



Vista Gold Australia Pty Ltd  
Mt Todd Discharge  
Treated Retention Pond 3 Ecotoxicological Report

January 2014



# Table of Contents

1.	Introduction.....	1
1.1	Project Background.....	1
1.2	Objective .....	1
1.3	Scope of Work .....	1
1.4	Limitations.....	2
1.5	Assumptions .....	2
2.	Direct Toxicity Assessment Methodology .....	3
2.1	Direct Toxicity Assessment.....	3
2.2	Surface Water Chemistry.....	5
2.3	Sample Sites .....	5
3.	Results .....	6
3.1	Ecotoxicology Testing of RP3 Treated Water (in-situ).....	6
3.2	Acute to Chronic Ratios (ACR) .....	7
3.3	Concentrations used to calculate the SSD .....	7
3.4	Species Protection Values .....	8
3.5	Dilution Factor.....	8
3.6	80% Species Protection Monitoring Values.....	9
4.	Conclusions and Recommendations .....	11
4.1	Conclusions .....	11
4.2	Recommendations.....	11
5.	References.....	12

# Table Index

Table 1	Species used in the Ecotoxicological Assessment of Treated RP3 Discharge .....	4
Table 2	Concentrations of Treated RP3 used in Bioassays .....	4
Table 3	Analytes for SW2 and Treated RP3.....	5
Table 4	Sampling Sites .....	5
Table 5	Summary of Treated RP3 Ecotox Results .....	6
Table 6	Values used to Calculate SSD.....	7
Table 7	Species Protection Values .....	8
Table 8	Dilution Rates of RP3 Treated Water (in-situ) to Meet 80 % SSD Dilution (1:132) .....	9
Table 9	Monitoring Values for SW4 Wet Season 2013/2014 .....	10
Table 10	RP3 Chemistry (Top 30 metres) .....	11

# Figure Index

Figure 1	Species Sensitivity Distribution Graph.....	8
----------	---	---

# Appendices

Appendix A – Ecotox Reports

Appendix B – Chemistry Reports

# 1. Introduction

## 1.1 Project Background

Vista Gold Australia Pty Ltd (Vista Gold) received a Waste Discharge Licence (WDL 178-3) on 26 November 2013 from the Northern Territory Environment Protection Authority (NT EPA). The WDL outlines environmental requirements for protection of the Edith River from mine wastewater discharges. Previously, Vista Gold derived interim site specific trigger values (ISSTVs) (GHD 2012) to meet the 95% species protection trigger values downstream of the site at SW10 (8.7 km from SW4) to meet the requirements of WDL 178-1. However, the use of dilution factors derived from direct toxicity assessment (DTA) for three water bodies at the Mt Todd mine site have been selected as the most appropriate method for deriving safe concentrations of metals for environmental protection of the Edith River to meet the requirements of WDL 178-3.

The DTA method is recommended by ANZECC & ARMCANZ (2000) where chemicals are present in a complex mixture. DTA allows the determination of direct biological effects on appropriate species to be assessed and also enables metal concentrations to be established that would not cause adverse environmental effects.

This report should be read in conjunction with the Waste Discharge Plan (GHD 2013) (<http://mttodd.com.au/content/waste-discharge-licence>).

## 1.2 Objective

WDL 178-3 requires that ecotoxicological assessment be conducted for a wastewater source. This treated retention pond (RP) 3 Ecotox DTA Report has been developed to address the relevant sections of the WDL 178-3 to derive a dilution factor for RP3 prior to discharging treated mine water into the Edith River.

## 1.3 Scope of Work

This Report addresses the following aspects of the WDL 178-3:

- The methodology for calculating the 80% species protection ANZECC & ARMCANZ (2000) dilution factor for ecosystem protection applied at SW4 for mine discharges from RP3.
- Deriving Monitoring Values for the treated RP3 mine water to be met at SW4 to check that the dilution factor for the treated mine water is being met.

## 1.4 Limitations

This Vista Gold Australia Retention Pond 3 Ecotoxicological Report (“Report”):

- Has been prepared by GHD Pty Ltd (“GHD”) for Vista Gold Australia Pty Ltd (Vista Gold) and the NT EPA.
- May only be used and relied on by Vista Gold and the NT EPA.
- Must not be copied to, used by, or relied on by any person other than Vista Gold without the prior written consent of Vista Gold.
- May only be used for the purpose of addressing WDL 178-3 requirements (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Vista Gold arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in section 1.3 of this Report.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report (“Assumptions”), including (but not limited to) those specified in section 1.5 below.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied on until 6 months, after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

## 1.5 Assumptions

The assumptions upon which this report is based are:

- The treated mine water tested for DTA was representative of the RP3 water at the time of testing.
- SW2 water used in the DTA was representative of early wet season Edith River water.

## 2. Direct Toxicity Assessment Methodology

### 2.1 Direct Toxicity Assessment

Direct Toxicity Assessment (DTA) provides an integrated measure of the toxicity of chemicals within a complex mixture, and accounts for interactions between compounds which may be additive, synergistic or ameliorative. DTA provides a better representation of natural environmental conditions than single chemical testing, and is therefore recommended by ANZECC & ARMCANZ (2000) for assessing the environmental impact from complex effluents.

The Mt Todd DTA program was designed in line with the recommendations contained in ANZECC & ARMCANZ (2000). ANZECC & ARMCANZ (2000) states that a DTA program should address the following design considerations:

- Test species selection
- Receiving water selection
- Nature of contaminant(s)
- Test methods
- Statistical considerations.

#### 2.1.1 Selected Species

ANZECC & ARMCANZ (2000) "Minimum requirements for DTA" (section 8.3.6.8) recommend that toxicity data from between three and five species representing at least four different taxonomic groups (where five species are used) is required for effluent DTA. Further information on species used in the DTAs conducted for Mt Todd discharge to the Edith River is shown in Table 1 below.

Often, due to laboratory issues, not all tests listed in Table 1 are available at the time of testing. DTAs conducted on RP1, RP7 and RP3 Pilot Trial used a maximum of seven species to provide confidence in the species sensitivity distribution calculation.

Tests were selected adhering to the following criteria:

- a minimum of five bioassays covering at least four taxa
- preferably chronic endpoints to avoid the used of application factors
- locally occurring species or species representative of the ecosystem
- dilution water sampled from SW2 (upstream site)
- sufficient test dilutions to obtain a statistically valid EC10 (i.e. tight 95% confidence limits)
- bioassay suite sensitive to a broad range of contaminants

The bioassays for the Mt Todd site are usually conducted by two laboratories: ERISS in Darwin and Ecotox Services Australasia located in Sydney, because not all bioassays are available from one laboratory. The cladoceran (*Moinodaphnia macleayi*) is the most sensitive bioassay species and is only able to be conducted by the ERISS Laboratory in Darwin, however, the laboratory was unable to conduct the test and another cladoceran species, *Ceriodaphnia dubia*, was used in place of the *M. macleayi*. Therefore, all bioassays, shown in Table 1, were conducted by Ecotox Services Australasia.

Table 1 Species used in the Ecotoxicological Assessment of Treated RP3 Discharge

Test Organism	Test Duration	Test Endpoint	Key Reference
<i>Selenastrum capricornutum</i> (green alga)	72 hour (chronic)	Growth inhibition	USEPA Method 1003.0 (2002)
<i>Lemna aequinoctialis</i> (duckweed)	96 hour (chronic)	Growth (frond number)	OECD Method 221 (2006)
<i>Ceriodaphnia dubia</i> (water flea)	3 brood (chronic)	Reproduction	USEPA Method 1002.0 (2002)
<i>Hydra viridissima</i> Pallas (green hydra)	96 hour (chronic)	Population growth	Riethmuller <i>et al.</i> (2003)
<i>Chironomus tepperi</i> (chironomid)	48 hour (acute)	Survival	USEPA (2002), OECD (2011)
<i>Macrobrachium bullatum</i> (shrimp)	96 hour (acute)	Survival	ESA SOP 123 (ESA 2012)
<i>Mealanotaenia splendida</i> (rainbowfish)	10 day (chronic)	Embryonic development and post hatch survival	USEPA (2002)

### 2.1.2 Concentrations Tested

Edith River water sampled from the upstream site SW2 was used as the diluent to assess the toxicity of the treated RP3 mine water. A laboratory control was run concurrently with all tests to confirm that the natural diluent water was not confounding the bioassays (as can happen in many cases). All samples were serially diluted with the SW2 river water to achieve the required test concentrations. Concentrations differed between bioassays due to methodologies used and sensitivity of the species tested as determined by previous bioassays. Bioassay dilutions for each species are shown in Table 2.

Table 2 Concentrations of Treated RP3 used in Bioassays

Microalga % RP3	Duckweed % RP3	Cladoceran % RP3	Hydra % RP3	Chironomid % RP3	Shrimp % RP3	Fish %RP3
0	0	0	0	0	0	0
0.1	0.2	0.1	6.3	6.3	6.3	3.1
0.2	0.4	0.2	12.5	12.5	12.5	6.3
0.4	0.8	0.4	25	25	25	12.5
0.8	1.5	0.8	50	50	50	25
1.6	3.0	1.5	100	100	100	50
3.1	6.0	3.0	-	-	-	100



### 2.1.3 Dilution Factors

Dilution factors are derived from results of DTA using bioassays representative of the receiving ecosystem which incorporates all actions of the constituents of the effluent. These results are placed in the BurrliOZ (Campbell *et al.* 2000) statistics program for calculation of a species sensitivity distribution and the concentration of effluent is determined to protect 80% of the populations in the receiving water from a 10% decrease in growth and/or reproduction.

Concentrations of individual chemicals cannot be extrapolated from DTAs for use as trigger values. However, individual chemical concentrations can be used for monitoring purposes to ensure that the dilution factors are met at the appropriate monitoring site. If the dilution factors are not met, the investigation procedure shown in Figure 1 of the Vista Gold Discharge Plan (GHD 2013) will be followed.

## 2.2 Surface Water Chemistry

Samples from SW2 (diluent) and treated RP3 water were analysed for the suite of analytes shown in Table 3.

Table 3 Analytes for SW2 and Treated RP3

	Analytes
In-Situ	DO, EC, pH
Metals (total and dissolved, i.e. 0.45 µm)	Al, Cd, Co, Cu, Cr, Fe, Pb, Mn, Hg, Ni, Zn
Others	SO <sub>4</sub> , Ca, Mg

### 2.3 Sample Sites

RP3 and SW2 sampling locations are shown in Table 4. The treated RP3 water was sampled at the surface as testing of the top 30 metres has shown it to be homogenous. The proposed pumping depth for discharge will be within the top 30 metres as it provides treated water with the highest pH and lowest metal concentrations.

Table 4 Sampling Sites

Site Name	Site Description	Easting (UTM)	Northing	Latitude (degree, decimal)	Longitude
SW2	Edith River at bridge on Edith Falls Road	0189088	8431347	-14.1718	132.12
RP3	Batman Pit	0187055	8434993	-14.1388	132.1015

## 3. Results

### 3.1 Ecotoxicology Testing of RP3 Treated Water (in-situ)

Sites at treated RP3 and SW2 were sampled on the 25 November 2013 and sent directly to the laboratory where testing commenced immediately upon receipt.

The species used were appropriate for the site and the EC10 and LC50 results were of sufficient quality to be used in the BurrliOZ (Campbell *et al.*, 2000) program for species sensitivity distribution (SSD) calculations. Not all species that were used in the ERISS (2005) toxicity testing program were available at the time of testing. The cladoceran (*Moinodaphnia macleayi*) has been replaced with the temperate cladoceran *Ceriodaphnia dubia*.

A copy of the Ecotox Report by Ecotox Services, “*Toxicity Assessment of a Treated Water Sample, December 2013*” is located in Appendix A. A summary of the results is provided in Appendix B.

The results of the site specific DTA testing performed by Ecotox Services used in this assessment do meet the laboratory NATA requirements for quality assurance/quality control (QA/QC) parameters. It must be noted however, that the majority of the reference toxicant results are in the lower 20% of the Cusum chart limits, indicating that the organisms used were more sensitive to the toxicants than is usual (Appendix A). This sensitivity means that the results presented here from this treated RP3 DTA are very conservative.

Table 5 Summary of Treated RP3 Ecotox Results

Test	EC/IC10 and LC10 (95% confidence limits) % Treated RP3	EC/IC50 and LC50 (95% confidence limits) % Treated RP3
Microalgal 72-hour growth inhibition	0.9 (0.6 – 1.0)	2.1 (1.9 – 2.2)
Duckweed 96-hour growth	0.8 (0.8 – 0.9)	1.1 (1.1 – 1.2)
Cladoceran 6-day reproduction	0.1**	0.2 (0.2 – 0.2)
Hydra 96-hour growth	10.9**	44.6 (36.8 – 57.3)
Chironomid 48-hour survival	100*	>100
Shrimp 96-hour survival	>100	>100
Fish 10 day embryonic development and post hatch survival	60.2**	95.2 (72.9 – 100)

\*No observable effect concentration (NOEC) \*\*95% confidence limits not provided

The results show that the algae, duckweed and cladoceran are the most sensitive species to the treated RP3 water. There was no acute toxicity observed from exposure to the treated RP3 water.

The cladoceran is sensitive to the treated RP3 water, which may be a reflection of the toxicity of the treated RP3 water to their food source (i.e. the unicellular alga).

The chironomid tests showed an interrupted dose response, therefore, the NOEC value has been used as it is not significantly different from the control results.

The chemistry results shown in Table 8 indicate that the toxicity observed in the algal, duckweed and cladoceran bioassays can be attributed to the presence of zinc and possibly cadmium and nickel, as other toxic metals were below detection limits and below the default 95% species protection trigger values.

### 3.2 Acute to Chronic Ratios (ACR)

Two of the bioassays used in this study were acute bioassays where survival was the end point. The chironomid and shrimp are acute bioassays and the LC50 results need to be adjusted so that they can be incorporated into the statistics to calculate the SSD. ANZECC & ARMCANZ (2000) recommend an acute to chronic factor of 10 to go from an acute LC50 to a chronic NOEC or EC10. This acute to chronic ratio (ACR) was applied to the chironomid and shrimp LC50 data to obtain a conservative chronic EC10.

### 3.3 Concentrations used to calculate the SSD

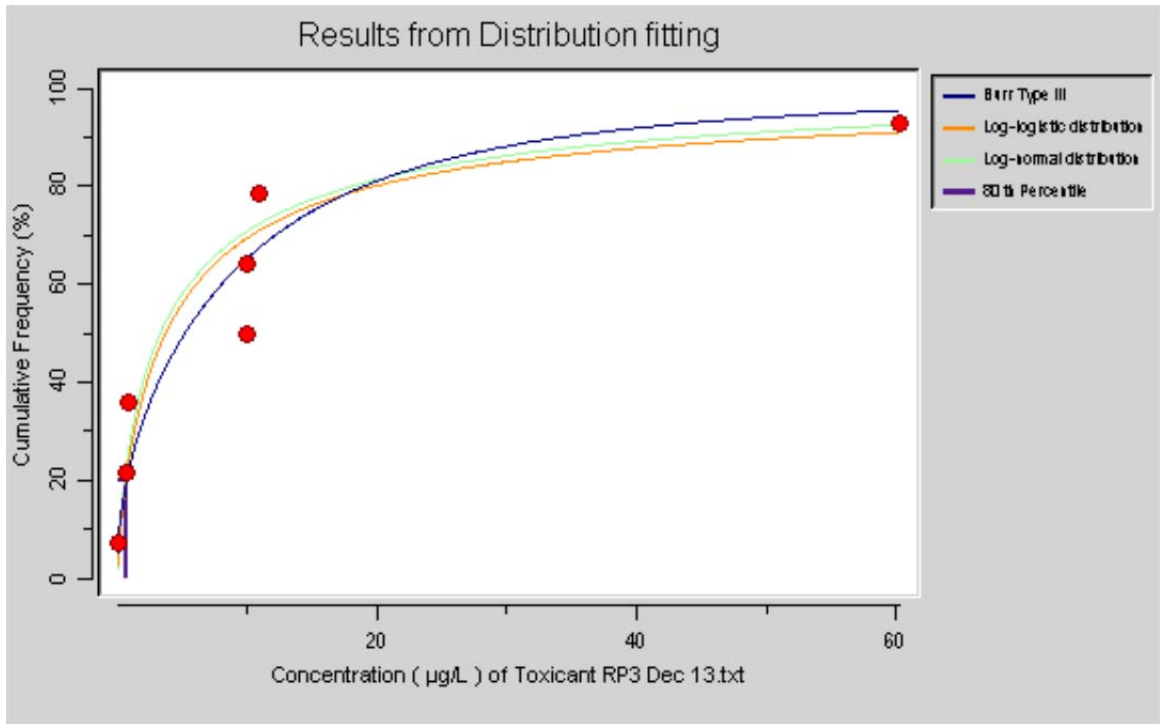
The acute bioassays required an ACR adjustment, applied to the LC50 values for the chironomid (LC50/10) and shrimp (LC50/10). The values used to calculate the SSD and dilution factors are shown in Table 6.

