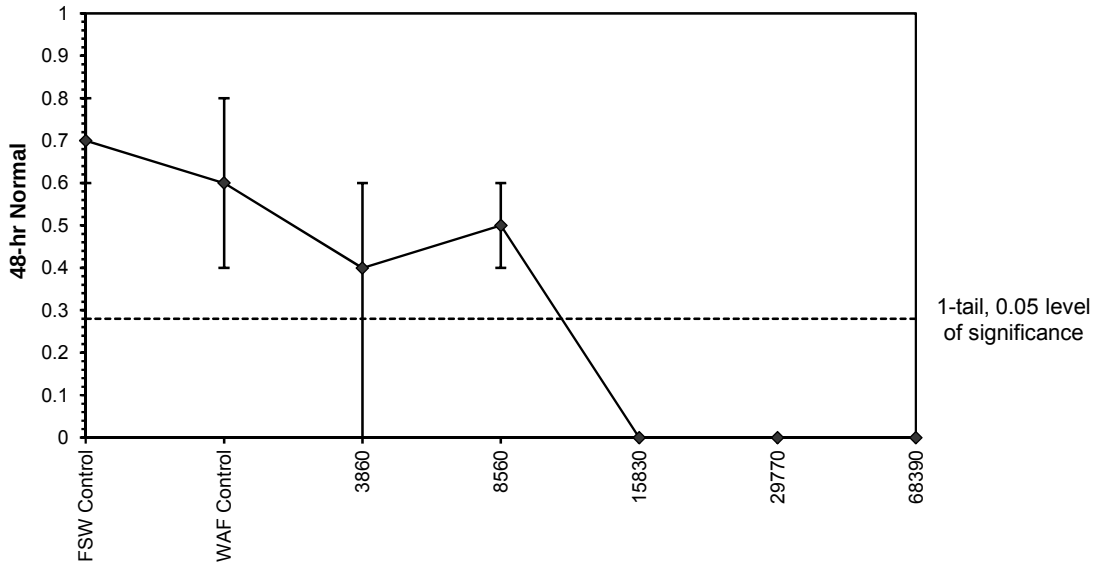
Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-25.0%	10506.94	9451.822	11679.84



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Dose-Response Plot



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% normal	70.00	60.00	80.00	10.69	4.67	8
WAF Control		60.00	40.00	80.00	16.33	6.74	4
3860		40.00	0.00	60.00	28.28	13.30	4
8560		50.00	40.00	60.00	11.55	6.80	4
15830		0.00	0.00	0.00	0.00		4
29770		0.00	0.00	0.00	0.00		4
68390		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
3860		8.10	8.10	8.10	0.00	0.00	1
8560		8.10	8.10	8.10	0.00	0.00	1
15830		8.00	8.00	8.00	0.00	0.00	1
29770		7.80	7.80	7.80	0.00	0.00	1
68390		7.30	7.30	7.30	0.00	0.00	1
FSW Control	DO %	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
3860		96.30	96.30	96.30	0.00	0.00	1
8560		95.70	95.70	95.70	0.00	0.00	1
15830		96.70	96.70	96.70	0.00	0.00	1
29770		95.60	95.60	95.60	0.00	0.00	1
68390		85.10	85.10	85.10	0.00	0.00	1
FSW Control	Salinity ppt	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
3860		35.10	35.10	35.10	0.00	0.00	1
8560		35.10	35.10	35.10	0.00	0.00	1
15830		35.20	35.20	35.20	0.00	0.00	1
29770		35.30	35.30	35.30	0.00	0.00	1
68390		35.30	35.30	35.30	0.00	0.00	1

Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Conc-gm/L	1	2	3	4	5	6	7	8
FSW Control	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000	0.6000	0.8000
WAF Control	0.8000	0.4000	0.6000	0.6000				
3860	0.4000	0.6000	0.6000	0.0000				
8560	0.6000	0.6000	0.4000	0.4000				
15830	0.0000	0.0000	0.0000	0.0000				
29770	0.0000	0.0000	0.0000	0.0000				
68390	0.0000	0.0000	0.0000	0.0000				

			Transform: Arcsin Square Root					1-Tailed			Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	0.7000	1.1667	0.9966	0.8861	1.1071	11.857	8					
WAF Control	0.6000	1.0000	0.8910	0.6847	1.1071	19.366	4	*			0.6000	1.0000
3860	0.4000	0.6667	0.6706	0.2255	0.8861	46.456	4	1.441	2.180	0.3334	0.4500	0.7500
8560	0.5000	0.8333	0.7854	0.6847	0.8861	14.802	4	0.691	2.180	0.3334	0.4500	0.7500
15830	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				0.0000	0.0000
29770	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				0.0000	0.0000
68390	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4				0.0000	0.0000

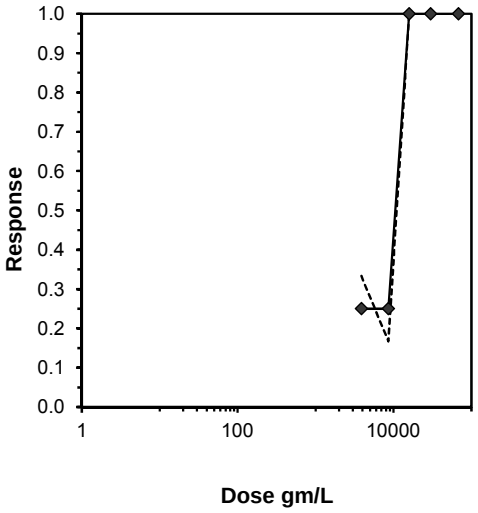
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.909212	0.859	-0.97373	1.125224
Bartlett's Test indicates equal variances (p = 0.28)	2.518146	9.21034		
The control means are not significantly different (p = 0.24)	1.260902	2.228139		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	8560	15830	11640.65		0.324825	0.537057	0.048608	0.046781	0.392639	2, 9
Treatments vs WAF Control										

Log-Logit Interpolation (200 Resamples)

Point	gm/L	SD	95% CL(Exp)		Skew
IC05*	4.388444	2798.854	0	12928.47	2.0197
IC10*	27.21423	3271.518	0	13008.23	1.3764
IC15*	144.3927	3767.918	0	13041.84	0.7201
IC20*	745.2861	4038.67	0	12835.18	0.2071
IC25	8560	3983.675	0	9023.806	-0.2610
IC40	8781.697	2442.853	0	9221.466	-2.2951
IC50	8946.181	1148.001	8126.509	9372.164	-5.9722

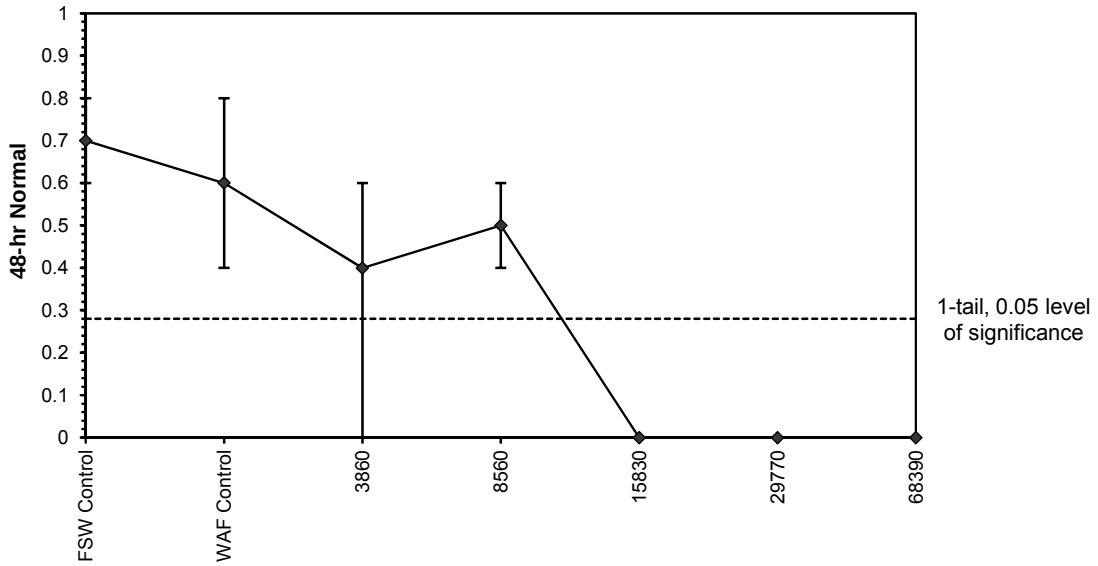
* indicates IC estimate less than the lowest concentration