Table 6 Values used to Calculate SSD

Bioassay	EC10 % RP3
Microalgal 72-hour growth inhibition	0.9
Duckweed 96-hour growth inhibition	0.8
Cladoceran 6-day reproduction	0.1
Hydra 96-hour growth	10.9
Chironomid 48-hour survival	10
Shrimp 96-hour survival	10
Fish 10-day Embryo hatching	60.2

### 3.4 Species Protection Values

The EC10 and LC50/10 values from Table 6 were input into the BurrI/OZ (Campbell *et al.*, 2000) statistics program for calculation of the 80% species protection value using the SSD. The calculated value and the dilution factor required to reach the concentration are provided in Table 7. The 80% SSD graph is shown in Figure 1.



*PC80 50% = 0.76 (501 Bootstrap samples)*

*Burr Type III distribution fitted to 7 observations*

Figure 1 Species Sensitivity Distribution Graph

Table 7 Species Protection Values

Species Protection Level	Concentration of Treated RP3 (%)	Dilution Factor
80%	0.76	132

### 3.5 Dilution Factor

The 80% species protection was selected as appropriate to provide a level of protection for the Edith River from the discharge of treated RP3 water over the dewatering period as required by the WDL 178-3. A dilution factor of 1:132 for the RP3 treated water (as at time of testing, 25/11/13) discharged into the Edith River will provide 80% of the species with protection from a 10% decrease in reproduction or growth (Table 7). The concentrations of chemicals at this dilution are shown in Table 8. This dilution factor will provide a conservative result as the water quality within RP3 is expected to improve during the wet season.

### 3.6 80% Species Protection Monitoring Values

The chemistry of the RP3 treated water at the 1:132 dilution is shown in Table 8. The complete chemistry results are located in Appendix B.

The levels of the 80% species protection dilution concentrations for cadmium (0.4 µg/L) and zinc (33.3 µg/L) have been selected as monitoring values to be met at SW4. These monitoring values will ensure that the dilution of the treated RP3 water is at 1:132 to meet the requirements of WDL 178-3. It must be noted that the concentrations of other metals and metalloids in the discharge will be below the 95% species protection trigger values at SW4 and, in most cases, also below the laboratory detection limits.

The concentrations of cadmium at 0.4 µg/L and zinc at 33.3 µg/L will be met at SW4 to ensure environmental protection of the Edith River. If this monitoring value is not met then action is triggered as shown in Figure 1 of the Discharge Plan (GHD 2013).

**Table 8 Dilution Rates of RP3 Treated Water (in-situ) to Meet 80 % SSD Dilution (1:132)**

Analytes (metals 0.45 µm)	SW2 25/11/13	RP3 Treated Water 25/11/13	Conc. in RP3 treated water at 1:132 to be met at SW4	ANZECC 80% species protection TVs/ISSTV	ANZECC 95% species protection TVs/ISSTV
pH	6.7	7.6	-	6-8	6-8
DO (%)	6.2	8.5	-	85-120	85-120
Conductivity (µS/cm)	19	2,700	-	20-250	20-250
Mg (mg/L)	<0.5	210	1.6	-	2.5*
Ca (mg/L)	<0.5	480	3.6	-	-
SO <sub>4</sub> (mg/L)	<1.0	1,900	14.4	129	129
Al (µg/L)	<10	<10	<10	150	149
Cd (µg/L)	<0.1	51	0.4	0.8	0.2
Co (µg/L)	<1.0	510	3.9	90	90
Cr (µg/L)	<1.0	<1.0	<1.0	40	1.0
Cu (µg/L)	<1.0	<1.0	<1.0	2.5	1.4
Fe (µg/L)	110	<10	<10	300	300
Mn (µg/L)	<5.0	6,000	45.5	3,600	1,700
Ni (µg/L)	<1.0	500	3.8	17	11
Pb (µg/L)	<1.0	<1.0	<1.0	9.4	3.4
Hg (µg/L)	<0.05	<0.05	<0.05	5.4	0.6
Zn (µg/L)	1.0	4,400	33.3	31	8.0

*Note: Cells in green are below the ISSTVs and ANZECC & ARM CANZ (2000) default 95% trigger values and below the laboratory detection limits \*van Dam et al (2010)*

The water quality sampled in November 2013 showed elevated cadmium, nickel and zinc when compared to the March 2013 sample used for the previous DTA. The elevated metals are related to the drop in pH from 8.8 in March 2013 to pH 7.6 in November 2013. This drop in pH is most likely due to mixing within the top 30 metres and turnover of the pit as the concentration of zinc below 30m has decreased since the March 2013 sampling.

Table 9 shows the monitoring values for each discharge point as of 24 December 2013.

Table 9 Monitoring Values for SW4 Wet Season 2013/2014

Discharge	Chemical	Concentration (µg/L) 0.45 µm filtered
RP3 Treated Water	Cd	0.4
	Zn	33.3
RP1 Untreated Water	Cu	No discharge
RP7 Untreated Water	Cu	No discharge

RP3 treated water will be assessed for toxicity prior to the 2014/2015 wet season and a revised dilution factor and revised monitoring values will be calculated.

Vista Gold are not proposing to discharge from RP1 or RP7 during the 2013/2014 wet season at this date. RP1 and RP7 mine waters will be assessed for toxicity prior to any discharge and revised dilution factors and monitoring values will be calculated.

## 4. Conclusions and Recommendations

### 4.1 Conclusions

Ongoing treatment of water in RP3 has resulted in substantial improvements in water quality since treatment began in November 2012 (Table 10).

The results of this direct toxicity assessment on treated water from RP3 show that a conservative dilution factor of 1:132 will provide an 80% species protection level at the downstream monitoring point SW4 on the Edith River. That is, one unit of RP3 water is to be diluted with 132 units flowing down the Edith River to mitigate any adverse impact on organisms within the receiving ecosystem. All metal concentrations will be below the 95% species protection default trigger values at SW4 at this dilution with the exception of cadmium and zinc.

Table 10 RP3 Chemistry (Top 30 metres)

Analyte Dissolved µg/L	20 Oct 2012	23 Nov 2012	20 Dec 2012	17 Jan 2013	14 Feb 2013	21 Mar 2013	25 Nov 2013
Aluminium	57,000	31,000	1,700	270	<10	<10	<10
Chromium	2	2	1	<1	<1	1	<1
Copper	10,000	11,000	9,900	5,400	140	<1	<1
Lead	210	190	160	86	<1	<1	<1
Cadmium	140	140	140	130	45	5.5	51
Zinc	36,000	34,000	38,000	39,000	8,400	82	4,400

Treatment of RP3 is changing the water quality throughout the pit. Even though treatment has ceased, the water quality below 30m is still improving with elevated pH and reduced metal concentrations (Table 10). The dilution factor of 1: 132 calculated in this report will be applied for discharging in the 2013/2014 wet season.

### 4.2 Recommendations

To meet the 80% species protection level required by WDL 178-3, based on ecotoxicological testing, it is recommended that a dilution factor of 1:132 be applied to the discharge of RP3 treated mine water, with the following monitoring values applied at SW4:

- Cd 0.4 µg/L
- Zn 33.3 µg/L

These monitoring values will apply until a further round of ecotoxicological testing is conducted to derive a new dilution factor and monitoring values prior to discharging in the 2014/2015 wet season.

## 5. References

ANZECC & ARMCANZ (2000) *Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. National water quality management strategy, Australian and New Zealand guidelines for fresh and marine water quality. ANZECC and ARMCANZ, Canberra, Australia.*

Campbell E., Palmer M.J., Shao Q., Warne M.StJ. and Wilson D. (2000) *BurriOZ: A computer program for calculating toxicant trigger values for the ANZECC and ARMCANZ water quality guidelines. Perth, Western Australia.*

ERISS. 2005. *Ecotoxicological assessment of retention pond water from Mount Todd gold mine. Internal Report 499. R. van Dam, A. Hogan, S. Nou and S. Markich. March 2005. Darwin, NT.*

GHD (2013). *Vista Gold Australia Pty. Ltd. Discharge Plan. Revision 1. February 2013.*

OECD (2006) *Lemna sp. Growth inhibition test. Method 221. OECD guideline for the testing of chemicals. Organisation for Economic Cooperation and Development. Paris.*

OECD (2011) *OECD guideline for the testing of chemicals. Test Guideline 235: Chironomus sp. Acute immobilisation test. Organisation for Economic Cooperation and Development. Paris.*

Riethmuller N., Camilleri C., Franklin N., Hogan A., King A., Markich S.J., Turley C. and van Dam R. (2003) *Green hydra population growth test. In: Ecotoxicological Testing Protocols for Australian Tropical Freshwater Ecosystems. Supervising Scientist Report 173. ERISS, Darwin, NT.*

USEPA (2002) *Short-term methods for measuring the chronic toxicity of effluents and receiving waters to freshwater organisms. 4th Edition. United States Environmental Protection Agency, Office of Water, Washington DC.*

van Dam R.A., Hogan A.C., McCullough C.D., Houston M.A., Humphrey C.L. and Harford A.J. 2010. *Aquatic toxicity of magnesium sulfate and the influence of calcium in very low ionic concentration water. Environmental Toxicology and Chemistry. 29(2):410-421.*



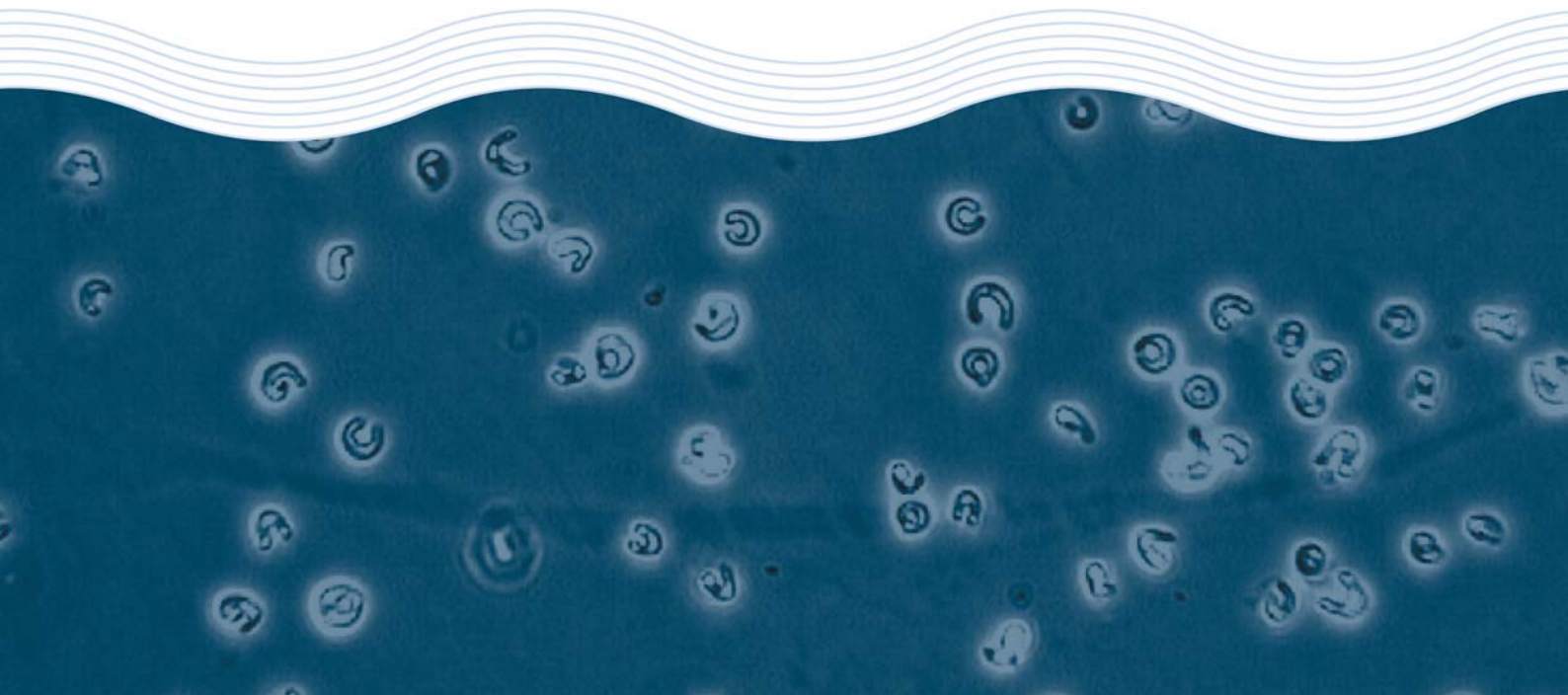
# Appendices

**Toxicity Assessment of a Treated  
Water Sample from Mt Todd**

**Vista Gold Australia Pty Ltd**

**Test Report**

**December 2013**



# **Toxicity Assessment of a Treated Water Sample from Mt Todd**

**Vista Gold Australia Pty Ltd**

**Test Report**

**December 2013**

## Toxicity Test Report: TR1108/1

(Page 1 of 2)

This document is issued in accordance with NATA's accreditation requirements

<b>Client:</b>	Vista Gold Pty Ltd Level 3, 43 Cavenagh Street Darwin NT 0801	<b>ESA Job #:</b>	PR1108
<b>Attention:</b>	Austin Brandis	<b>Date Sampled:</b>	25 November 2013
<b>Client Ref:</b>	Not applicable	<b>Date Received:</b>	26 November 2013
		<b>Sampled By:</b>	Client
		<b>ESA Quote #:</b>	PL1108_q03

<b>Lab ID No.:</b>	<b>Sample Name:</b>	<b>Sample Description:</b>
6368	SW2	Aqueous sample, pH 7.5, conductivity 21.7µS/cm. Sample received at room temperature in apparent good condition
6369	RP3	Aqueous sample, pH 7.7, conductivity 2900µS/cm. Sample received at room temperature in apparent good condition

<b>Test Performed:</b>	72-hr microalgal growth inhibition test using the green alga <i>Selenastrum capricornutum</i>
<b>Test Protocol:</b>	ESA SOP 103 (ESA 2013), based on USEPA (2002)
<b>Test Temperature:</b>	The test was performed at 25±1°C.
<b>Deviations from Protocol:</b>	Nil
<b>Comments on Solution Preparation:</b>	The samples were filtered to 0.45µm prior to testing. The highest concentration was prepared by diluting sample 6369 'RP3' with sample 6368 'SW2'. Sample 6369 'RP3' was then serially diluted with sample 6368 'SW2' to achieve the test concentrations. A USEPA control and a diluent control (SW2) were tested concurrently with the sample.
<b>Source of Test Organisms:</b>	ESA Laboratory culture, originally sourced from CSIRO Microalgal Supply Service, TAS
<b>Test Initiated:</b>	13 December 2013 at 1330h

Sample 6369: RP3 Concentration (%)	Cell Yield x10 <sup>4</sup> cells/mL (Mean ± SD)	Vacant	Vacant
USEPA Control	18.1 ± 3.0		
Diluent Control	20.7 ± 1.0		
0.1	19.8 ± 0.6		
0.2	19.9 ± 1.1		
0.4	20.4 ± 0.6		
0.8	19.4 ± 0.6		
1.6	13.2 ± 0.6 *		
3.1	4.4 ± 1.0 *		
<b>72-hr IC10 = 0.9 (0.6-1.0)%</b>			
<b>72-hr IC50 = 2.1 (2.0-2.2)%</b>			
<b>NOEC = 0.8%</b>			
<b>LOEC = 1.6%</b>			

\*Significantly lower cell yield compared with the Diluent Control (Dunnett's Test, 1-tailed, P=0.05)

## Toxicity Test Report: TR1108/1

(Page 2 of 2)

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean cell density	$\geq 16.0 \times 10^4$ cells/mL	$19.1 \times 10^4$ cells/mL	Yes
Control coefficient of variation	<20%	16.3%	Yes
Reference Toxicant within cusum chart limits	1.3-5.3g KCl/L	2.6g KCl/L	Yes

Test Report Authorised by:



Dr Rick Krassoi, Director on 23 December 2013

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

**NATA Accredited Laboratory Number: 14709**

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the APLAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports. This document shall not be reproduced except in full.