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
End Date:	27/09/2015 14:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
Comments:					

Dose-Response Plot



Marine Copepod Development Test-% Normal

Start Date:	22/09/2015 14:00	Test ID:	PR1244/02	Sample ID:	Borossa Field Condensate
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Sample Date:		Protocol:		Test Species:	PC-Parvocalanus crassirostris
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Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% normal	70.00	60.00	80.00	10.69	4.67	8
WAF Control		60.00	40.00	80.00	16.33	6.74	4
3860		40.00	0.00	60.00	28.28	13.30	4
8560		50.00	40.00	60.00	11.55	6.80	4
15830		0.00	0.00	0.00	0.00		4
29770		0.00	0.00	0.00	0.00		4
68390		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
3860		8.10	8.10	8.10	0.00	0.00	1
8560		8.10	8.10	8.10	0.00	0.00	1
15830		8.00	8.00	8.00	0.00	0.00	1
29770		7.80	7.80	7.80	0.00	0.00	1
68390		7.30	7.30	7.30	0.00	0.00	1
FSW Control	DO %	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
3860		96.30	96.30	96.30	0.00	0.00	1
8560		95.70	95.70	95.70	0.00	0.00	1
15830		96.70	96.70	96.70	0.00	0.00	1
29770		95.60	95.60	95.60	0.00	0.00	1
68390		85.10	85.10	85.10	0.00	0.00	1
FSW Control	Salinity ppt	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
3860		35.10	35.10	35.10	0.00	0.00	1
8560		35.10	35.10	35.10	0.00	0.00	1
15830		35.20	35.20	35.20	0.00	0.00	1
29770		35.30	35.30	35.30	0.00	0.00	1
68390		35.30	35.30	35.30	0.00	0.00	1

Appendix R: Statistical Analyses of the Fish Imbalance and Growth Test

Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4
FSW Control	1.0000	1.0000	1.0000	1.0000
WAF Control	1.0000	1.0000	1.0000	1.0000
4.8	1.0000	1.0000	1.0000	1.0000
9.7	1.0000	1.0000	1.0000	1.0000
19.3	0.8000	0.8000	1.0000	1.0000
38.6	0.2000	0.2000	0.2000	0.2000
77.2	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
FSW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
WAF Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		0	20
4.8	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
9.7	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
19.3	0.9000	0.9000	1.2262	1.1071	1.3453	11.212	4	14.00	10.00	2	20
*38.6	0.2000	0.2000	0.4636	0.4636	0.4636	0.000	4	10.00	10.00	16	20
77.2	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20

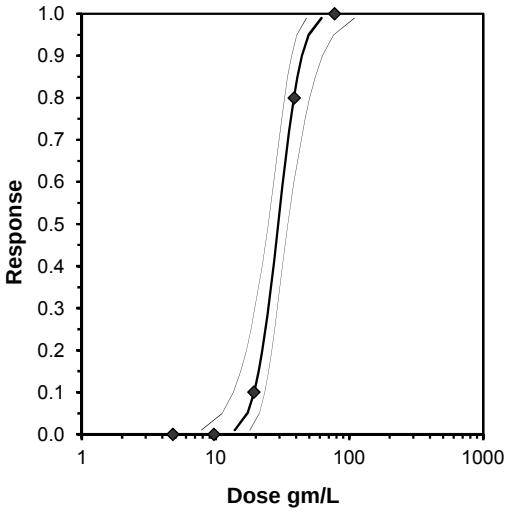
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.63123	0.905	5.4E-15	2.980392
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	19.3	38.6	27.29432	
Treatments vs WAF Control				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	7.178029	1.531775	4.175749	10.18031	0	0.036857	7.814728	1	1.466663	0.139314	3
Intercept	-5.52775	2.261845	-9.96097	-1.09453							
TSCR											

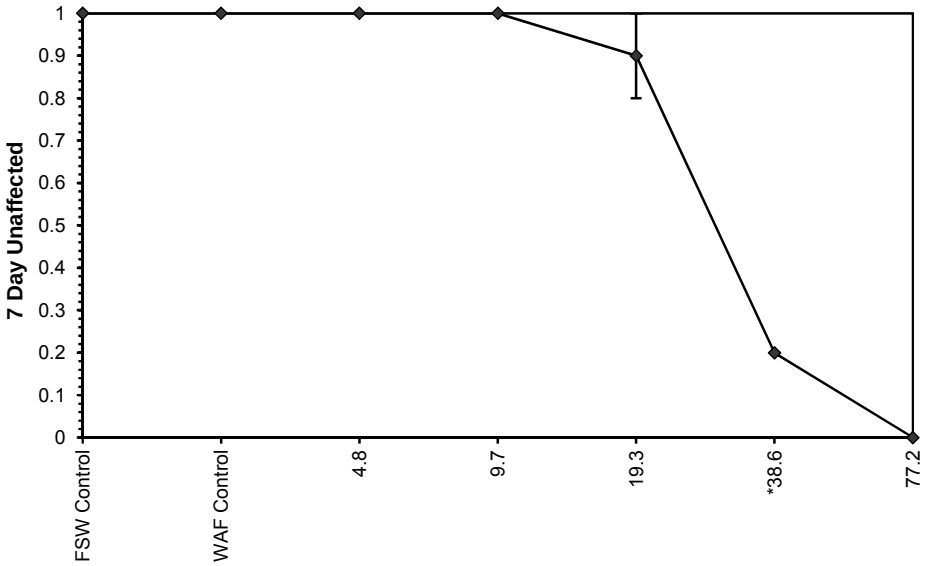
Point	Probits	gm/L	95% Fiducial Limits	
EC01	2.674	13.88578	7.816206	17.95356
EC05	3.355	17.27874	11.23676	21.21538
EC10	3.718	19.41445	13.58027	23.28484
EC15	3.964	21.00263	15.38899	24.86277
EC20	4.158	22.35701	16.95756	26.25341
EC25	4.326	23.58834	18.39006	27.56814
EC40	4.747	27.00029	22.27634	31.5769
EC50	5.000	29.28622	24.7131	34.66116
EC60	5.253	31.76568	27.14661	38.42481
EC75	5.674	36.36044	31.12336	46.50115
EC80	5.842	38.36303	32.69047	50.41624
EC85	6.036	40.83692	34.52706	55.54199
EC90	6.282	44.17752	36.87479	62.9259
EC95	6.645	49.63802	40.48028	76.03354
EC99	7.326	61.76696	47.84469	109.285



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	Loading Rate				

Dose-Response Plot



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	Loading Rate				

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
4.8		100.00	100.00	100.00	0.00	0.00	4
9.7		100.00	100.00	100.00	0.00	0.00	4
19.3		90.00	80.00	100.00	11.55	3.78	4
38.6		20.00	20.00	20.00	0.00	0.00	4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
4.8		7.74	7.34	8.30	0.43	8.50	4
9.7		8.26	7.94	8.58	0.30	6.63	4
19.3		7.74	6.22	9.04	1.16	13.93	4
38.6		1.36	1.20	1.60	0.17	30.57	4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.10	8.10	8.10	0.00	0.00	1
19.3		8.00	8.00	8.00	0.00	0.00	1
38.6		7.80	7.80	7.80	0.00	0.00	1
77.2		7.30	7.30	7.30	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
4.8		35.10	35.10	35.10	0.00	0.00	1
9.7		35.10	35.10	35.10	0.00	0.00	1
19.3		35.20	35.20	35.20	0.00	0.00	1
38.6		35.30	35.30	35.30	0.00	0.00	1
77.2		35.30	35.30	35.30	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
4.8		96.30	96.30	96.30	0.00	0.00	1
9.7		95.70	95.70	95.70	0.00	0.00	1
19.3		96.70	96.70	96.70	0.00	0.00	1
38.6		95.60	95.60	95.60	0.00	0.00	1
77.2		85.10	85.10	85.10	0.00	0.00	1

Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06b	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	1.0000	1.0000	1.0000	1.0000
WAF Control	1.0000	1.0000	1.0000	1.0000
3860	1.0000	1.0000	1.0000	1.0000
8560	1.0000	1.0000	1.0000	1.0000
15830	0.8000	0.8000	1.0000	1.0000
29770	0.2000	0.2000	0.2000	0.2000
68390	0.0000	0.0000	0.0000	0.0000

			Transform: Arcsin Square Root					Rank	1-Tailed	Number	Total
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Resp	Number
FSW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
WAF Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		0	20
3860	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
8560	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
15830	0.9000	0.9000	1.2262	1.1071	1.3453	11.212	4	14.00	10.00	2	20
*29770	0.2000	0.2000	0.4636	0.4636	0.4636	0.000	4	10.00	10.00	16	20
68390	0.0000	0.0000	0.2255	0.2255	0.2255	0.000	4			20	20

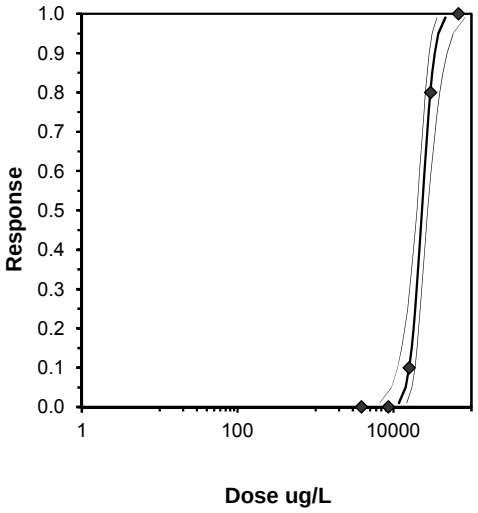
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.63123	0.905	5.4E-15	2.980392
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	15830	29770	21708.5	
Treatments vs WAF Control				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	7.794081	1.747035	4.369893	11.21827	0	0.010855	7.814728	1	4.365154	0.128302	3
Intercept	-29.0224	7.620937	-43.9594	-14.0853							
TSCR											

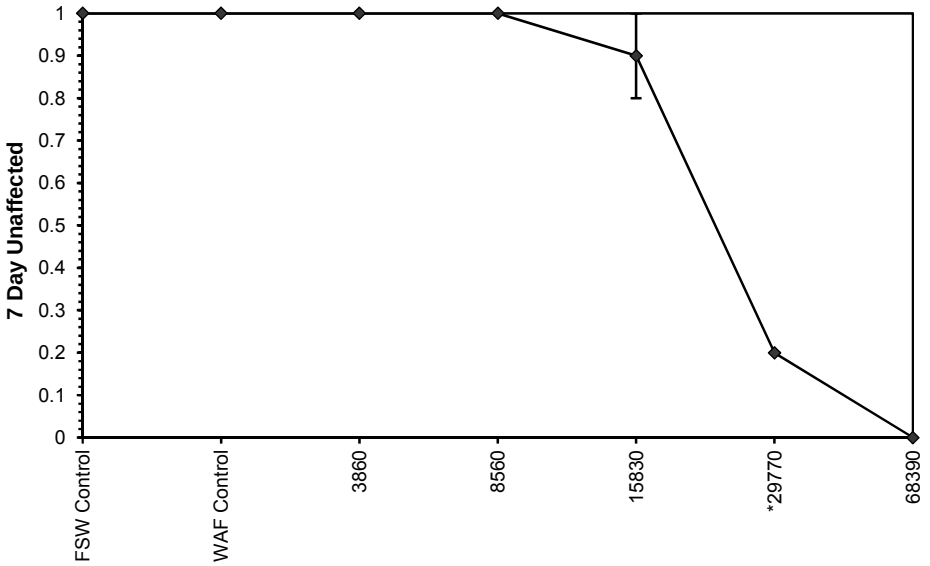
Point	Probits	ug/L	95% Fiducial Limits	
EC01	2.674	11659.45	6649.302	14800.89
EC05	3.355	14259.87	9408.471	17228.43
EC10	3.718	15875.53	11275.41	18756.63
EC15	3.964	17067.8	12704.42	19919.32
EC20	4.158	18078.91	13934.91	20944.57
EC25	4.326	18993.97	15050.69	21916.11
EC40	4.747	21510.44	18029.4	24903.08
EC50	5.000	23182.19	19851.65	27226.81
EC60	5.253	24983.86	21633.54	30076.32
EC75	5.674	28293.92	24480.92	36177.54
EC80	5.842	29726	25588.28	39117.39
EC85	6.036	31487.01	26878.99	42948.14
EC90	6.282	33851.71	28519.97	48434.02
EC95	6.645	37687.14	31023.54	58093.9
EC99	7.326	46092.54	36082.36	82267.42



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06b	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Dose-Response Plot



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06b	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
3860		100.00	100.00	100.00	0.00	0.00	4
8560		100.00	100.00	100.00	0.00	0.00	4
15830		90.00	80.00	100.00	11.55	3.78	4
29770		20.00	20.00	20.00	0.00	0.00	4
68390		0.00	0.00	0.00	0.00		4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
3860		7.74	7.34	8.30	0.43	8.50	4
8560		8.26	7.94	8.58	0.30	6.63	4
15830		7.74	6.22	9.04	1.16	13.93	4
29770		1.36	1.20	1.60	0.17	30.57	4
68390		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
3860		8.10	8.10	8.10	0.00	0.00	1
8560		8.10	8.10	8.10	0.00	0.00	1
15830		8.00	8.00	8.00	0.00	0.00	1
29770		7.80	7.80	7.80	0.00	0.00	1
68390		7.30	7.30	7.30	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
3860		35.10	35.10	35.10	0.00	0.00	1
8560		35.10	35.10	35.10	0.00	0.00	1
15830		35.20	35.20	35.20	0.00	0.00	1
29770		35.30	35.30	35.30	0.00	0.00	1
68390		35.30	35.30	35.30	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
3860		96.30	96.30	96.30	0.00	0.00	1
8560		95.70	95.70	95.70	0.00	0.00	1
15830		96.70	96.70	96.70	0.00	0.00	1
29770		95.60	95.60	95.60	0.00	0.00	1
68390		85.10	85.10	85.10	0.00	0.00	1

Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	Loading Rate				

Conc-gm/L	1	2	3	4
FSW Control	8.4200	10.1200	7.1200	7.6600
WAF Control	8.0800	9.0200	7.1600	7.6600
4.8	7.3400	8.3000	7.8400	7.4600
9.7	7.9400	8.4400	8.5800	8.0800
19.3	7.7200	6.2200	7.9600	9.0400
38.6	1.2800	1.2000	1.6000	1.3600
77.2	0.0000	0.0000	0.0000	0.0000