**Citations:**

ESA (2013) *ESA SOP 103 – Green Alga, Selenastrum capricornutum, Growth Test*. Issue No 10. Ecotox Services Australasia, Sydney, NSW.

USEPA (2002) *Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms*. Fourth Edition. EPA-821-R-02-013. United States Environmental Protection Agency, Office of Research and Development, Washington DC, USA,

## Toxicity Test Report: TR1108/2

(Page 1 of 2)

This document is issued in accordance with NATA's accreditation requirements

<b>Client:</b>	Vista Gold Pty Ltd Level 3, 43 Cavenagh Street Darwin NT 0801	<b>ESA Job #:</b>	PR1108
<b>Attention:</b>	Austin Brandis	<b>Date Sampled:</b>	25 November 2013
<b>Client Ref:</b>	Not applicable	<b>Date Received:</b>	26 November 2013
		<b>Sampled By:</b>	Client
		<b>ESA Quote #:</b>	PL1108_q03

<b>Lab ID No.:</b>	<b>Sample Name:</b>	<b>Sample Description:</b>
6368	SW2	Aqueous sample, pH 7.5, conductivity 21.7µS/cm. Sample received at room temperature in apparent good condition
6369	RP3	Aqueous sample, pH 7.7, conductivity 2900µS/cm. Sample received at room temperature in apparent good condition

<b>Test Performed:</b>	96-hr Growth inhibition of the freshwater aquatic duckweed <i>Lemna aequinoctialis</i>
<b>Test Protocol:</b>	ESA SOP 112 (ESA 2012), based on OECD method 221 (2006)
<b>Test Temperature:</b>	The test was performed at 29±2°C.
<b>Deviations from Protocol:</b>	Nil
<b>Comments on Solution Preparation:</b>	The highest concentration was prepared by diluting sample 6369 'RP3' with sample 6368 'SW2'. Sample 6369 'RP3' was then serially diluted with sample 6368 'SW2' to achieve the test concentrations. A CAAC control and a diluent control (SW2) were tested concurrently with the sample.
<b>Source of Test Organisms:</b>	ESA Laboratory culture
<b>Test Initiated:</b>	11 December 2013 at 1500h

Sample 6369: RP3 Concentration (%)	Specific Growth Rate (Mean ± SD)	Vacant	Vacant
CAAC Control	0.32 ± 0.02		
Diluent Control	0.31 ± 0.01		
0.2	0.33 ± 0.03		
0.4	0.33 ± 0.02		
0.8	0.31 ± 0.01		
1.5	0.01 ± 0.02 *		
3.0	0.00 ± 0.00		
6.0	0.00 ± 0.00		
<b>96-hr IC10 = 0.8 (0.8-0.9)%</b>			
<b>96-hr IC50 = 1.1 (1.1-1.2)%</b>			
<b>NOEC = 0.8%</b>			
<b>LOEC = 1.5%</b>			

\*Significantly lower specific growth rate compared with the Diluent Control (Steel's Many-One Rank Test, 1-tailed, P=0.05)

## Toxicity Test Report: TR1108/2

(Page 2 of 2)

QA/QC Parameter	Criterion	This Test	Criterion met?
Control frond doubling time	<3.0 days	2.2days	Yes
Reference Toxicant within cusum chart limits	7.4-59.4mg Mg/L	13.2mg Mg/L	Yes



Test Report Authorised by:

Dr Rick Krassoi, Director on 23 December 2013

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

**NATA Accredited Laboratory Number: 14709**

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the APLAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports. This document shall not be reproduced except in full.

**Citations:**

ESA (2012) *SOP 112 – Duckweed Growth Inhibition Test*. Issue No. 5. Ecotox Services Australasia, Sydney NSW

OECD (2006) *Lemna sp. Growth Inhibition Test*. Method 221. OECD Guideline for the Testing of Chemicals. Organisation for Economic Cooperation and Development, Paris

## Toxicity Test Report: TR1108/3

(Page 1 of 2)

This document is issued in accordance with NATA's accreditation requirements

<b>Client:</b>	Vista Gold Pty Ltd Level 3, 43 Cavenagh Street Darwin NT 0801	<b>ESA Job #:</b>	PR1108
<b>Attention:</b>	Austin Brandis	<b>Date Sampled:</b>	25 November 2013
<b>Client Ref:</b>	Not applicable	<b>Date Received:</b>	26 November 2013
		<b>Sampled By:</b>	Client
		<b>ESA Quote #:</b>	PL1108_q03

<b>Lab ID No.:</b>	<b>Sample Name:</b>	<b>Sample Description:</b>
6368	SW2	Aqueous sample, pH 7.5, conductivity 21.7µS/cm. Sample received at room temperature in apparent good condition
6369	RP3	Aqueous sample, pH 7.7, conductivity 2900µS/cm. Sample received at room temperature in apparent good condition

<b>Test Performed:</b>	48-hr acute (survival) toxicity test using the freshwater chironomid <i>Chironomus tepperi</i>
<b>Test Protocol:</b>	ESA SOP 121 (ESA 2012), based on OECD (2011) USEPA (2002) and Bailey <i>et al.</i> (2000)
<b>Test Temperature:</b>	The test was performed at 25±1°C.
<b>Deviations from Protocol:</b>	Nil
<b>Comments on Solution Preparation:</b>	Sample 6369 'RP3' was serially diluted with sample 6368 'SW2' to achieve the test concentrations. A DMW control and a diluent control (SW2) were tested concurrently with the sample.
<b>Source of Test Organisms:</b>	ESA Laboratory culture
<b>Age of Test Organisms:</b>	8-9 days old
<b>Test Initiated:</b>	29 November 2013 at 1530h

Sample 6369: RP3 Concentration (%)	% Survival (Mean ± SD)	Vacant	Vacant
DMW Control	100 ± 0.0		
Diluent Control	100 ± 0.0		
6.3	100 ± 0.0		
12.5	85.0 ± 19.2		
25	80.0 ± 16.3		
50	90.0 ± 20.0		
100	75.0 ± 30.0		
<b>48-hr EC10 = 15.6%*</b>			
<b>48-hr EC50 = &gt;100%</b>			
<b>NOEC = 100%</b>			
<b>LOEC = &gt;100%</b>			

\*95% confidence limits are not available



## Toxicity Test Report: TR1108/3

(Page 2 of 2)

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % survival	≥85.0%	100%	Yes
Reference Toxicant within cusum chart limits	25.3-1355.2µg Cu/L	215.2µg Cu/L	Yes



Test Report Authorised by:

Dr Rick Krassoi, Director on 23 December 2013

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

### NATA Accredited Laboratory Number: 14709

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the APLAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports. This document shall not be reproduced except in full.

### Citations:

- Bailey, H.C., Krassoi, R., Elphick, J.R., Mulhall, A., Hunt, P., Tedmanson, L. and Lovell, A. (2000) Application of *Ceriodaphnia cf. dubia* for whole effluent toxicity tests in the Hawkesbury-Nepean watershed, New South Wales, Australia: method development and validation. *Environmental Toxicology and Chemistry* 19:88-93.
- ESA (2012) *SOP 121 – Acute toxicity test using Chironomus tepperi*. Issue No. 1. Ecotox Services Australasia, Sydney, New South Wales.
- OECD (2011) OECD Guideline for the Testing of Chemicals. Test Guideline 235: *Chironomus sp*, Acute Immobilisation Test.
- USEPA (2002) *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*. 4<sup>th</sup> Ed. United States Environmental Protection Agency, Office of Water, Washington DC.

## Toxicity Test Report: TR1108/4

(Page 1 of 2)

This document is issued in accordance with NATA's accreditation requirements

<b>Client:</b>	Vista Gold Pty Ltd Level 3, 43 Cavenagh Street Darwin NT 0801	<b>ESA Job #:</b>	PR1108
<b>Attention:</b>	Austin Brandis	<b>Date Sampled:</b>	25 November 2013
<b>Client Ref:</b>	Not applicable	<b>Date Received:</b>	26 November 2013
		<b>Sampled By:</b>	Client
		<b>ESA Quote #:</b>	PL1108_q03

<b>Lab ID No.:</b>	<b>Sample Name:</b>	<b>Sample Description:</b>
6368	SW2	Aqueous sample, pH 7.5, conductivity 21.7µS/cm. Sample received at room temperature in apparent good condition
6369	RP3	Aqueous sample, pH 7.7, conductivity 2900µS/cm. Sample received at room temperature in apparent good condition

\*Ammonia analysis is not covered by Ecotox Services Australasia's scope of accreditation

<b>Test Performed:</b>	96-hr acute toxicity test using the freshwater hydra <i>hydra viridissima</i>
<b>Test Protocol:</b>	ESA SOP 125 (2012), based on Riethmuller et al. (2003)
<b>Test Temperature:</b>	The test was performed at 27±1°C.
<b>Deviations from Protocol:</b>	Nil
<b>Comments on Solution Preparation:</b>	Sample 6369 'RP3' was serially diluted with sample 6368 'SW2' to achieve the test concentrations. A Laboratory Water control and a diluent control (SW2) were tested concurrently with the sample.
<b>Source of Test Organisms:</b>	ESA Laboratory culture
<b>Test Initiated:</b>	27 November 2013 at 1500h

Sample 6369: RP3		Vacant	Vacant
Concentration (%)	Population Growth Rate (Mean ± SD)		
Lab Control	0.36 ± 0.01		
Diluent Control	0.40 ± 0.01		
6.3	0.37 ± 0.02		
12.5	0.35 ± 0.02 *		
25	0.28 ± 0.02 *		
50	0.18 ± 0.04 *		
100	0.00 ± 0.00		
<b>96-hr IC10 = 10.9%**</b>			
<b>96-hr IC50 = 44.6 (36.8-57.3)%</b>			
<b>NOEC = 6.3%</b>			
<b>LOEC = 12.5%</b>			

\*Significantly lower population growth rate compared with the Diluent Control (Dunnett's Test, 1-tailed, P=0.05)

\*\*95% confidence limits are not available

**Toxicity Test Report: TR1108/4**

**(Page 2 of 2)**

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean population growth rate	≥0.25	0.36	Yes
Reference Toxicant within cusum chart limits	1.0-17.0µg Cu/L	2.1µg Cu/L	Yes



Test Report Authorised by:

Dr Rick Krassoi, Director on 23 December 2013

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

**NATA Accredited Laboratory Number: 14709**

This document is issued in accordance with NATA’s accreditation requirements. Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the APLAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports. This document shall not be reproduced except in full.

**Citations:**

- ESA (2012) SOP 125 –*Hydra Population Growth Test*. Issue No 1. Ecotox Services Australasia, Sydney, NSW
- Riethmuller N, Camilleri C, Franklin N, Hogan A, King A, Koch A, Markich SJ, Turley C and van Dam R (2003). Green Hydra Population Growth Test. In: *Ecotoxicological testing protocols for Australian tropical freshwater ecosystems*. Supervising Scientist Report 173, Supervising Scientist, Darwin NT.



## Toxicity Test Report: TR1108/5

(Page 1 of 2)

This document is issued in accordance with NATA's accreditation requirements

<b>Client:</b>	Vista Gold Pty Ltd Level 3, 43 Cavenagh Street Darwin NT 0801	<b>ESA Job #:</b>	PR1108
<b>Attention:</b>	Austin Brandis	<b>Date Sampled:</b>	25 November 2013
<b>Client Ref:</b>	Not applicable	<b>Date Received:</b>	26 November 2013
		<b>Sampled By:</b>	Client
		<b>ESA Quote #:</b>	PL1108_q03

<b>Lab ID No.:</b>	<b>Sample Name:</b>	<b>Sample Description:</b>
6368	SW2	Aqueous sample, pH 7.5, conductivity 21.7µS/cm. Sample received at room temperature in apparent good condition
6369	RP3	Aqueous sample, pH 7.7, conductivity 2900µS/cm. Sample received at room temperature in apparent good condition

<b>Test Performed:</b>	Rainbowfish embryo hatching test using <i>Melanotaenia splendida splendida</i>
<b>Test Protocol:</b>	ESA SOP 126 (2013), based on USEPA (2002), but adapted for use with native rainbowfish
<b>Test Temperature:</b>	The test was performed at 25±1°C.
<b>Deviations from Protocol:</b>	Solution were renewed every 48 hours instead of every 24 hours
<b>Comments on Solution Preparation:</b>	Sample 6369 'RP3' was serially diluted with sample 6368 'SW2' to achieve the test concentrations. A DMW control and a diluent control (SW2) were tested concurrently with the sample.
<b>Source of Test Organisms:</b>	ESA Laboratory culture
<b>Test Initiated:</b>	27 November 2013 at 1600h

Sample 6369: RP3	Concentration (%)	% Survival (Mean ± SD)	Vacant	Vacant
DMW Control		85.0 ± 19.2		
Diluent Control		80.0 ± 16.3		
	3.1	65.0 ± 19.2		
	6.3	90.0 ± 11.6		
	12.5	95.0 ± 10.0		
	25	100 ± 0.0		
	50	90.0 ± 11.6		
	100	40.0 ± 40.0		
<b>11-d IC10 = 60.2%*</b>				
<b>11-d EC50 = 95.2 (72.9-100)%</b>				
<b>NOEC = 100%</b>				
<b>LOEC = &gt;100%</b>				

\*95% confidence limits are not available

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % survival	≥80.0%	85.0%	Yes
Reference Toxicant within cusum chart limit	11.5-459.5µg Cu/L	44.2µg Cu/L	Yes



## Toxicity Test Report: TR1108/5

(Page 2 of 2)

Test Report Authorised by:

Dr Rick Krassoi, Director on 23 December 2013

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

**NATA Accredited Laboratory Number: 14709**

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the APLAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports. This document shall not be reproduced except in full.

**Citations:**

ESA (2013) *SOP 126- Rainbowfish Embryo Hatching Test*. Issue N°3. Ecotox Services Australasia, Sydney NSW

USEPA (2002) *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. 4<sup>th</sup> Ed. United States Environmental Protection Agency, Office of Water, Washington DC.