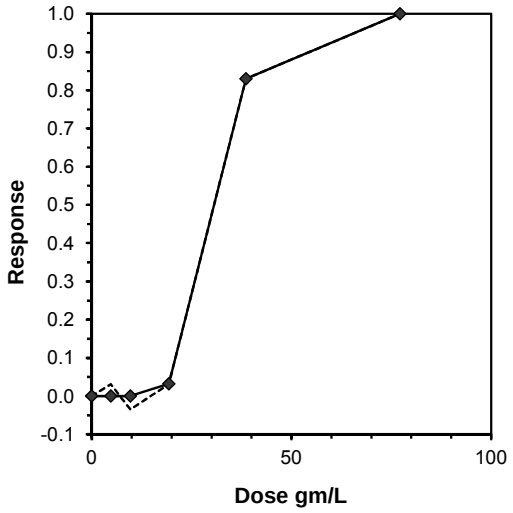
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	8.3300	1.0439	8.3300	7.1200	10.1200	15.691	4					
WAF Control	7.9800	1.0000	7.9800	7.1600	9.0200	9.884	4	*			7.9917	1.0000
4.8	7.7350	0.9693	7.7350	7.3400	8.3000	5.595	4	0.513	2.360	1.1266	7.9917	1.0000
9.7	8.2600	1.0351	8.2600	7.9400	8.5800	3.629	4	-0.587	2.360	1.1266	7.9917	1.0000
19.3	7.7350	0.9693	7.7350	6.2200	9.0400	15.020	4	0.513	2.360	1.1266	7.7350	0.9679
*38.6	1.3600	0.1704	1.3600	1.2000	1.6000	12.707	4	13.868	2.360	1.1266	1.3600	0.1702
77.2	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4				0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.940823	0.905	-0.16077	2.019523
Bartlett's Test indicates equal variances (p = 0.04)	10.16842	13.2767		
The control means are not significantly different (p = 0.66)	0.458533	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	19.3	38.6	27.29432		1.126604	0.141178	34.69307	0.455773	8.9E-10	4, 15
Treatments vs WAF Control										

Linear Interpolation (200 Resamples)

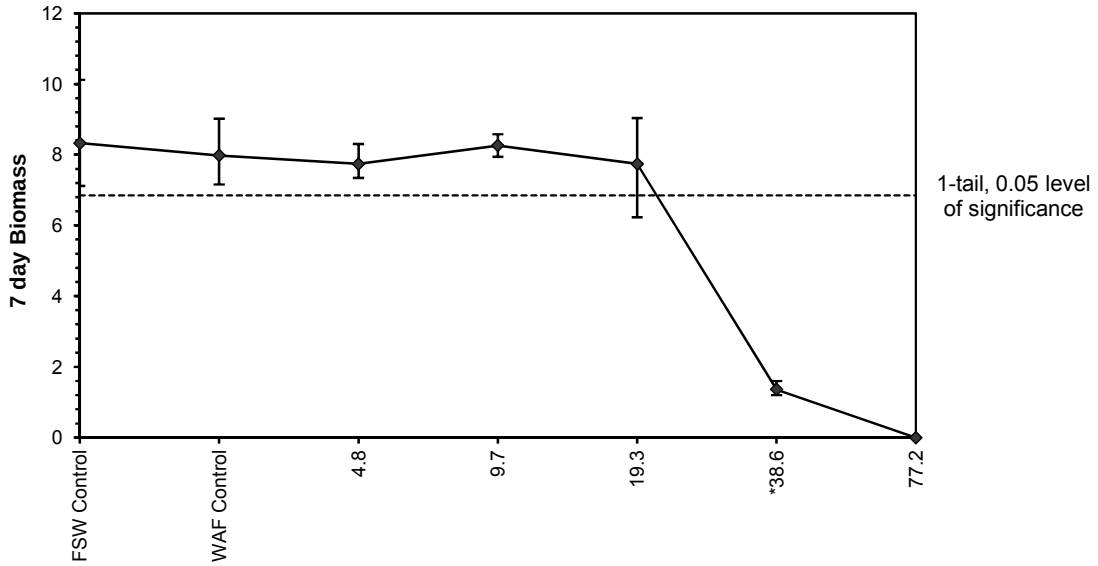
Point	gm/L	SD	95% CL(Exp)		Skew
IC05	19.733	5.770	0.000	20.929	-1.2041
IC10	20.942	2.422	8.439	22.092	-2.6612
IC15	22.152	1.438	15.155	23.255	-2.0412
IC20	23.362	1.168	17.945	24.430	-1.4775
IC25	24.572	1.055	19.614	25.602	-1.2318
IC40	28.201	0.804	24.611	29.105	-1.1814
IC50	30.620	0.643	27.794	31.439	-1.0997



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	Loading Rate				

Dose-Response Plot



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	Loading Rate				

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
4.8		100.00	100.00	100.00	0.00	0.00	4
9.7		100.00	100.00	100.00	0.00	0.00	4
19.3		90.00	80.00	100.00	11.55	3.78	4
38.6		20.00	20.00	20.00	0.00	0.00	4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
4.8		7.74	7.34	8.30	0.43	8.50	4
9.7		8.26	7.94	8.58	0.30	6.63	4
19.3		7.74	6.22	9.04	1.16	13.93	4
38.6		1.36	1.20	1.60	0.17	30.57	4
77.2		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
4.8		8.10	8.10	8.10	0.00	0.00	1
9.7		8.10	8.10	8.10	0.00	0.00	1
19.3		8.00	8.00	8.00	0.00	0.00	1
38.6		7.80	7.80	7.80	0.00	0.00	1
77.2		7.30	7.30	7.30	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
4.8		35.10	35.10	35.10	0.00	0.00	1
9.7		35.10	35.10	35.10	0.00	0.00	1
19.3		35.20	35.20	35.20	0.00	0.00	1
38.6		35.30	35.30	35.30	0.00	0.00	1
77.2		35.30	35.30	35.30	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
4.8		96.30	96.30	96.30	0.00	0.00	1
9.7		95.70	95.70	95.70	0.00	0.00	1
19.3		96.70	96.70	96.70	0.00	0.00	1
38.6		95.60	95.60	95.60	0.00	0.00	1
77.2		85.10	85.10	85.10	0.00	0.00	1

Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06b	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	8.4200	10.1200	7.1200	7.6600
WAF Control	8.0800	9.0200	7.1600	7.6600
3860	7.3400	8.3000	7.8400	7.4600
8560	7.9400	8.4400	8.5800	8.0800
15830	7.7200	6.2200	7.9600	9.0400
29770	1.2800	1.2000	1.6000	1.3600
68390	0.0000	0.0000	0.0000	0.0000

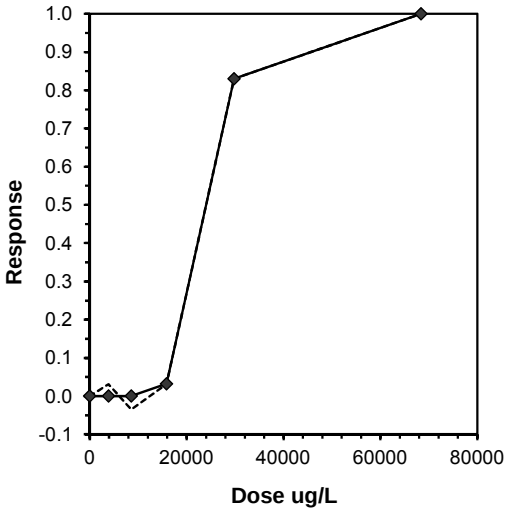
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
FSW Control	8.3300	1.0439	8.3300	7.1200	10.1200	15.691	4					
WAF Control	7.9800	1.0000	7.9800	7.1600	9.0200	9.884	4	*			7.9917	1.0000
3860	7.7350	0.9693	7.7350	7.3400	8.3000	5.595	4	0.513	2.360	1.1266	7.9917	1.0000
8560	8.2600	1.0351	8.2600	7.9400	8.5800	3.629	4	-0.587	2.360	1.1266	7.9917	1.0000
15830	7.7350	0.9693	7.7350	6.2200	9.0400	15.020	4	0.513	2.360	1.1266	7.7350	0.9679
*29770	1.3600	0.1704	1.3600	1.2000	1.6000	12.707	4	13.868	2.360	1.1266	1.3600	0.1702
68390	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4				0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.940823	0.905	-0.16077	2.019523
Bartlett's Test indicates equal variances (p = 0.04)	10.16842	13.2767		
The control means are not significantly different (p = 0.66)	0.458533	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	15830	29770	21708.5		1.126604	0.141178	34.69307	0.455773	8.9E-10	4, 15
Treatments vs WAF Control										