## Toxicity Test Report: TR1108/6

(Page 1 of 2)

<b>Client:</b>	Vista Gold Pty Ltd Level 3, 43 Cavenagh Street Darwin NT 0801	<b>ESA Job #:</b>	PR1108
<b>Attention:</b>	Austin Brandis	<b>Date Sampled:</b>	25 November 2013
<b>Client Ref:</b>	Not applicable	<b>Date Received:</b>	26 November 2013
		<b>Sampled By:</b>	Client
		<b>ESA Quote #:</b>	PL1108_q03

<b>Lab ID No.:</b>	<b>Sample Name:</b>	<b>Sample Description:</b>
6368	SW2	Aqueous sample, pH 7.5, conductivity 21.7µS/cm. Sample received at room temperature in apparent good condition
6369	RP3	Aqueous sample, pH 7.7, conductivity 2900µS/cm. Sample received at room temperature in apparent good condition

<b>Test Performed:</b>	96-hr acute survival test using the freshwater shrimp <i>Macrobrachium bullatum</i>
<b>Test Protocol:</b>	ESA SOP 123 (ESA 2012), based on USEPA (1996)
<b>Test Temperature:</b>	The test was performed at 25±1°C.
<b>Deviations from Protocol:</b>	Nil
<b>Comments on Solution Preparation:</b>	Sample 6369 'RP3' was serially diluted with sample 6368 'SW2' to achieve the test concentrations. A DMW control and a diluent control (SW2) were tested concurrently with the sample.
<b>Source of Test Organisms:</b>	Hatchery reared, NT
<b>Test Initiated:</b>	3 December 2013 at 1600h

Sample 6369: RP3 Concentration (%)	% Unaffected (Mean ± SD)	Vacant	Vacant
DMW Control	95.0 ± 10.0		
Diluent Control	95.0 ± 10.0		
6.3	100 ± 0.0		
12.5	100 ± 0.0		
25	95.0 ± 10.0		
50	95.0 ± 10.0		
100	100 ± 0.0		
<b>96-hr EC10 = &gt;100%</b>			
<b>96-hr EC50 = &gt;100%</b>			
<b>NOEC = 100%</b>			
<b>LOEC = &gt;100%</b>			

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % unaffected	≥90.0%	95.0%	Yes
Reference Toxicant within cusum chart limits	27.3-306.9µg Cu/L	112.0µg Cu/L	Yes

**Toxicity Test Report: TR1108/6**

**(Page 2 of 2)**

Test Report Authorised by:



Dr Rick Krasso, Director on 23 December 2013

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 123 –*Acute Toxicity Test Using Freshwater Shrimp*. Issue No 1. Ecotox Services Australasia, Sydney, NSW

USEPA (1996) Ecological Effects Test Guidelines: OPPTS 850.1035 Mysid Acute Toxicity Test. Public Draft. United States Environmental Protection Agency, Washington DC, USA.

## Toxicity Test Report: TR1108/7

(Page 1 of 2)

This document is issued in accordance with NATA's accreditation requirements

<b>Client:</b>	Vista Gold Pty Ltd Level 3, 43 Cavenagh Street Darwin NT 0801	<b>ESA Job #:</b>	PR1108
<b>Attention:</b>	Austin Brandis	<b>Date Sampled:</b>	25 November 2013
<b>Client Ref:</b>	Not applicable	<b>Date Received:</b>	26 November 2013
		<b>Sampled By:</b>	Client
		<b>ESA Quote #:</b>	PL1108_q03

<b>Lab ID No.:</b>	<b>Sample Name:</b>	<b>Sample Description:</b>
6368	SW2	Aqueous sample, pH 7.5, conductivity 21.7µS/cm. Sample received at room temperature in apparent good condition
6369	RP3	Aqueous sample, pH 7.7, conductivity 2900µS/cm. Sample received at room temperature in apparent good condition

<b>Test Performed:</b>	Partial life-cycle toxicity test using the freshwater cladoceran <i>Ceriodaphnia cf dubia</i>
<b>Test Protocol:</b>	ESA SOP 102 (ESA 2011), based on USEPA (2002) and Bailey <i>et al.</i> (2000)
<b>Test Temperature:</b>	The test was performed at 25±1°C.
<b>Deviations from Protocol:</b>	Nil
<b>Comments on Solution Preparation:</b>	Sample 6369 'RP3' was serially diluted with sample 6368 'SW2' to achieve the test concentrations. A DMW control and a diluent control (SW2) were tested concurrently with the sample.
<b>Source of Test Organisms:</b>	ESA Laboratory culture
<b>Test Initiated:</b>	16 December 2013 at 1330h

Sample 6369: RP3		Sample 6369: RP3	
Concentration (%)	% Survival at 7 days (Mean ± SD)	Concentration (%)	Number of Young (Mean ± SD)
DMW Control	100 ± 0.0	DMW Control	15.6 ± 3.2
Diluent Control	100 ± 0.0	Diluent Control	14.5 ± 3.5
0.1	100 ± 0.0	0.1	14.7 ± 3.5
0.2	100 ± 0.0	0.2	6.7 ± 2.5 **
0.4	100 ± 0.0	0.4	2.9 ± 1.2 **
0.8	100 ± 0.0	0.8	1.8 ± 1.6 **
1.5	50.0 ± 52.7 *	1.5	1.7 ± 1.1 **
3.0	50.0 ± 52.7 *	3.0	1.6 ± 1.2 **
<b>7 day EC10 (survival) = 0.9 (0.2-1.3)%</b>		<b>7 day IC10 (reproduction) = 0.1%***</b>	
<b>7 day EC50 (survival) = 2.4%***</b>		<b>7 day IC50 (reproduction) = 0.2 (0.2-0.2)%</b>	
<b>NOEC = 0.8%</b>		<b>NOEC = 0.1%</b>	
<b>LOEC = 1.5%</b>		<b>LOEC = 0.2%</b>	

\*Significantly lower survival compared with the Diluent Control (Fisher's Exact Test, 1-tailed, P=0.05)

\*\* Significantly lower number of young compared with the Diluent Control (Wilcoxon Rank Sum Test, 1-tailed, P=0.05)

\*\*\*95% confidence limits not reliable

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % survival	≥80.0%	100%	Yes
Control mean number of young	≥15.0	15.6	Yes
Reference Toxicant within cusum chart limits	161.0-342.3mgKCl/L	205.1mgKCl/L	Yes



## Toxicity Test Report: TR1108/7

(Page 2 of 2)

Test Report Authorised by:



Dr Rick Krassoi, Director on 23 December 2013

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

**NATA Accredited Laboratory Number: 14709**

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the APLAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports. This document shall not be reproduced except in full.

**Citations:**

Bailey, H.C., Krassoi, R., Elphick, J.R., Mulhall, A., Hunt, P., Tedmanson, L. and Lovell, A. (2000) Application of *Ceriodaphnia cf. dubia* for whole effluent toxicity tests in the Hawkesbury-Nepean watershed, New South Wales, Australia: method development and validation. *Environmental Toxicology and Chemistry* 19:88-93.

ESA (2011) ESA SOP 102 – *Acute Toxicity Test Using Ceriodaphnia dubia*. Issue No 8. Ecotox Services Australasia, Sydney, NSW.

USEPA (2002) *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. 4<sup>th</sup> Ed. United States Environmental Protection Agency, Office of Water, Washington DC.

# Chain-of-Custody Documentation

# Sample Receipt Notification

**Attention** : Austin Brandis

**Client** : Vista Gold Pty Ltd  
Level 3, 43 Cavenagh St  
Darwin NT 0801

**Email** :  
**Telephone** :  
**Facsimile** :

**Date** : 20/12/2013

**Re** : Receipt of Samples

**Pages** : 2

**ESA Project** : PR1108

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** : 26/11/2013

**Time samples received** : 10:00

**No. of samples received** : 2

**Sample matrix** : Aqueous

**Sample temperature** : room temperature

**Comments** : Includes 5x20L SW2 (ESA ID#6368) aqnd 2x20L RP3 (ESA ID# 6369)

---

## **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

# Chain-of-Custody / Service Request Form



Datasheet ID: 601.1  
Last Revised: 22 January 2013

Customer: Vista Gold Australia Pty Ltd Ship To: Ecotox Services Australasia  
 Contact Name: Austin Brandis Attention: Tina Micevska

Phone: 0889017730 Email: [abrandis@envirotechmonitoring.com.au](mailto:abrandis@envirotechmonitoring.com.au) (please provide an email address for sample receipt notification)

Sampled by: Vista Gold Staff

Sample Date (day/month/year)	Sample Time	Sample Name (exactly as written on the sample vessel)	Sample Method (eg. Grab, composite etc.)	Number and Volume of Containers (eg 2 x 1L)	Tests Requested (See reverse for guidance)			Comments / Instructions  <b>Note that testing will be delayed if an incomplete chain of custody is received</b>
					See page 3 for ecotox tests and concentrations	Subcontracted Water Chemistry as per Page 4		
25/11/2013	11:00	RP3	Grab	2 x 20L	X	X		Additional treatment of samples (i.e. spiking) Sub-contracted services (i.e. chemical analyses) Dilutions required (if different than 100% down to 6.25%) Sample holding time restriction (if applicable) Sample used for litigation (if applicable) Note: An MSDS must be attached if Available ESA Project Number: PR 1108
25/11/2013	11:00	SW2	Grab	5 x 20L	X	X	Test Water – Mine Water. Contains some heavy metals. pH neutral Diluent – Natural River Water	

1) Released By: Austin Brandis	Date: 25/11/2013	2) Received By: Tina	Date: 26/11/13	3) Released By:	Date:	4) Received By:	Date:
Of:	Time:	Of:	Time: 10:00	Of:	Time:	Of:	Time:

**Note that the chain-of-custody documentation will provide definitive information on the tests to be performed.**

**Statistical Printouts for the  
*Selenastrum* Growth Inhibition  
Tests**

**Microalgal Growth inhibition Test-Growth-Cell Yield**

Start Date:	13/12/2013 13:30	Test ID:	PR1108/11	Sample ID:	RP3
End Date:	16/12/2013 12:00	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 103	Test Species:	SC-Selenastrum capricornutum

Comments:

Conc-%	1	2	3	4	5	6	7	8
USEPA Control	216300	160300	238300	180300	165300	163300	162300	165300
Diluent Control	198300	210300	219300	201300				
0.1	190300	200300	204300	197300				
0.2	190300	205300	211300	188300				
0.4	205300	196300	210300	203300				
0.8	192300	187300	202300	193300				
1.6	140300	130300	132300	125300				
3.1	36300	44300	36300	57300				

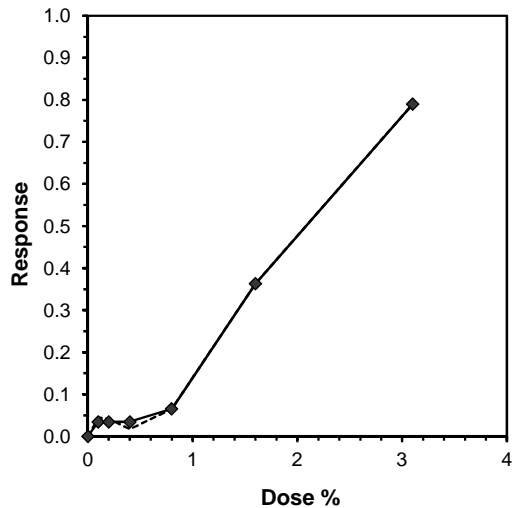
Conc-%	Transform: Untransformed							t-Stat	1-Tailed Critical	MSD	Isotonic	
	Mean	N-Mean	Mean	Min	Max	CV%	N				Mean	N-Mean
USEPA Control	181425	0.8752	181425	160300	238300	16.288	8					
Diluent Control	207300	1.0000	207300	198300	219300	4.576	4		*		207300	1.0000
0.1	198050	0.9554	198050	190300	204300	2.984	4	1.611	2.451	14078.57	200216.7	0.9658
0.2	198800	0.9590	198800	188300	211300	5.669	4	1.480	2.451	14078.57	200216.7	0.9658
0.4	203800	0.9831	203800	196300	210300	2.847	4	0.609	2.451	14078.57	200216.7	0.9658
0.8	193800	0.9349	193800	187300	202300	3.222	4	2.351	2.451	14078.57	193800	0.9349
*1.6	132050	0.6370	132050	125300	140300	4.724	4	13.103	2.451	14078.57	132050	0.6370
*3.1	43550	0.2101	43550	36300	57300	22.760	4	28.513	2.451	14078.57	43550	0.2101

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.933804	0.924	0.361873	-0.9502
Bartlett's Test indicates equal variances (p = 0.85)	2.656183	16.81189		
The control means are not significantly different (p = 0.13)	1.672463	2.228139		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	0.8	1.6	1.131371	125	14078.57	0.067914	1.47E+10	65964286	6.6E-18	6, 21
Treatments vs Diluent Control										

**Linear Interpolation (200 Resamples)**

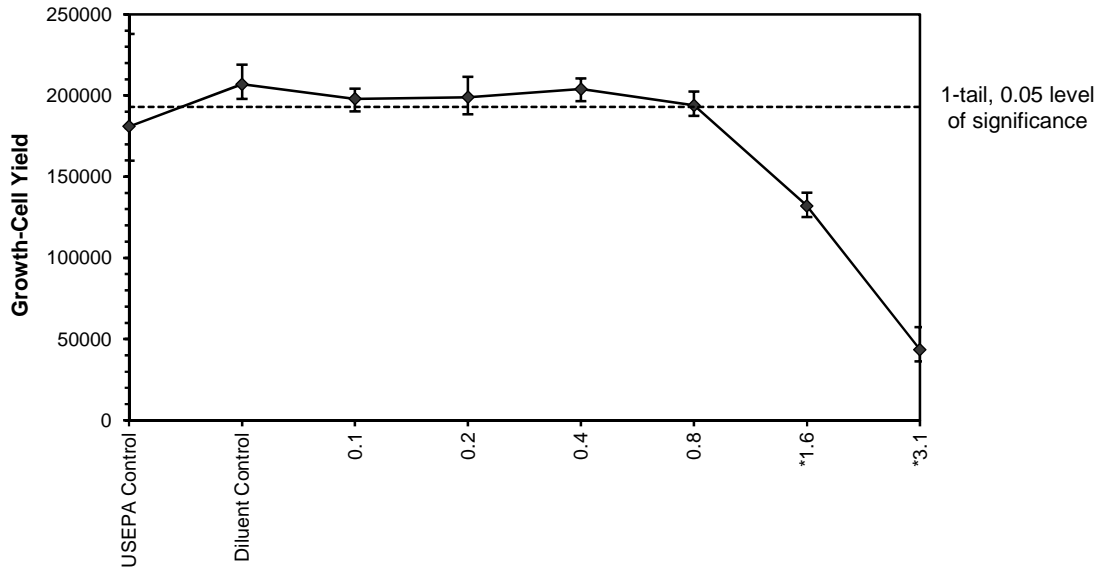
Point	%	SD	95% CL(Exp)		Skew
IC05	0.6046	0.2547	0.0000	0.9784	-0.7624
IC10	0.8937	0.0685	0.6115	1.0216	-1.6731
IC15	1.0280	0.0496	0.8620	1.1500	-0.3851
IC20	1.1622	0.0462	1.0053	1.2810	-0.3239
IC25	1.2965	0.0443	1.1494	1.4107	-0.2037
IC40	1.7300	0.0553	1.5741	1.8761	-0.0399
IC50	2.0814	0.0516	1.9537	2.2309	0.2147



**Microalgal Growth inhibition Test-Growth-Cell Yield**

Start Date: 13/12/2013 13:30 Test ID: PR1108/11 Sample ID: RP3  
End Date: 16/12/2013 12:00 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 103 Test Species: SC-Selenastrum capricornutum  
Comments:

**Dose-Response Plot**



**Microalgal Growth inhibition Test-Growth-Cell Yield**

Start Date:	13/12/2013 13:30	Test ID:	PR1108/11	Sample ID:	RP3
End Date:	16/12/2013 12:00	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 103	Test Species:	SC-Selenastrum capricornutum
Comments:					