Linear Interpolation (200 Resamples)

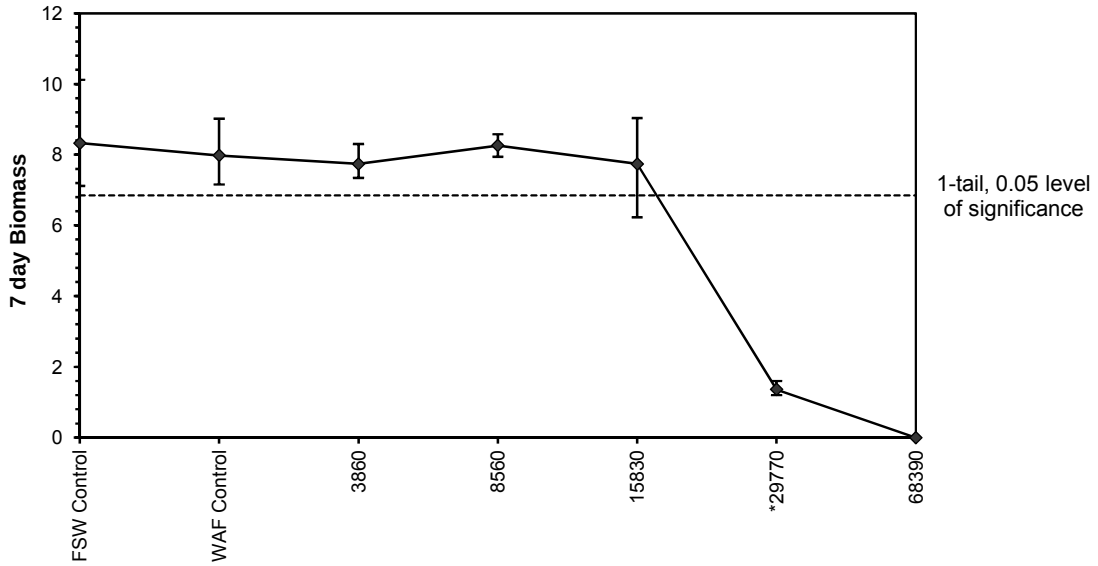
Point	ug/L	SD	95% CL(Exp)		Skew
IC05	16142.51	4671.806	0	17012.18	-1.2421
IC10	17016.27	1954.101	7373.185	17857.61	-2.6555
IC15	17890.02	1097.801	11899.05	18703.04	-2.2030
IC20	18763.78	880.4609	14909.07	19548.47	-1.5117
IC25	19637.53	784.3117	16057.69	20393.89	-1.1569
IC40	22258.8	599.5128	19503.55	22930.18	-1.1881
IC50	24006.31	479.4807	21800.79	24621.04	-1.2016



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06b	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Dose-Response Plot



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/06b	Sample ID:	Barossa Field Condensate
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
3860		100.00	100.00	100.00	0.00	0.00	4
8560		100.00	100.00	100.00	0.00	0.00	4
15830		90.00	80.00	100.00	11.55	3.78	4
29770		20.00	20.00	20.00	0.00	0.00	4
68390		0.00	0.00	0.00	0.00		4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
3860		7.74	7.34	8.30	0.43	8.50	4
8560		8.26	7.94	8.58	0.30	6.63	4
15830		7.74	6.22	9.04	1.16	13.93	4
29770		1.36	1.20	1.60	0.17	30.57	4
68390		0.00	0.00	0.00	0.00		4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
3860		8.10	8.10	8.10	0.00	0.00	1
8560		8.10	8.10	8.10	0.00	0.00	1
15830		8.00	8.00	8.00	0.00	0.00	1
29770		7.80	7.80	7.80	0.00	0.00	1
68390		7.30	7.30	7.30	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
3860		35.10	35.10	35.10	0.00	0.00	1
8560		35.10	35.10	35.10	0.00	0.00	1
15830		35.20	35.20	35.20	0.00	0.00	1
29770		35.30	35.30	35.30	0.00	0.00	1
68390		35.30	35.30	35.30	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
3860		96.30	96.30	96.30	0.00	0.00	1
8560		95.70	95.70	95.70	0.00	0.00	1
15830		96.70	96.70	96.70	0.00	0.00	1
29770		95.60	95.60	95.60	0.00	0.00	1
68390		85.10	85.10	85.10	0.00	0.00	1

Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/08	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	LR				

Conc-gm/L	1	2	3	4
FSW Control	1.0000	1.0000	1.0000	1.0000
WAF Control	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000
9.9	1.0000	1.0000	1.0000	1.0000
19.9	1.0000	1.0000	1.0000	1.0000
39.8	1.0000	1.0000	1.0000	1.0000
79.5	1.0000	1.0000	0.4000	0.0000

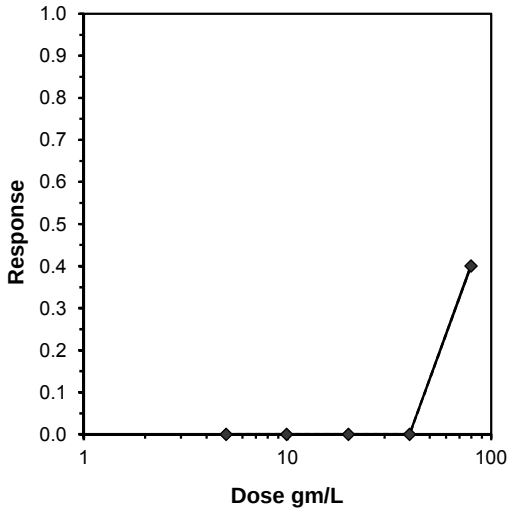
			Transform: Arcsin Square Root					Rank	1-Tailed	Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
FSW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
WAF Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		1.0000	1.0000
5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
9.9	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
19.9	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
39.8	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
79.5	0.6000	0.6000	0.9002	0.2255	1.3453	60.771	4	14.00	10.00	0.6000	0.6000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.557919	0.916	-0.86578	7.231261
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	79.5	>79.5		
Treatments vs WAF Control				

Log-Logit Interpolation (200 Resamples)

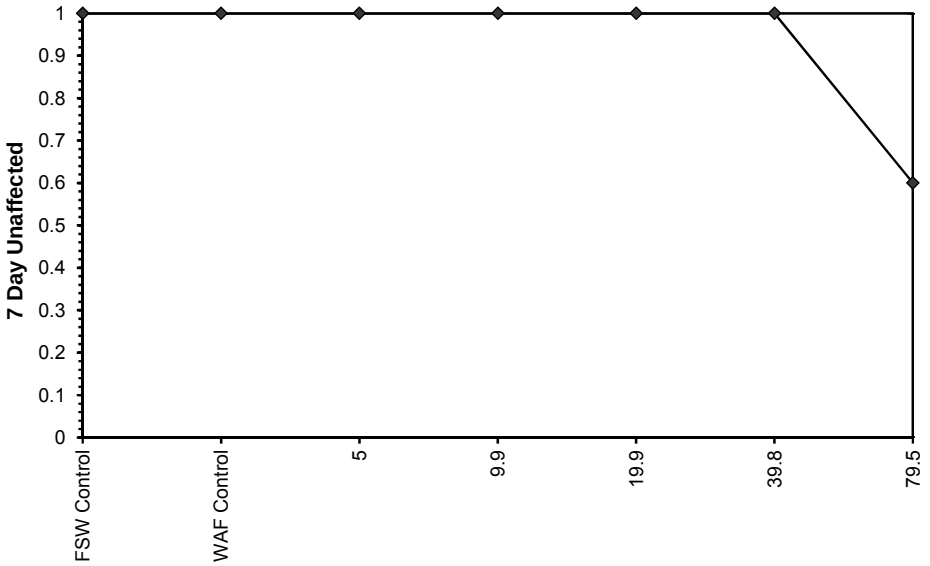
Point	gm/L	SD	95% CL(Exp)	Skew
IC05	65.174			
IC10	69.103			
IC15	71.651			
IC20	73.631			
IC25	75.307			
IC40	>79.5			
IC50	>79.5			



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/08	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	LR				

Dose-Response Plot



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/08	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	LR				

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
5		100.00	100.00	100.00	0.00	0.00	4
9.9		100.00	100.00	100.00	0.00	0.00	4
19.9		100.00	100.00	100.00	0.00	0.00	4
39.8		100.00	100.00	100.00	0.00	0.00	4
79.5		60.00	0.00	100.00	48.99	11.67	4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
5		8.65	7.82	9.24	0.60	8.93	4
9.9		7.95	7.18	9.34	0.95	12.29	4
19.9		8.11	7.64	8.32	0.32	6.97	4
39.8		8.57	7.90	9.46	0.66	9.50	4
79.5		4.95	0.00	8.58	3.78	39.25	4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
5		8.10	8.10	8.10	0.00	0.00	1
9.9		8.20	8.20	8.20	0.00	0.00	1
19.9		8.20	8.20	8.20	0.00	0.00	1
39.8		8.20	8.20	8.20	0.00	0.00	1
79.5		8.20	8.20	8.20	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
5		35.40	35.40	35.40	0.00	0.00	1
9.9		35.20	35.20	35.20	0.00	0.00	1
19.9		35.20	35.20	35.20	0.00	0.00	1
39.8		35.20	35.20	35.20	0.00	0.00	1
79.5		35.20	35.20	35.20	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
5		96.40	96.40	96.40	0.00	0.00	1
9.9		96.90	96.90	96.90	0.00	0.00	1
19.9		96.60	96.60	96.60	0.00	0.00	1
39.8		96.70	96.70	96.70	0.00	0.00	1
79.5		94.70	94.70	94.70	0.00	0.00	1

Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/07b	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	1.0000	1.0000	1.0000	1.0000
WAF Control	1.0000	1.0000	1.0000	1.0000
1410	1.0000	1.0000	1.0000	1.0000
2770	1.0000	1.0000	1.0000	1.0000
4850	1.0000	1.0000	1.0000	1.0000
11450	1.0000	1.0000	1.0000	1.0000
22480	1.0000	1.0000	0.4000	0.0000

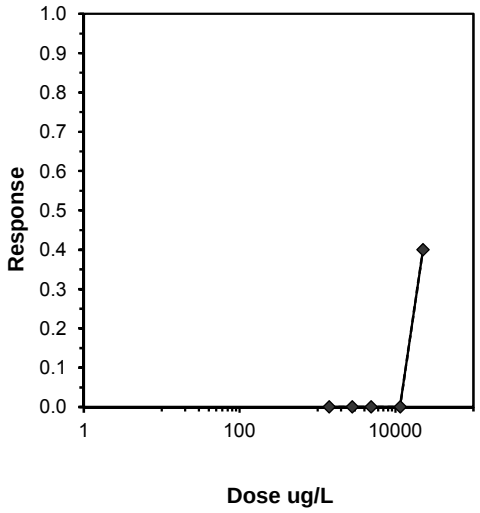
			Transform: Arcsin Square Root					Rank	1-Tailed	Isotonic	
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
FSW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
WAF Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		1.0000	1.0000
1410	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
2770	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
4850	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
11450	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
22480	0.6000	0.6000	0.9002	0.2255	1.3453	60.771	4	14.00	10.00	0.6000	0.6000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.557919	0.916	-0.86578	7.231261
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 1.00)	0	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	22480	>22480		
Treatments vs WAF Control				

Log-Logit Interpolation (200 Resamples)

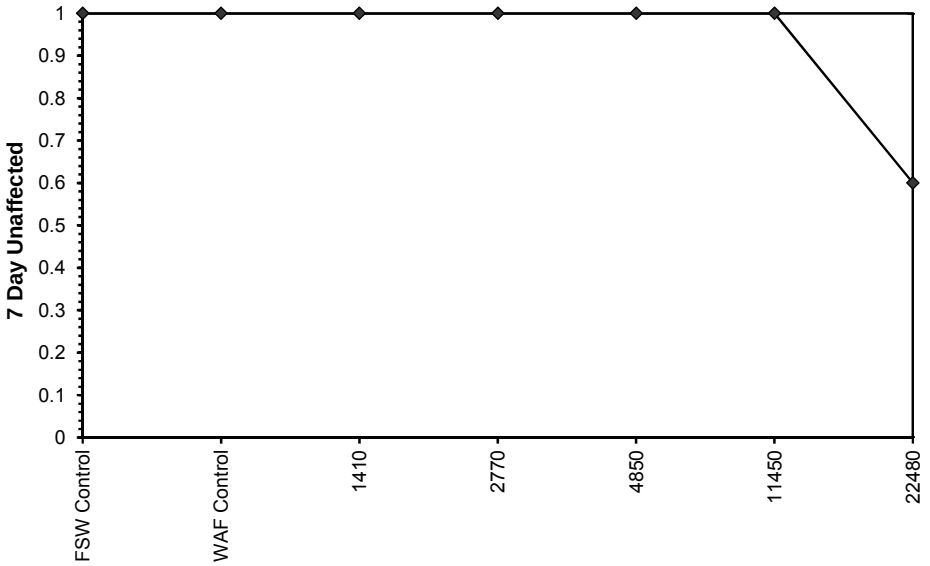
Point	ug/L	SD	95% CL(Exp)	Skew
IC05	18505.88			
IC10	19596.3			
IC15	20303.38			
IC20	20852.52			
IC25	21317.26			
IC40	>22480			
IC50	>22480			



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/07b	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Dose-Response Plot



Fish Growth Test-7 Day Unaffected

Start Date:	22/09/2015 12:30	Test ID:	PR1244/07b	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
1410		100.00	100.00	100.00	0.00	0.00	4
2770		100.00	100.00	100.00	0.00	0.00	4
4850		100.00	100.00	100.00	0.00	0.00	4
11450		100.00	100.00	100.00	0.00	0.00	4
22480		60.00	0.00	100.00	48.99	11.67	4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
1410		8.65	7.82	9.24	0.60	8.93	4
2770		7.95	7.18	9.34	0.95	12.29	4
4850		8.11	7.64	8.32	0.32	6.97	4
11450		8.57	7.90	9.46	0.66	9.50	4
22480		4.95	0.00	8.58	3.78	39.25	4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
1410		8.10	8.10	8.10	0.00	0.00	1
2770		8.10	8.10	8.10	0.00	0.00	1
4850		8.00	8.00	8.00	0.00	0.00	1
11450		7.80	7.80	7.80	0.00	0.00	1
22480		7.30	7.30	7.30	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
1410		35.10	35.10	35.10	0.00	0.00	1
2770		35.10	35.10	35.10	0.00	0.00	1
4850		35.20	35.20	35.20	0.00	0.00	1
11450		35.30	35.30	35.30	0.00	0.00	1
22480		35.30	35.30	35.30	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
1410		96.30	96.30	96.30	0.00	0.00	1
2770		95.70	95.70	95.70	0.00	0.00	1
4850		96.70	96.70	96.70	0.00	0.00	1
11450		95.60	95.60	95.60	0.00	0.00	1
22480		85.10	85.10	85.10	0.00	0.00	1

Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/08	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	LR				

Conc-gm/L	1	2	3	4
FSW Control	8.4200	10.1200	7.1200	7.6600
WAF Control	8.0800	9.0200	7.1600	7.6600
5	8.8000	9.2400	7.8200	8.7400
9.9	9.3400	7.7200	7.5600	7.1800
19.9	8.1800	8.3200	8.3000	7.6400
39.8	8.3000	7.9000	9.4600	8.6200
79.5	7.0600	8.5800	4.1600	0.0000