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
USEPA Control	Cell Yield	18.14	16.03	23.83	2.96	9.48	8
Diluent Control		20.73	19.83	21.93	0.95	4.70	4
0.1		19.81	19.03	20.43	0.59	3.88	4
0.2		19.88	18.83	21.13	1.13	5.34	4
0.4		20.38	19.63	21.03	0.58	3.74	4
0.8		19.38	18.73	20.23	0.62	4.08	4
1.6		13.21	12.53	14.03	0.62	5.98	4
3.1		4.36	3.63	5.73	0.99	22.86	4
USEPA Control	pH	7.50	7.50	7.50	0.00	0.00	1
Diluent Control		7.20	7.20	7.20	0.00	0.00	1
0.1		7.20	7.20	7.20	0.00	0.00	1
0.2		7.20	7.20	7.20	0.00	0.00	1
0.4		7.20	7.20	7.20	0.00	0.00	1
0.8		7.10	7.10	7.10	0.00	0.00	1
1.6		7.10	7.10	7.10	0.00	0.00	1
3.1		7.10	7.10	7.10	0.00	0.00	1
USEPA Control	Conductivity uS/cm	96.40	96.40	96.40	0.00	0.00	1
Diluent Control		111.80	111.80	111.80	0.00	0.00	1
0.1		117.20	117.20	117.20	0.00	0.00	1
0.2		122.40	122.40	122.40	0.00	0.00	1
0.4		134.90	134.90	134.90	0.00	0.00	1
0.8		146.90	146.90	146.90	0.00	0.00	1
1.6		186.10	186.10	186.10	0.00	0.00	1
3.1		235.00	235.00	235.00	0.00	0.00	1



# **Statistical Printouts for the Duckweed Growth Inhibition Tests**

**Duckweed Growth Inhibition Test-Specific Growth Rate**

Start Date:	11/12/2013 15:00	Test ID:	PR1108/02	Sample ID:	RP3
End Date:	15/12/2013 14:15	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 112	Test Species:	LA-Lemna aequinoctialis

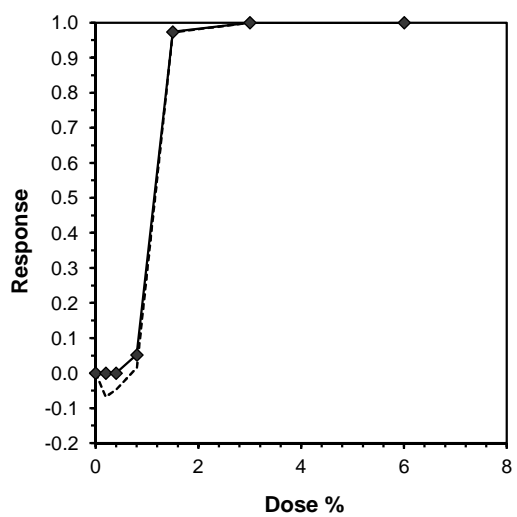
Conc-%	1	2	3	4
CAAC Control	0.2974	0.3375	0.3280	0.2974
Diluent Control	0.3080	0.3280	0.3080	0.3080
0.2	0.3280	0.3720	0.3182	0.3182
0.4	0.3280	0.3553	0.3182	0.3080
0.8	0.2974	0.3182	0.3080	0.3080
1.5	0.0334	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000
6	0.0000	0.0000	0.0000	0.0000

Conc-%	Mean	N-Mean	Transform: Untransformed					Rank Sum	1-Tailed Critical	Isotonic	
			Mean	Min	Max	CV%	N			Mean	N-Mean
CAAC Control	0.3151	1.0065	0.3151	0.2974	0.3375	6.595	4				
Diluent Control	0.3130	1.0000	0.3130	0.3080	0.3280	3.196	4	*		0.3249	1.0000
0.2	0.3341	1.0674	0.3341	0.3182	0.3720	7.684	4	23.50	10.00	0.3249	1.0000
0.4	0.3274	1.0459	0.3274	0.3080	0.3553	6.210	4	22.00	10.00	0.3249	1.0000
0.8	0.3079	0.9837	0.3079	0.2974	0.3182	2.764	4	16.00	10.00	0.3079	0.9479
*1.5	0.0083	0.0267	0.0083	0.0000	0.0334	200.000	4	10.00	10.00	0.0083	0.0257
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4			0.0000	0.0000
6	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 non-normal distribution (p <= 0.05)	0.868032	0.905	1.202266	0.739986
Bartlett's Test indicates equal variances (p = 0.39)	4.137926	13.2767		
The control means are not significantly different (p = 0.87)	0.177034	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	0.8	1.5	1.095445	125

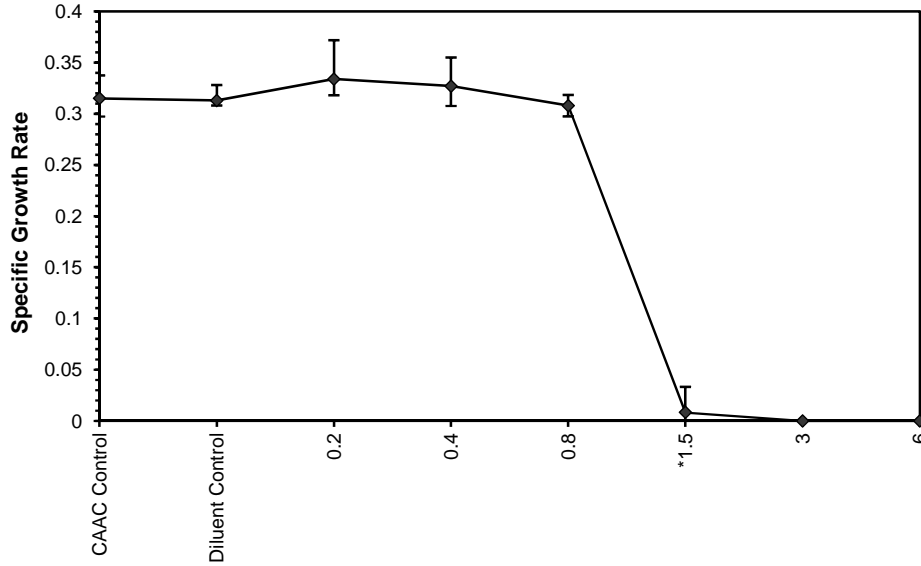
Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL(Exp)		Skew
IC05	0.7836	0.1010	0.2524	0.8467	-1.4236
IC10	0.8363	0.0142	0.7915	0.8721	-0.0384
IC15	0.8743	0.0134	0.8330	0.9095	0.0166
IC20	0.9122	0.0128	0.8734	0.9473	0.0319
IC25	0.9502	0.0123	0.9138	0.9851	0.0640
IC40	1.0641	0.0115	1.0298	1.0992	0.2860
IC50	1.1400	0.0117	1.1080	1.1781	0.4961



**Duckweed Growth Inhibition Test-Specific Growth Rate**

Start Date: 11/12/2013 15:00 Test ID: PR1108/02 Sample ID: RP3  
End Date: 15/12/2013 14:15 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 112 Test Species: LA-Lemna aequinoctialis  
Comments:

**Dose-Response Plot**



**Duckweed Growth Inhibition Test-Specific Growth Rate**

Start Date:	11/12/2013 15:00	Test ID:	PR1108/02	Sample ID:	RP3
End Date:	15/12/2013 14:15	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 112	Test Species:	LA-Lemna aequinoctialis
Comments:					

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
CAAC Control	Specific Growth Rate	0.32	0.30	0.34	0.02	45.75	4
Diluent Control		0.31	0.31	0.33	0.01	31.95	4
0.2		0.33	0.32	0.37	0.03	47.95	4
0.4		0.33	0.31	0.36	0.02	43.55	4
0.8		0.31	0.30	0.32	0.01	29.96	4
1.5		0.01	0.00	0.03	0.02	1548.04	4
3		0.00	0.00	0.00	0.00		4
6		0.00	0.00	0.00	0.00		4
CAAC Control	pH	6.10	6.10	6.10	0.00	0.00	1
Diluent Control		6.40	6.40	6.40	0.00	0.00	1
0.2		6.40	6.40	6.40	0.00	0.00	1
0.4		6.40	6.40	6.40	0.00	0.00	1
0.8		6.40	6.40	6.40	0.00	0.00	1
1.5		6.40	6.40	6.40	0.00	0.00	1
3		6.40	6.40	6.40	0.00	0.00	1
6		6.30	6.30	6.30	0.00	0.00	1
CAAC Control	Cond uS/cm	37.70	37.70	37.70	0.00	0.00	1
Diluent Control		49.90	49.90	49.90	0.00	0.00	1
0.2		59.00	59.00	59.00	0.00	0.00	1
0.4		68.30	68.30	68.30	0.00	0.00	1
0.8		86.90	86.90	86.90	0.00	0.00	1
1.5		123.50	123.50	123.50	0.00	0.00	1
3		185.60	185.60	185.60	0.00	0.00	1
6		316.00	316.00	316.00	0.00	0.00	1

**Statistical Printouts for the Acute  
Test with *Chironomus tepperi***

**Chironomid Acute Toxicity Test-48hr Survival**

Start Date:	29/11/2013 15:30	Test ID:	PR1108/06	Sample ID:	RP3
End Date:	1/12/2013 13:00	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 121	Test Species:	CT-Chironomus tepperi

Conc-%	1	2	3	4
DMW Control	1.0000	1.0000	1.0000	1.0000
Diluent Control	1.0000	1.0000	1.0000	1.0000
6.3	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	0.8000	0.6000
25	0.6000	0.8000	1.0000	0.8000
50	1.0000	0.6000	1.0000	1.0000
100	1.0000	0.6000	0.4000	1.0000

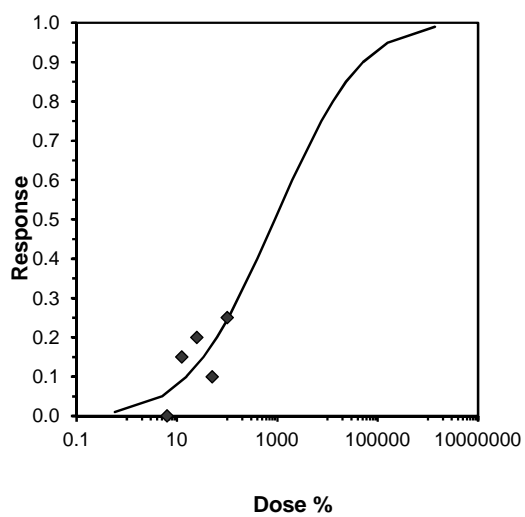
Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical	Number Resp	Total Number
			Mean	Min	Max	CV%	N				
DMW Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4				
Diluent Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	*		0	20
6.3	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	0	20
12.5	0.8500	0.8500	1.1709	0.8861	1.3453	18.840	4	14.00	10.00	3	20
25	0.8000	0.8000	1.1114	0.8861	1.3453	16.874	4	12.00	10.00	4	20
50	0.9000	0.9000	1.2305	0.8861	1.3453	18.660	4	16.00	10.00	2	20
100	0.7500	0.7500	1.0653	0.6847	1.3453	31.308	4	14.00	10.00	5	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.917818	0.916	-0.52866	-0.03472
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	100	>100		1
Treatments vs Diluent Control				

Parameter	Value	SE	95% Fiducial Limits	Maximum Likelihood-Probit						
				Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	0.72947	0.389976	-0.03488 1.493822	0	3.978342	7.814728	0.26	2.950671	1.370859	4
Intercept	2.847575	0.609858	1.652254 4.042896							

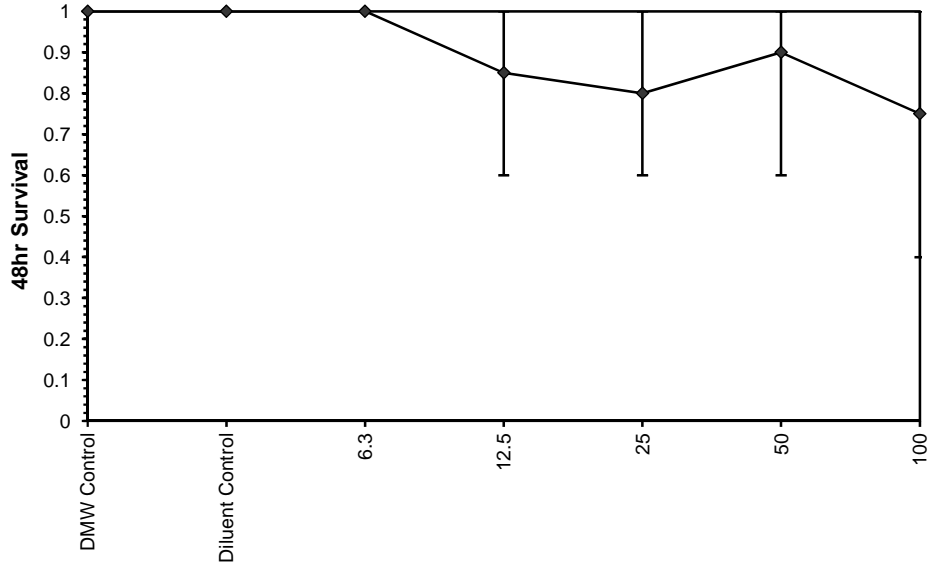
Point	Probits	%	95% Fiducial Limits
EC01	2.674	0.577532	
EC05	3.355	4.963735	
EC10	3.718	15.62588	
EC15	3.964	33.87404	
EC20	4.158	62.65086	
EC25	4.326	106.1795	
EC40	4.747	401.2065	
EC50	5.000	892.6292	
EC60	5.253	1985.978	
EC75	5.674	7504.149	
EC80	5.842	12717.89	
EC85	6.036	23522.06	
EC90	6.282	50991.46	
EC95	6.645	160521.6	
EC99	7.326	1379643	



**Chironomid Acute Toxicity Test-48hr Survival**

Start Date: 29/11/2013 15:30 Test ID: PR1108/06 Sample ID: RP3  
End Date: 1/12/2013 13:00 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 121 Test Species: CT-Chironomus tepperi  
Comments:

**Dose-Response Plot**



**Chironomid Acute Toxicity Test-48hr Survival**

Start Date:	29/11/2013 15:30	Test ID:	PR1108/06	Sample ID:	RP3
End Date:	1/12/2013 13:00	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 121	Test Species:	CT-Chironomus tepperi
Comments:					

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	% Survival	100.00	100.00	100.00	0.00	0.00	4
Diluent Control		100.00	100.00	100.00	0.00	0.00	4
6.3		100.00	100.00	100.00	0.00	0.00	4
12.5		85.00	60.00	100.00	19.15	5.15	4
25		80.00	60.00	100.00	16.33	5.05	4
50		90.00	60.00	100.00	20.00	4.97	4
100		75.00	40.00	100.00	30.00	7.30	4
DMW Control	pH	8.20	8.20	8.20	0.00	0.00	1
Diluent Control		6.70	6.70	6.70	0.00	0.00	1
6.3		6.70	6.70	6.70	0.00	0.00	1
12.5		6.90	6.90	6.90	0.00	0.00	1
25		7.10	7.10	7.10	0.00	0.00	1
50		7.40	7.40	7.40	0.00	0.00	1
100		7.80	7.80	7.80	0.00	0.00	1
DMW Control	DO (%)	98.90	98.90	98.90	0.00	0.00	1
Diluent Control		96.60	96.60	96.60	0.00	0.00	1
6.3		96.80	96.80	96.80	0.00	0.00	1
12.5		97.60	97.60	97.60	0.00	0.00	1
25		98.60	98.60	98.60	0.00	0.00	1
50		103.80	103.80	103.80	0.00	0.00	1
100		109.20	109.20	109.20	0.00	0.00	1
DMW Control	Conductivity (uS/cm)	172.90	172.90	172.90	0.00	0.00	1
Diluent Control		21.60	21.60	21.60	0.00	0.00	1
6.3		300.00	300.00	300.00	0.00	0.00	1
12.5		531.00	531.00	531.00	0.00	0.00	1
25		947.00	947.00	947.00	0.00	0.00	1
50		1667.00	1667.00	1667.00	0.00	0.00	1
100		2910.00	2910.00	2910.00	0.00	0.00	1



# **Statistical Printouts for *Hydra* Population Growth Tests**

**Hydra Population Growth Test-Growth Rate**

Start Date:	27/11/2013 15:00	Test ID:	PR1108/03	Sample ID:	RP3
End Date:	1/12/2013 17:45	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 125	Test Species:	HV-Hydra viridissima