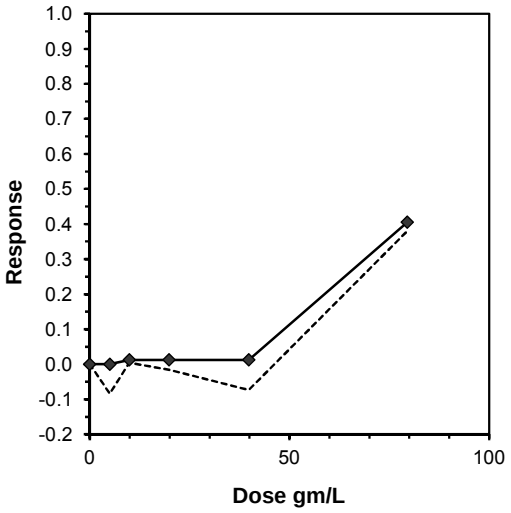
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-gm/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
FSW Control	8.3300	1.0439	8.3300	7.1200	10.1200	15.691	4				
WAF Control	7.9800	1.0000	7.9800	7.1600	9.0200	9.884	4	*		8.3150	1.0000
5	8.6500	1.0840	8.6500	7.8200	9.2400	6.896	4	22.00	10.00	8.3150	1.0000
9.9	7.9500	0.9962	7.9500	7.1800	9.3400	11.999	4	18.00	10.00	8.2100	0.9874
19.9	8.1100	1.0163	8.1100	7.6400	8.3200	3.938	4	20.00	10.00	8.2100	0.9874
39.8	8.5700	1.0739	8.5700	7.9000	9.4600	7.730	4	22.00	10.00	8.2100	0.9874
79.5	4.9500	0.6203	4.9500	0.0000	8.5800	76.266	4	13.00	10.00	4.9500	0.5953

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.824168	0.916	-0.91513	6.12451
Bartlett's Test indicates unequal variances (p = 5.86E-04)	21.74163	15.08627		
The control means are not significantly different (p = 0.66)	0.458533	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	79.5	>79.5		
Treatments vs WAF Control				

Linear Interpolation (200 Resamples)

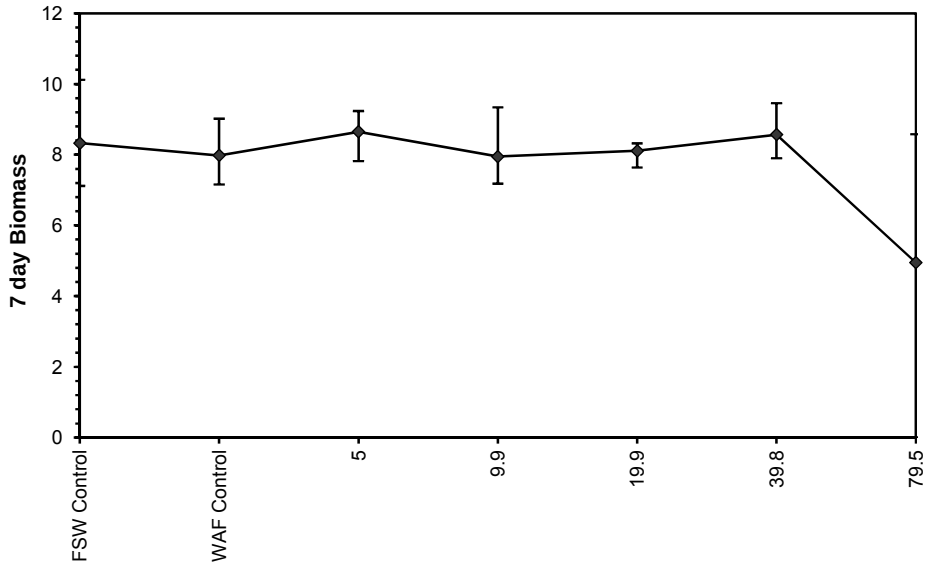
Point	gm/L	SD	95% CL(Exp)	Skew
IC05	43.584			
IC10	48.647			
IC15	53.710			
IC20	58.773			
IC25	63.836			
IC40	79.025			
IC50	>79.5			



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/08	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	LR				

Dose-Response Plot



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/08	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	LR				

Auxiliary Data Summary

Conc-gm/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
5		100.00	100.00	100.00	0.00	0.00	4
9.9		100.00	100.00	100.00	0.00	0.00	4
19.9		100.00	100.00	100.00	0.00	0.00	4
39.8		100.00	100.00	100.00	0.00	0.00	4
79.5		60.00	0.00	100.00	48.99	11.67	4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
5		8.65	7.82	9.24	0.60	8.93	4
9.9		7.95	7.18	9.34	0.95	12.29	4
19.9		8.11	7.64	8.32	0.32	6.97	4
39.8		8.57	7.90	9.46	0.66	9.50	4
79.5		4.95	0.00	8.58	3.78	39.25	4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
5		8.10	8.10	8.10	0.00	0.00	1
9.9		8.20	8.20	8.20	0.00	0.00	1
19.9		8.20	8.20	8.20	0.00	0.00	1
39.8		8.20	8.20	8.20	0.00	0.00	1
79.5		8.20	8.20	8.20	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
5		35.40	35.40	35.40	0.00	0.00	1
9.9		35.20	35.20	35.20	0.00	0.00	1
19.9		35.20	35.20	35.20	0.00	0.00	1
39.8		35.20	35.20	35.20	0.00	0.00	1
79.5		35.20	35.20	35.20	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
5		96.40	96.40	96.40	0.00	0.00	1
9.9		96.90	96.90	96.90	0.00	0.00	1
19.9		96.60	96.60	96.60	0.00	0.00	1
39.8		96.70	96.70	96.70	0.00	0.00	1
79.5		94.70	94.70	94.70	0.00	0.00	1

Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/07b	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Conc-ug/L	1	2	3	4
FSW Control	8.4200	10.1200	7.1200	7.6600
WAF Control	8.0800	9.0200	7.1600	7.6600
1410	8.8000	9.2400	7.8200	8.7400
2770	9.3400	7.7200	7.5600	7.1800
4850	8.1800	8.3200	8.3000	7.6400
11450	8.3000	7.9000	9.4600	8.6200
22480	7.0600	8.5800	4.1600	0.0000

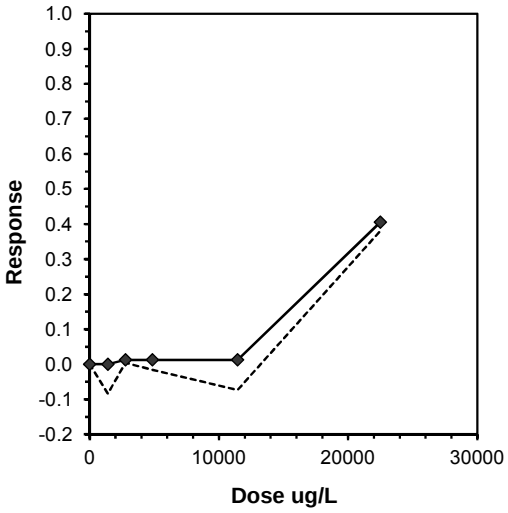
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-ug/L	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
FSW Control	8.3300	1.0439	8.3300	7.1200	10.1200	15.691	4				
WAF Control	7.9800	1.0000	7.9800	7.1600	9.0200	9.884	4	*		8.3150	1.0000
1410	8.6500	1.0840	8.6500	7.8200	9.2400	6.896	4	22.00	10.00	8.3150	1.0000
2770	7.9500	0.9962	7.9500	7.1800	9.3400	11.999	4	18.00	10.00	8.2100	0.9874
4850	8.1100	1.0163	8.1100	7.6400	8.3200	3.938	4	20.00	10.00	8.2100	0.9874
11450	8.5700	1.0739	8.5700	7.9000	9.4600	7.730	4	22.00	10.00	8.2100	0.9874
22480	4.9500	0.6203	4.9500	0.0000	8.5800	76.266	4	13.00	10.00	4.9500	0.5953

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.824168	0.916	-0.91513	6.12451
Bartlett's Test indicates unequal variances (p = 5.86E-04)	21.74163	15.08627		
The control means are not significantly different (p = 0.66)	0.458533	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	22480	>22480		
Treatments vs WAF Control				

Linear Interpolation (200 Resamples)

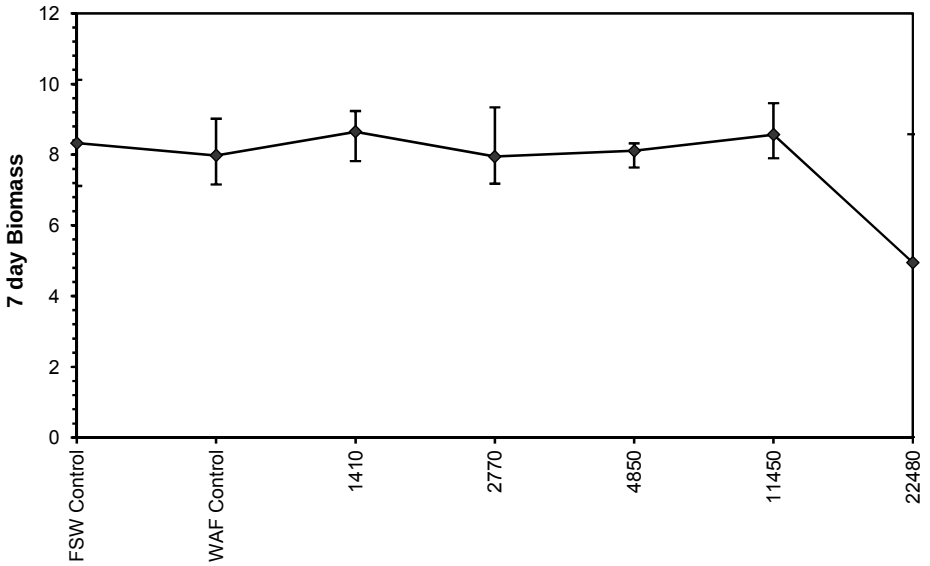
Point	ug/L	SD	95% CL(Exp)	Skew
IC05	12501.4			
IC10	13908.07			
IC15	15314.73			
IC20	16721.39			
IC25	18128.06			
IC40	22348.05			
IC50	>22480			



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/07b	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Dose-Response Plot



Fish Growth Test-7 day Biomass

Start Date:	22/09/2015 12:30	Test ID:	PR1244/07b	Sample ID:	Barossa Field Condensate Weathered
End Date:	29/09/2015 11:00	Lab ID:	7323	Sample Type:	WAF-Water Accommodated Fraction
Sample Date:		Protocol:	ESA 122	Test Species:	LT-Lates calcarifer
Comments:	TRH				

Auxiliary Data Summary

Conc-ug/L	Parameter	Mean	Min	Max	SD	CV%	N
FSW Control	% Un-affected	100.00	100.00	100.00	0.00	0.00	4
WAF Control		100.00	100.00	100.00	0.00	0.00	4
1410		100.00	100.00	100.00	0.00	0.00	4
2770		100.00	100.00	100.00	0.00	0.00	4
4850		100.00	100.00	100.00	0.00	0.00	4
11450		100.00	100.00	100.00	0.00	0.00	4
22480		60.00	0.00	100.00	48.99	11.67	4
FSW Control	Biomass	8.33	7.12	10.12	1.31	13.72	4
WAF Control		7.98	7.16	9.02	0.79	11.13	4
1410		8.65	7.82	9.24	0.60	8.93	4
2770		7.95	7.18	9.34	0.95	12.29	4
4850		8.11	7.64	8.32	0.32	6.97	4
11450		8.57	7.90	9.46	0.66	9.50	4
22480		4.95	0.00	8.58	3.78	39.25	4
FSW Control	pH	8.20	8.20	8.20	0.00	0.00	1
WAF Control		8.20	8.20	8.20	0.00	0.00	1
1410		8.10	8.10	8.10	0.00	0.00	1
2770		8.10	8.10	8.10	0.00	0.00	1
4850		8.00	8.00	8.00	0.00	0.00	1
11450		7.80	7.80	7.80	0.00	0.00	1
22480		7.30	7.30	7.30	0.00	0.00	1
FSW Control	Salinity	34.90	34.90	34.90	0.00	0.00	1
WAF Control		35.10	35.10	35.10	0.00	0.00	1
1410		35.10	35.10	35.10	0.00	0.00	1
2770		35.10	35.10	35.10	0.00	0.00	1
4850		35.20	35.20	35.20	0.00	0.00	1
11450		35.30	35.30	35.30	0.00	0.00	1
22480		35.30	35.30	35.30	0.00	0.00	1
FSW Control	% DO	99.80	99.80	99.80	0.00	0.00	1
WAF Control		92.80	92.80	92.80	0.00	0.00	1
1410		96.30	96.30	96.30	0.00	0.00	1
2770		95.70	95.70	95.70	0.00	0.00	1
4850		96.70	96.70	96.70	0.00	0.00	1
11450		95.60	95.60	95.60	0.00	0.00	1
22480		85.10	85.10	85.10	0.00	0.00	1

Appendix C. Burrlioz Output Report

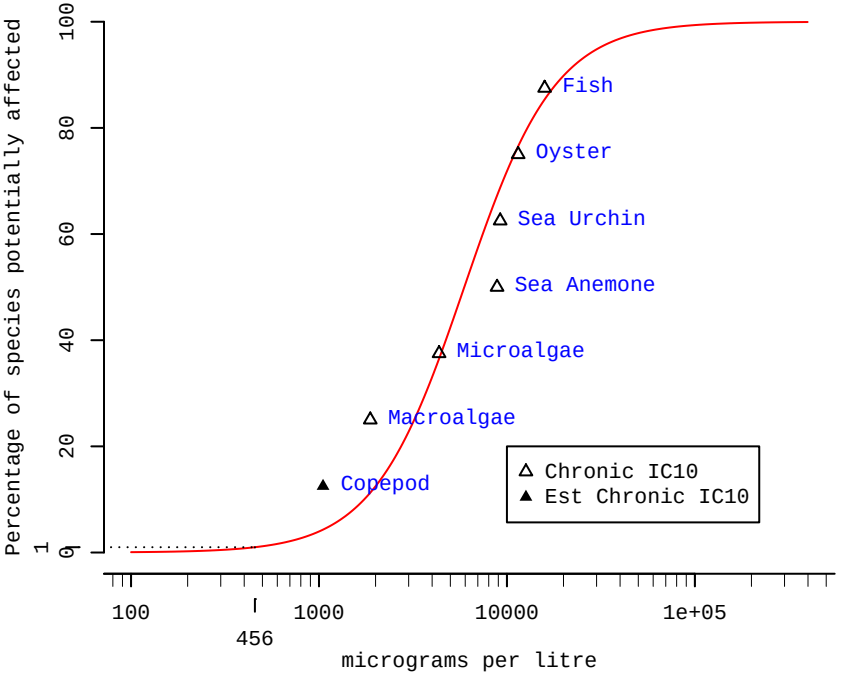
Burrlioz 2.0 report

Toxicant: Barossa-3 condensate
Input file: C:\Users\cxxwilson\Documents\Celeste Desktop\Conoco Phillips\Barossa\Ecotox\
Time read: Thu Dec 10 10:10:24 2015
Units: micrograms per litre
Model: log logistic

Protection level information

Protect. level	Guideline Value	lower 95% CI	upper 95% CI
99%	456	121	4285
95%	1146	367	5928
90%	1739	605	6680
80%	2735	1051	7859

notes: 6 chronic IC10 values and 1 estimated chronic value



Data:

Data	Species	Type	Test
4355.2	Isochrysis aff. Galbana	Microalgae	Chronic IC10
1873.9	Ecklonia radiata	Macroalgae	Chronic IC10
9206.2	Heliocidaris tuberculata	Sea Urchin	Chronic IC10
11478.4	Saccostrea echinata	Oyster	Chronic IC10
1050.7	Parvocalanus crassirostris	Copepod	Est Chronic IC10
8862.4	Aiptasia pulchella	Sea Anemone	Chronic IC10
15875.5	Lates calcarifer	Fish	Chronic IC10