Conc-%	1	2	3	4
Lab Control	0.3631	0.3408	0.3735	0.3577
Diluent Control	0.4113	0.3835	0.3931	0.3978
6.3	0.3785	0.3631	0.3522	0.3931
12.5	0.3408	0.3785	0.3522	0.3349
25	0.2747	0.2508	0.2964	0.2821
50	0.2052	0.1495	0.2151	0.1366
100	0.0000	0.0000	0.0000	0.0000

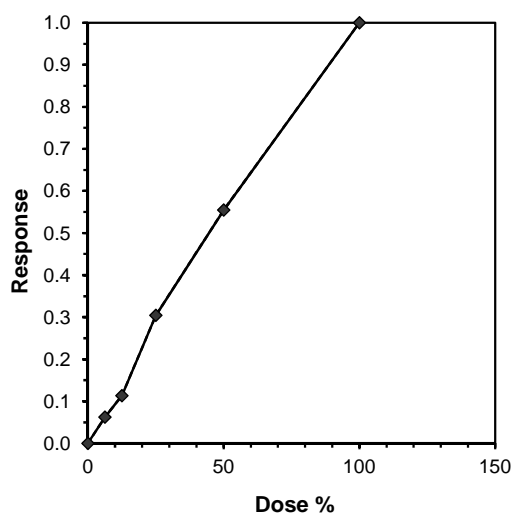
Conc-%	Mean	N-Mean	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%					Mean	N-Mean
Lab Control	0.3588	0.9050	0.3588	0.3408	0.3735	3.801	4					
Diluent Control	0.3964	1.0000	0.3964	0.3835	0.4113	2.918	4	*			0.3964	1.0000
6.3	0.3717	0.9377	0.3717	0.3522	0.3931	4.812	4	1.493	2.360	0.0390	0.3717	0.9377
*12.5	0.3516	0.8870	0.3516	0.3349	0.3785	5.493	4	2.709	2.360	0.0390	0.3516	0.8870
*25	0.2760	0.6962	0.2760	0.2508	0.2964	6.904	4	7.282	2.360	0.0390	0.2760	0.6962
*50	0.1766	0.4455	0.1766	0.1366	0.2151	22.252	4	13.294	2.360	0.0390	0.1766	0.4455
100	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 ( $p > 0.05$ )	0.986267	0.905	0.039134	-0.5998
Bartlett's Test indicates equal variances ( $p = 0.34$ )	4.493741	13.2767		
The control means are significantly different ( $p = 5.62E-03$ )	4.210484	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	6.3	12.5	8.87412	15.87302	0.039023	0.098441	0.031861	0.000547	5.8E-09	4, 15

Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL(Exp)		Skew
IC05*	5.058	1.778	1.741	11.554	1.0502
IC10	10.912	2.081	3.003	16.251	-0.4746
IC15	14.926	1.215	11.420	18.657	-0.0332
IC20	18.202	1.094	15.134	21.302	-0.0506
IC25	21.478	1.188	18.378	25.348	0.0922
IC40	34.596	2.070	29.625	41.557	0.3929
IC50	44.566	3.337	36.762	57.349	0.5809

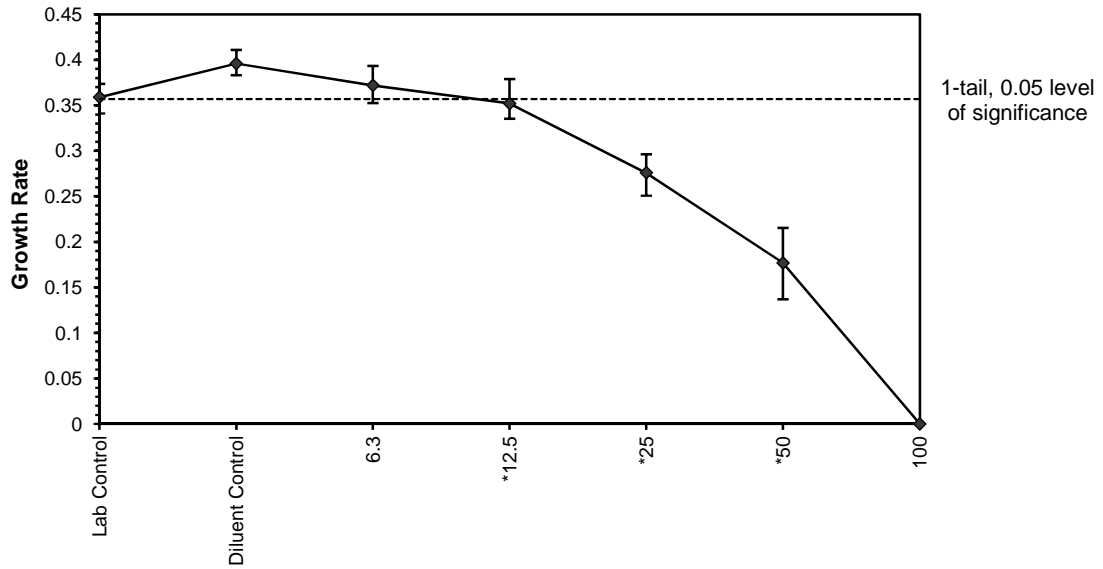
\* indicates IC estimate less than the lowest concentration



Hydra Population Growth Test-Growth Rate

Start Date: 27/11/2013 15:00 Test ID: PR1108/03 Sample ID: RP3  
End Date: 1/12/2013 17:45 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 125 Test Species: HV-Hydra viridissima  
Comments:

Dose-Response Plot



**Hydra Population Growth Test-Growth Rate**

Start Date: 27/11/2013 15:00      Test ID: PR1108/03      Sample ID: RP3  
 End Date: 1/12/2013 17:45      Lab ID: 6369      Sample Type: AQ-Aqueous  
 Sample Date:      Protocol: ESA 125      Test Species: HV-Hydra viridissima  
 Comments:

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
Lab Control	Growth Rate	0.36	0.34	0.37	0.01	32.55	4
Diluent Control		0.40	0.38	0.41	0.01	27.13	4
6.3		0.37	0.35	0.39	0.02	35.98	4
12.5		0.35	0.33	0.38	0.02	39.52	4
25		0.28	0.25	0.30	0.02	50.02	4
50		0.18	0.14	0.22	0.04	112.25	4
100		0.00	0.00	0.00	0.00		4
Lab Control	Conductivity	29.70	29.70	29.70	0.00	0.00	1
Diluent Control		19.10	19.10	19.10	0.00	0.00	1
6.3		303.00	303.00	303.00	0.00	0.00	1
12.5		537.00	537.00	537.00	0.00	0.00	1
25		945.00	945.00	945.00	0.00	0.00	1
50		1648.00	1648.00	1648.00	0.00	0.00	1
100		2890.00	2890.00	2890.00	0.00	0.00	1
Lab Control	pH	6.90	6.90	6.90	0.00	0.00	1
Diluent Control		6.60	6.60	6.60	0.00	0.00	1
6.3		6.80	6.80	6.80	0.00	0.00	1
12.5		6.90	6.90	6.90	0.00	0.00	1
25		7.10	7.10	7.10	0.00	0.00	1
50		7.50	7.50	7.50	0.00	0.00	1
100		7.80	7.80	7.80	0.00	0.00	1
Lab Control	DO, % sat	99.10	99.10	99.10	0.00	0.00	1
Diluent Control		95.30	95.30	95.30	0.00	0.00	1
6.3		98.90	98.90	98.90	0.00	0.00	1
12.5		98.90	98.90	98.90	0.00	0.00	1
25		99.60	99.60	99.60	0.00	0.00	1
50		100.60	100.60	100.60	0.00	0.00	1
100		103.50	103.50	103.50	0.00	0.00	1

# **Statistical Printouts for the Fish Embryonic Post Hatch Survival Tests**

**Fish Embryonic Development and Post-Hatch Survival Test-Survival**

Start Date:	27/11/2013 16:00	Test ID:	PR1108/07	Sample ID:	RP3
End Date:	8/12/2013 12:15	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 126	Test Species:	MS-Melanotaenia splendida

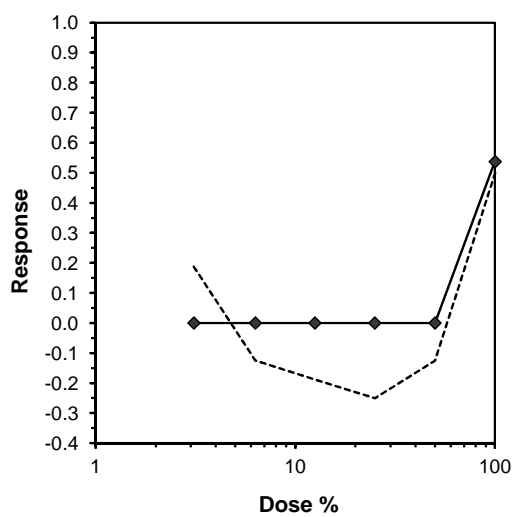
Conc-%	1	2	3	4
DMW Control	1.0000	0.6000	1.0000	0.8000
Diluent Control	0.6000	1.0000	0.8000	0.8000
3.1	0.6000	0.4000	0.8000	0.8000
6.3	1.0000	1.0000	0.8000	0.8000
12.5	1.0000	0.8000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	0.8000	1.0000	1.0000	0.8000
100	1.0000	0.2000	0.2000	0.2000

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical	Isotonic	
			Mean	Min	Max	CV%	N			Mean	N-Mean
DMW Control	0.8500	1.0625	1.1709	0.8861	1.3453	18.840	4				
Diluent Control	0.8000	1.0000	1.1114	0.8861	1.3453	16.874	4	*		0.8667	1.0000
3.1	0.6500	0.8125	0.9463	0.6847	1.1071	21.467	4	14.50	10.00	0.8667	1.0000
6.3	0.9000	1.1250	1.2262	1.1071	1.3453	11.212	4	21.00	10.00	0.8667	1.0000
12.5	0.9500	1.1875	1.2857	1.1071	1.3453	9.261	4	22.50	10.00	0.8667	1.0000
25	1.0000	1.2500	1.3453	1.3453	1.3453	0.000	4	24.00	10.00	0.8667	1.0000
50	0.9000	1.1250	1.2262	1.1071	1.3453	11.212	4	21.00	10.00	0.8667	1.0000
100	0.4000	0.5000	0.6841	0.4636	1.3453	64.442	4	13.50	10.00	0.4000	0.4615

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.882017	0.924	1.430131	4.281494
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.70)	0.411217	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	>100		1
Treatments vs Diluent Control				

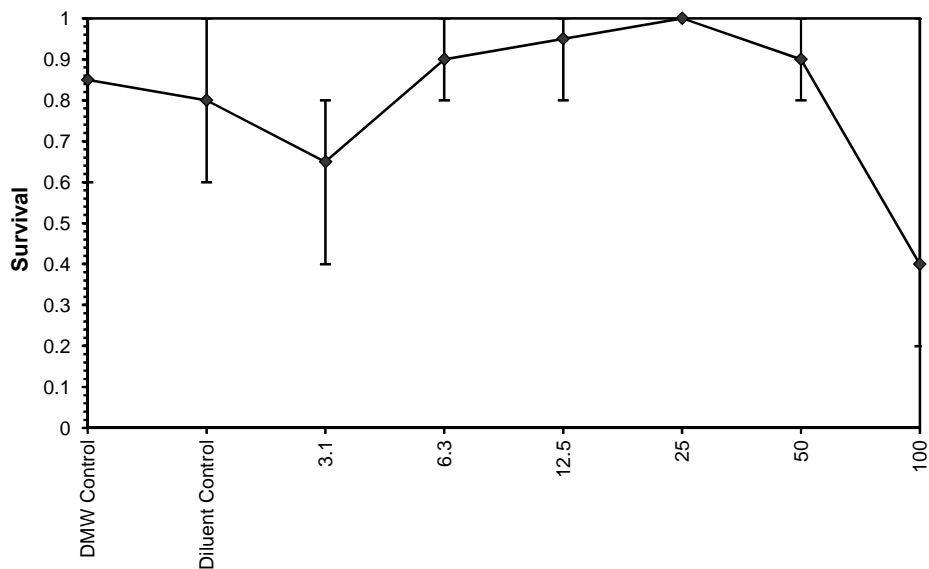
Log-Logit Interpolation (200 Resamples)				
Point	%	SD	95% CL(Exp)	Skew
IC05	55.354			
IC10	60.172			
IC15	64.680			
IC20	69.014			
IC25	73.271			
IC40	86.308			
IC50	95.927			



Fish Embryonic Development and Post-Hatch Survival Test-Survival

Start Date: 27/11/2013 16:00 Test ID: PR1108/07 Sample ID: RP3  
End Date: 8/12/2013 12:15 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 126 Test Species: MS-Melanotaenia splendida  
Comments:

Dose-Response Plot



**Fish Embryonic Development and Post-Hatch Survival Test-Survival**

Start Date: 27/11/2013 16:00    Test ID: PR1108/07    Sample ID: RP3  
 End Date: 8/12/2013 12:15    Lab ID: 6369    Sample Type: AQ-Aqueous  
 Sample Date:    Protocol: ESA 126    Test Species: MS-Melanotaenia splendida  
 Comments:

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	% Survival	85.00	60.00	100.00	19.15	5.15	4
Diluent Control		80.00	60.00	100.00	16.33	5.05	4
3.1		65.00	40.00	80.00	19.15	6.73	4
6.3		90.00	80.00	100.00	11.55	3.78	4
12.5		95.00	80.00	100.00	10.00	3.33	4
25		100.00	100.00	100.00	0.00	0.00	4
50		90.00	80.00	100.00	11.55	3.78	4
100		40.00	20.00	100.00	40.00	15.81	4
DMW Control	pH	8.00	8.00	8.00	0.00	0.00	1
Diluent Control		7.50	7.50	7.50	0.00	0.00	1
3.1		7.00	7.00	7.00	0.00	0.00	1
6.3		6.90	6.90	6.90	0.00	0.00	1
12.5		6.80	6.80	6.80	0.00	0.00	1
25		6.80	6.80	6.80	0.00	0.00	1
50		7.00	7.00	7.00	0.00	0.00	1
100		7.70	7.70	7.70	0.00	0.00	1
DMW Control	DO (%)	99.70	99.70	99.70	0.00	0.00	1
Diluent Control		89.20	89.20	89.20	0.00	0.00	1
3.1		93.00	93.00	93.00	0.00	0.00	1
6.3		94.10	94.10	94.10	0.00	0.00	1
12.5		94.60	94.60	94.60	0.00	0.00	1
25		96.20	96.20	96.20	0.00	0.00	1
50		100.70	100.70	100.70	0.00	0.00	1
100		103.00	103.00	103.00	0.00	0.00	1
DMW Control	Conductivity (uS/cm)	173.30	173.30	173.30	0.00	0.00	1
Diluent Control		21.70	21.70	21.70	0.00	0.00	1
3.1		161.30	161.30	161.30	0.00	0.00	1
6.3		285.00	285.00	285.00	0.00	0.00	1
12.5		523.00	523.00	523.00	0.00	0.00	1
25		920.00	920.00	920.00	0.00	0.00	1
50		1662.00	1662.00	1662.00	0.00	0.00	1
100		2900.00	2900.00	2900.00	0.00	0.00	1



**Fish Embryonic Development and Post-Hatch Survival Test-Survival**

Start Date:	27/11/2013 16:00	Test ID:	PR1108/07	Sample ID:	RP3
End Date:	8/12/2013 12:15	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 126	Test Species:	MS-Melanotaenia splendida

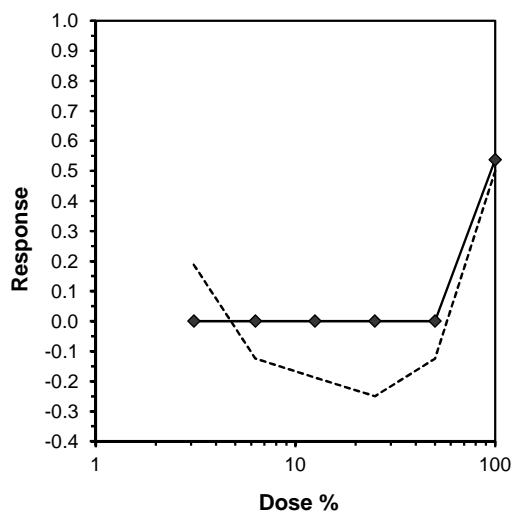
Conc-%	1	2	3	4
DMW Control	1.0000	0.6000	1.0000	0.8000
Diluent Control	0.6000	1.0000	0.8000	0.8000
3.1	0.6000	0.4000	0.8000	0.8000
6.3	1.0000	1.0000	0.8000	0.8000
12.5	1.0000	0.8000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	0.8000	1.0000	1.0000	0.8000
100	1.0000	0.2000	0.2000	0.2000

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical	Number Resp	Total Number
			Mean	Min	Max	CV%	N				
DMW Control	0.8500	1.0625	1.1709	0.8861	1.3453	18.840	4				
Diluent Control	0.8000	1.0000	1.1114	0.8861	1.3453	16.874	4	*		4	20
3.1	0.6500	0.8125	0.9463	0.6847	1.1071	21.467	4	14.50	10.00	7	20
6.3	0.9000	1.1250	1.2262	1.1071	1.3453	11.212	4	21.00	10.00	2	20
12.5	0.9500	1.1875	1.2857	1.1071	1.3453	9.261	4	22.50	10.00	1	20
25	1.0000	1.2500	1.3453	1.3453	1.3453	0.000	4	24.00	10.00	0	20
50	0.9000	1.1250	1.2262	1.1071	1.3453	11.212	4	21.00	10.00	2	20
100	0.4000	0.5000	0.6841	0.4636	1.3453	64.442	4	13.50	10.00	12	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.882017	0.924	1.430131	4.281494
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.70)	0.411217	2.446912		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	>100		1
Treatments vs Diluent Control				

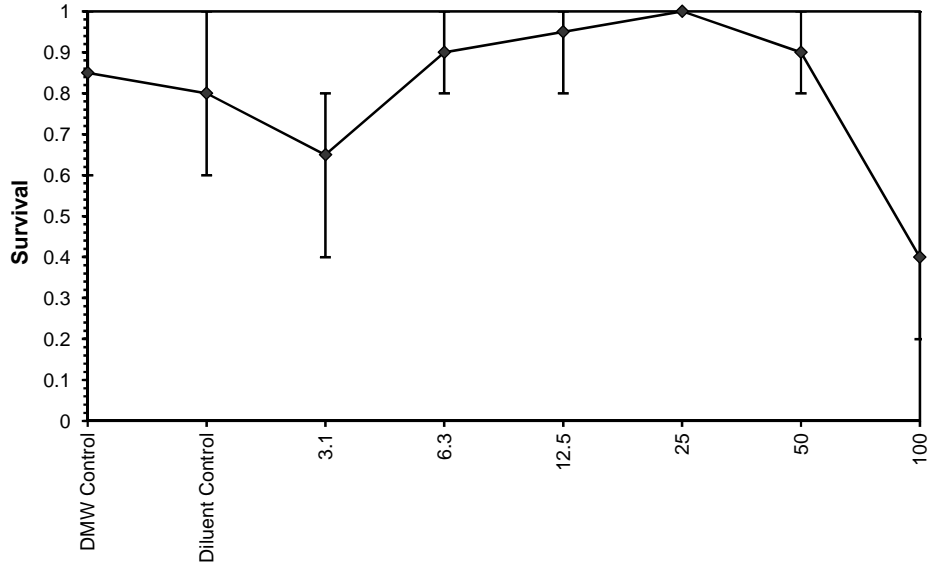
Trimmed Spearman-Kärber			
Trim Level	EC50	95% CL	
0.0%			
5.0%			
10.0%			
20.0%			
Auto-46.2%	95.170	72.906	124.232



**Fish Embryonic Development and Post-Hatch Survival Test-Survival**

Start Date: 27/11/2013 16:00 Test ID: PR1108/07 Sample ID: RP3  
End Date: 8/12/2013 12:15 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 126 Test Species: MS-Melanotaenia splendida  
Comments:

**Dose-Response Plot**



**Fish Embryonic Development and Post-Hatch Survival Test-Survival**

Start Date: 27/11/2013 16:00    Test ID: PR1108/07    Sample ID: RP3  
 End Date: 8/12/2013 12:15    Lab ID: 6369    Sample Type: AQ-Aqueous  
 Sample Date:    Protocol: ESA 126    Test Species: MS-Melanotaenia splendida  
 Comments:

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	% Survival	85.00	60.00	100.00	19.15	5.15	4
Diluent Control		80.00	60.00	100.00	16.33	5.05	4
3.1		65.00	40.00	80.00	19.15	6.73	4
6.3		90.00	80.00	100.00	11.55	3.78	4
12.5		95.00	80.00	100.00	10.00	3.33	4
25		100.00	100.00	100.00	0.00	0.00	4
50		90.00	80.00	100.00	11.55	3.78	4
100		40.00	20.00	100.00	40.00	15.81	4
DMW Control	pH	8.00	8.00	8.00	0.00	0.00	1
Diluent Control		7.50	7.50	7.50	0.00	0.00	1
3.1		7.00	7.00	7.00	0.00	0.00	1
6.3		6.90	6.90	6.90	0.00	0.00	1
12.5		6.80	6.80	6.80	0.00	0.00	1
25		6.80	6.80	6.80	0.00	0.00	1
50		7.00	7.00	7.00	0.00	0.00	1
100		7.70	7.70	7.70	0.00	0.00	1
DMW Control	DO (%)	99.70	99.70	99.70	0.00	0.00	1
Diluent Control		89.20	89.20	89.20	0.00	0.00	1
3.1		93.00	93.00	93.00	0.00	0.00	1
6.3		94.10	94.10	94.10	0.00	0.00	1
12.5		94.60	94.60	94.60	0.00	0.00	1
25		96.20	96.20	96.20	0.00	0.00	1
50		100.70	100.70	100.70	0.00	0.00	1
100		103.00	103.00	103.00	0.00	0.00	1
DMW Control	Conductivity (uS/cm)	173.30	173.30	173.30	0.00	0.00	1
Diluent Control		21.70	21.70	21.70	0.00	0.00	1
3.1		161.30	161.30	161.30	0.00	0.00	1
6.3		285.00	285.00	285.00	0.00	0.00	1
12.5		523.00	523.00	523.00	0.00	0.00	1
25		920.00	920.00	920.00	0.00	0.00	1
50		1662.00	1662.00	1662.00	0.00	0.00	1
100		2900.00	2900.00	2900.00	0.00	0.00	1

# **Statistical Printouts for the Freshwater Shrimp Tests**

**Freshwater Shrimp Acute Toxicity Test-96 hr Survival**

Start Date:	3/12/2013 16:00	Test ID:	PR1108/08	Sample ID:	RP3
End Date:	7/12/2013 16:30	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 123	Test Species:	MB-Macrobrachium bullatum

Comments:

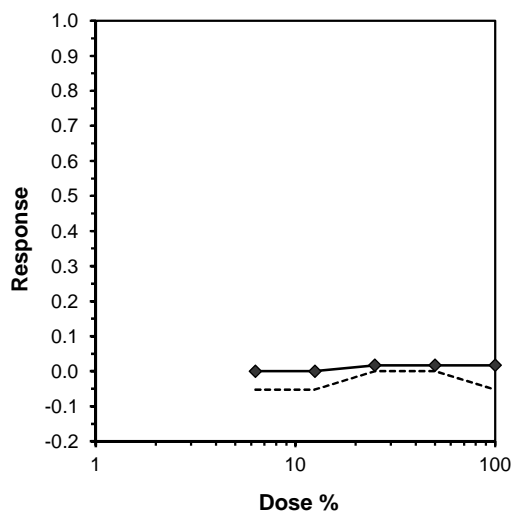
Conc-%	1	2	3	4
DMW Control	1.0000	1.0000	1.0000	0.8000
Diluent Control	1.0000	1.0000	0.8000	1.0000
6.3	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	0.8000	1.0000
50	1.0000	1.0000	0.8000	1.0000
100	1.0000	1.0000	1.0000	1.0000

Conc-%	Mean	N-Mean	Transform: Arcsin Square Root					Rank Sum	1-Tailed Critical	Isotonic	
			Mean	Min	Max	CV%	N			Mean	N-Mean
DMW Control	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4				
Diluent Control	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	*		0.9833	1.0000
6.3	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	20.00	10.00	0.9833	1.0000
12.5	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	20.00	10.00	0.9833	1.0000
25	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	18.00	10.00	0.9667	0.9831
50	0.9500	1.0000	1.2857	1.1071	1.3453	9.261	4	18.00	10.00	0.9667	0.9831
100	1.0000	1.0526	1.3453	1.3453	1.3453	0.000	4	20.00	10.00	0.9667	0.9831

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.668306	0.916	-1.74394	2.373016
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	100	>100		1
Treatments vs Diluent Control				

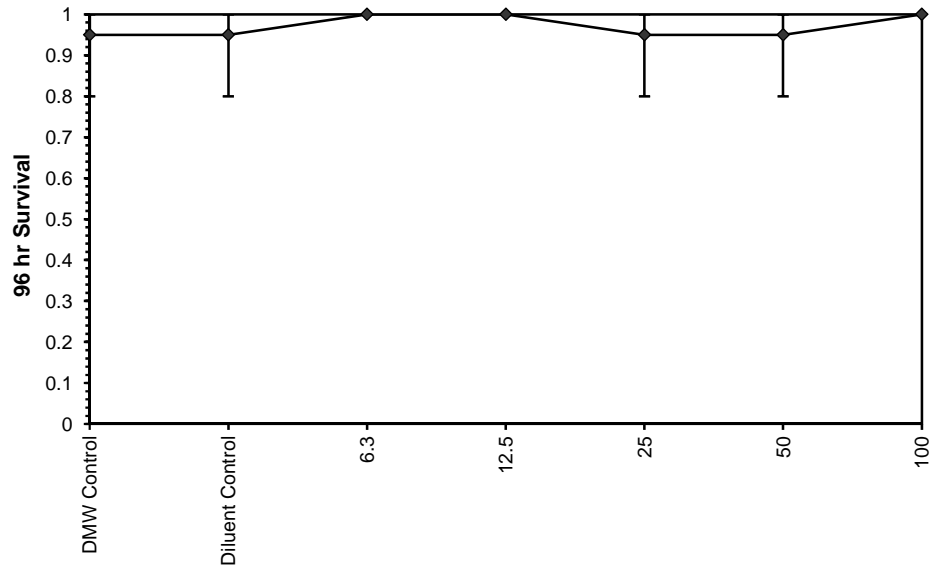
Log-Logit Interpolation (200 Resamples)				
Point	%	SD	95% CL(Exp)	Skew
IC05	>100			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			



**Freshwater Shrimp Acute Toxicity Test-96 hr Survival**

Start Date: 3/12/2013 16:00      Test ID: PR1108/08      Sample ID: RP3  
End Date: 7/12/2013 16:30      Lab ID: 6369      Sample Type: AQ-Aqueous  
Sample Date:      Protocol: ESA 123      Test Species: MB-Macrobrachium bullatum  
Comments:

**Dose-Response Plot**



**Freshwater Shrimp Acute Toxicity Test-96 hr Survival**

Start Date:	3/12/2013 16:00	Test ID:	PR1108/08	Sample ID:	RP3
End Date:	7/12/2013 16:30	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 123	Test Species:	MB-Macrobrachium bullatum
Comments:					

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	% Survival	95.00	80.00	100.00	10.00	3.33	4
Diluent Control		95.00	80.00	100.00	10.00	3.33	4
6.3		100.00	100.00	100.00	0.00	0.00	4
12.5		100.00	100.00	100.00	0.00	0.00	4
25		95.00	80.00	100.00	10.00	3.33	4
50		95.00	80.00	100.00	10.00	3.33	4
100		100.00	100.00	100.00	0.00	0.00	4
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
Diluent Control		7.50	7.50	7.50	0.00	0.00	1
6.3		7.50	7.50	7.50	0.00	0.00	1
12.5		7.00	7.00	7.00	0.00	0.00	1
25		7.10	7.10	7.10	0.00	0.00	1
50		7.30	7.30	7.30	0.00	0.00	1
100		7.70	7.70	7.70	0.00	0.00	1
DMW Control	DO (%)	100.70	100.70	100.70	0.00	0.00	1
Diluent Control		97.10	97.10	97.10	0.00	0.00	1
6.3		97.50	97.50	97.50	0.00	0.00	1
12.5		97.70	97.70	97.70	0.00	0.00	1
25		97.40	97.40	97.40	0.00	0.00	1
50		96.90	96.90	96.90	0.00	0.00	1
100		97.10	97.10	97.10	0.00	0.00	1
DMW Control	Conductivity (uS/cm)	173.60	173.60	173.60	0.00	0.00	1
Diluent Control		18.60	18.60	18.60	0.00	0.00	1
6.3		291.00	291.00	291.00	0.00	0.00	1
12.5		528.00	528.00	528.00	0.00	0.00	1
25		942.00	942.00	942.00	0.00	0.00	1
50		1661.00	1661.00	1661.00	0.00	0.00	1
100		2910.00	2910.00	2910.00	0.00	0.00	1

**Statistical Printouts for the 7-d  
Chronic Test with *Ceriodaphnia  
dubia***



**Ceriodaphnia Partial Life-Cycle Test-Reproduction**

Start Date:	16/12/2013 13:30	Test ID:	PR1108/02	Sample ID:	RP3
End Date:	23/12/2013 10:30	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia

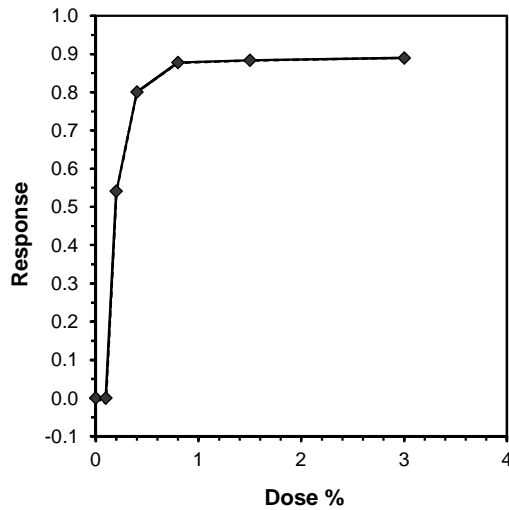
Conc-%	1	2	3	4	5	6	7	8	9	10
DMW Control	20.000	19.000	16.000	13.000	18.000	16.000	16.000	9.000	14.000	15.000
Diluent Control	14.000	15.000	17.000	11.000	7.000	13.000	17.000	17.000	15.000	19.000
0.1	16.000	17.000	14.000	17.000	8.000	13.000	17.000	10.000	16.000	19.000
0.2	7.000	6.000	5.000	11.000	8.000	7.000	8.000	7.000	7.000	1.000
0.4	1.000	5.000	3.000	4.000	4.000	3.000	2.000	3.000	2.000	2.000
0.8	1.000	3.000	5.000	1.000	2.000	2.000	0.000	2.000	0.000	
1.5	2.000	3.000	2.000	0.000	2.000	1.000	3.000	2.000	2.000	0.000
3	2.000	2.000	2.000	2.000	0.000	1.000	2.000	0.000	1.000	4.000

Conc-%	Mean	N-Mean	Transform: Untransformed					Rank Sum	1-Tailed Critical	Isotonic	
			Mean	Min	Max	CV%	N			Mean	N-Mean
DMW Control	15.600	1.0759	15.6000	9.0000	20.0000	20.316	10				
Diluent Control	14.500	1.0000	14.5000	7.0000	19.0000	24.165	10	*		14.600	1.0000
0.1	14.700	1.0138	14.7000	8.0000	19.0000	23.576	10	107.00	73.00	14.600	1.0000
*0.2	6.700	0.4621	6.7000	1.0000	11.0000	37.922	10	60.50	73.00	6.700	0.4589
*0.4	2.900	0.2000	2.9000	1.0000	5.0000	41.283	10	55.00	73.00	2.900	0.1986
*0.8	1.778	0.1226	1.7778	0.0000	5.0000	87.945	9	45.00	60.00	1.778	0.1218
*1.5	1.700	0.1172	1.7000	0.0000	3.0000	62.315	10	55.00	73.00	1.700	0.1164
*3	1.600	0.1103	1.6000	0.0000	4.0000	73.362	10	55.00	73.00	1.600	0.1096

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates non-normal distribution (p <= 0.05)	1.186323	0.895	-0.98421	2.561473
Bartlett's Test indicates unequal variances (p = 1.59E-04)	26.77824	16.81189		
The control means are not significantly different (p = 0.47)	0.736248	2.100922		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Wilcoxon Rank Sum Test	0.1	0.2	0.141421	1000
Treatments vs Diluent Control				

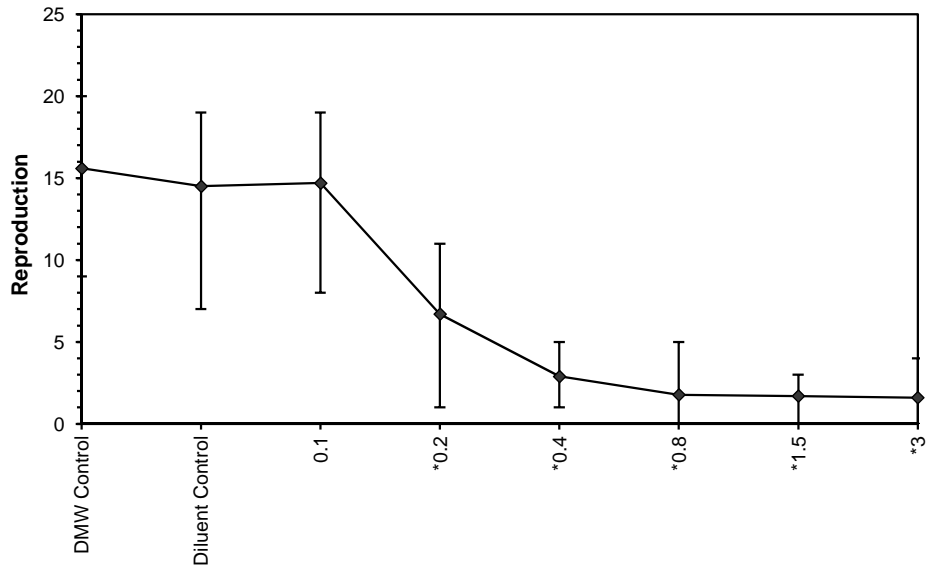
Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL		Skew
IC05	0.1092	0.0252	0.0285	0.1113	-1.7822
IC10	0.1185	0.0166	0.0570	0.1227	-2.6684
IC15	0.1277	0.0123	0.0855	0.1340	-2.7940
IC20	0.1370	0.0105	0.1068	0.1454	-2.2541
IC25	0.1462	0.0096	0.1193	0.1567	-1.5647
IC40	0.1739	0.0093	0.1506	0.1908	0.0900
IC50	0.1924	0.0153	0.1738	0.2353	1.5507



**Ceriodaphnia Partial Life-Cycle Test-Reproduction**

Start Date: 16/12/2013 13:30 Test ID: PR1108/02 Sample ID: RP3  
End Date: 23/12/2013 10:30 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 102 Test Species: CD-Ceriodaphnia dubia  
Comments:

**Dose-Response Plot**



**Ceriodaphnia Partial Life-Cycle Test-Reproduction**

Start Date:	16/12/2013 13:30	Test ID:	PR1108/02	Sample ID:	RP3
End Date:	23/12/2013 10:30	Lab ID:	6369	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:					

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	No of Young	15.60	9.00	20.00	3.17	11.41	10
Diluent Control		14.50	7.00	19.00	3.50	12.91	10
0.1		14.70	8.00	19.00	3.47	12.66	10
0.2		6.70	1.00	11.00	2.54	23.79	10
0.4		2.90	1.00	5.00	1.20	37.73	10
0.8		1.78	0.00	5.00	1.56	70.33	9
1.5		1.70	0.00	3.00	1.06	60.54	10
3		1.60	0.00	4.00	1.17	67.71	10
DMW Control	% survival	100.00	100.00	100.00	0.00	0.00	10
Diluent Control		100.00	100.00	100.00	0.00	0.00	10
0.1		100.00	100.00	100.00	0.00	0.00	10
0.2		100.00	100.00	100.00	0.00	0.00	10
0.4		100.00	100.00	100.00	0.00	0.00	10
0.8		100.00	100.00	100.00	0.00	0.00	9
1.5		50.00	0.00	100.00	52.70	14.52	10
3		50.00	0.00	100.00	52.70	14.52	10
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
Diluent Control		7.30	7.30	7.30	0.00	0.00	1
0.1		7.20	7.20	7.20	0.00	0.00	1
0.2		7.10	7.10	7.10	0.00	0.00	1
0.4		7.10	7.10	7.10	0.00	0.00	1
0.8		6.90	6.90	6.90	0.00	0.00	1
1.5		6.90	6.90	6.90	0.00	0.00	1
3		6.90	6.90	6.90	0.00	0.00	1
DMW Control	DO %	99.00	99.00	99.00	0.00	0.00	1
Diluent Control		100.90	100.90	100.90	0.00	0.00	1
0.1		100.50	100.50	100.50	0.00	0.00	1
0.2		99.90	99.90	99.90	0.00	0.00	1
0.4		99.70	99.70	99.70	0.00	0.00	1
0.8		99.80	99.80	99.80	0.00	0.00	1
1.5		99.80	99.80	99.80	0.00	0.00	1
3		100.40	100.40	100.40	0.00	0.00	1
DMW Control	Cond uS/cm	179.80	179.80	179.80	0.00	0.00	1
Diluent Control		179.80	179.80	179.80	0.00	0.00	1
0.1		32.90	32.90	32.90	0.00	0.00	1
0.2		37.20	37.20	37.20	0.00	0.00	1
0.4		46.40	46.40	46.40	0.00	0.00	1
0.8		64.40	64.40	64.40	0.00	0.00	1
1.5		100.10	100.10	100.10	0.00	0.00	1
3		170.20	170.20	170.20	0.00	0.00	1

**Ceriodaphnia Partial Life-Cycle Test-7 Day Survival**

Start Date: 16/12/2013 13:30 Test ID: PR1108/02 Sample ID: RP3  
 End Date: 23/12/2013 10:30 Lab ID: 6369 Sample Type: AQ-Aqueous  
 Sample Date: Protocol: ESA 102 Test Species: CD-Ceriodaphnia dubia  
 Comments:

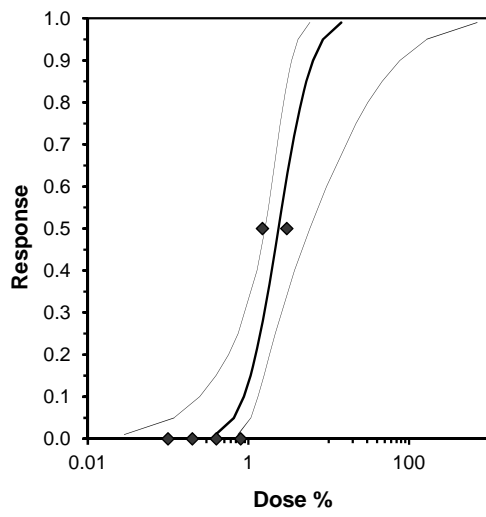
Conc-%	1	2	3	4	5	6	7	8	9	10
DMW Control	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Diluent Control	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1.5	0.0000	1.0000	1.0000	0.0000	0.0000	1.0000	0.0000	1.0000	0.0000	1.0000
3	0.0000	1.0000	0.0000	1.0000	1.0000	0.0000	1.0000	1.0000	0.0000	0.0000

Conc-%	Mean	N-Mean	Resp	Not Resp	Total	N	Fisher's Exact P	1-Tailed Critical	Number Resp	Total Number
DMW Control	1.0000	1.0000	0	10	10	10	0.6238			
Diluent Control	1.0000	1.0000	0	10	10	10	*		0	10
0.1	1.0000	1.0000	0	10	10	10	1.0000	0.0500	0	10
0.2	1.0000	1.0000	0	10	10	10	1.0000	0.0500	0	10
0.4	1.0000	1.0000	0	10	10	10	1.0000	0.0500	0	10
0.8	1.0000	1.0000	0	9	9	9	1.0000	0.0500	0	9
*1.5	0.5000	0.5000	5	5	10	10	0.0163	0.0500	5	10
*3	0.5000	0.5000	5	5	10	10	0.0163	0.0500	5	10

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Fisher's Exact Test	0.8	1.5	1.095445	125
Treatments vs Diluent Control				

Parameter	Value	SE	95% Fiducial Limits	Maximum Likelihood-Probit						
				Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	2.976816	0.971097	1.073466 4.880166	0	3.97566	9.487729	0.41	0.374219	0.335929	7
Intercept	3.88602	0.329684	3.239839 4.532201							
TSCR										

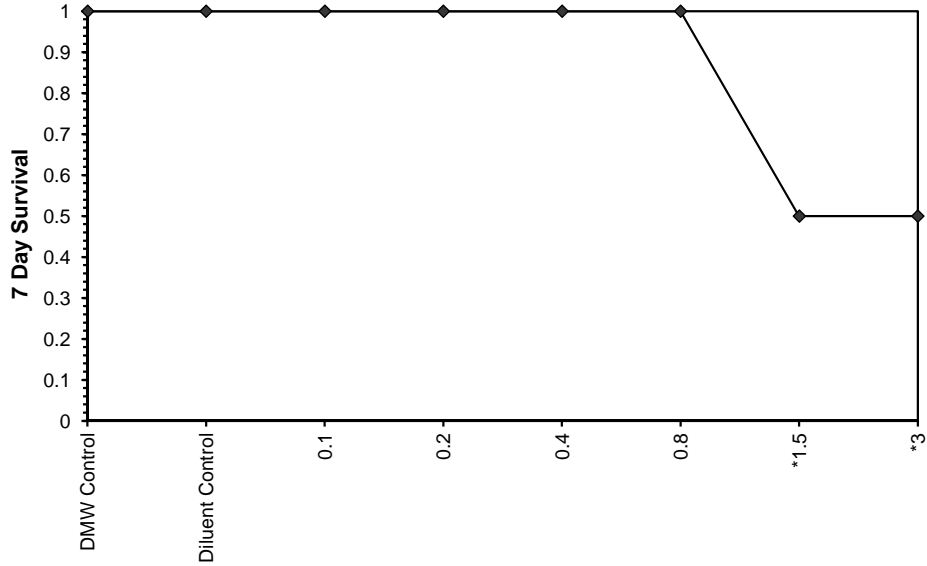
Point	Probits	%	95% Fiducial Limits
EC01	2.674	0.391498	0.028529 0.74125
EC05	3.355	0.66323	0.117986 1.066382
EC10	3.718	0.878431	0.245824 1.324347
EC15	3.964	1.061818	0.394916 1.565639
EC20	4.158	1.234506	0.562604 1.829756
EC25	4.326	1.404875	0.742772 2.146252
EC40	4.747	1.945861	1.280952 3.746453
EC50	5.000	2.367111	1.606831 5.795692
EC60	5.253	2.879555	1.92853 9.370682
EC75	5.674	3.988408	2.491194 21.83772
EC80	5.842	4.53883	2.734199 30.81237
EC85	6.036	5.277	3.036866 46.18792
EC90	6.282	6.37866	3.452778 77.15344
EC95	6.645	8.448377	4.155259 165.8857
EC99	7.326	14.31223	5.827223 703.794



**Ceriodaphnia Partial Life-Cycle Test-7 Day Survival**

Start Date: 16/12/2013 13:30 Test ID: PR1108/02 Sample ID: RP3  
End Date: 23/12/2013 10:30 Lab ID: 6369 Sample Type: AQ-Aqueous  
Sample Date: Protocol: ESA 102 Test Species: CD-Ceriodaphnia dubia  
Comments:

**Dose-Response Plot**



**Ceriodaphnia Partial Life-Cycle Test-7 Day Survival**

Start Date: 16/12/2013 13:30    Test ID: PR1108/02    Sample ID: RP3  
 End Date: 23/12/2013 10:30    Lab ID: 6369    Sample Type: AQ-Aqueous  
 Sample Date:    Protocol: ESA 102    Test Species: CD-Ceriodaphnia dubia  
 Comments:

**Auxiliary Data Summary**

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
DMW Control	No of Young	15.60	9.00	20.00	3.17	11.41	10
Diluent Control		14.50	7.00	19.00	3.50	12.91	10
0.1		14.70	8.00	19.00	3.47	12.66	10
0.2		6.70	1.00	11.00	2.54	23.79	10
0.4		2.90	1.00	5.00	1.20	37.73	10
0.8		1.78	0.00	5.00	1.56	70.33	9
1.5		1.70	0.00	3.00	1.06	60.54	10
3		1.60	0.00	4.00	1.17	67.71	10
DMW Control	% survival	100.00	100.00	100.00	0.00	0.00	10
Diluent Control		100.00	100.00	100.00	0.00	0.00	10
0.1		100.00	100.00	100.00	0.00	0.00	10
0.2		100.00	100.00	100.00	0.00	0.00	10
0.4		100.00	100.00	100.00	0.00	0.00	10
0.8		100.00	100.00	100.00	0.00	0.00	9
1.5		50.00	0.00	100.00	52.70	14.52	10
3		50.00	0.00	100.00	52.70	14.52	10
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
Diluent Control		7.30	7.30	7.30	0.00	0.00	1
0.1		7.20	7.20	7.20	0.00	0.00	1
0.2		7.10	7.10	7.10	0.00	0.00	1
0.4		7.10	7.10	7.10	0.00	0.00	1
0.8		6.90	6.90	6.90	0.00	0.00	1
1.5		6.90	6.90	6.90	0.00	0.00	1
3		6.90	6.90	6.90	0.00	0.00	1
DMW Control	DO %	99.00	99.00	99.00	0.00	0.00	1
Diluent Control		100.90	100.90	100.90	0.00	0.00	1
0.1		100.50	100.50	100.50	0.00	0.00	1
0.2		99.90	99.90	99.90	0.00	0.00	1
0.4		99.70	99.70	99.70	0.00	0.00	1
0.8		99.80	99.80	99.80	0.00	0.00	1
1.5		99.80	99.80	99.80	0.00	0.00	1
3		100.40	100.40	100.40	0.00	0.00	1
DMW Control	Cond uS/cm	179.80	179.80	179.80	0.00	0.00	1
Diluent Control		179.80	179.80	179.80	0.00	0.00	1
0.1		32.90	32.90	32.90	0.00	0.00	1
0.2		37.20	37.20	37.20	0.00	0.00	1
0.4		46.40	46.40	46.40	0.00	0.00	1
0.8		64.40	64.40	64.40	0.00	0.00	1
1.5		100.10	100.10	100.10	0.00	0.00	1
3		170.20	170.20	170.20	0.00	0.00	1

# Appendix B – Chemistry Reports

**CERTIFICATE OF ANALYSIS**

**101665**

**Client:**

**Vista Gold Australia Pty Ltd**  
Mt Todd Mine Site  
Edith Falls Rd  
NT 2067

**Attention:** Austin Brandis

**Sample log in details:**

Your Reference: **PR1108**  
No. of samples: 2 Waters  
Date samples received / completed instructions received 2/12/2013 / 2/12/2013

**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: 9/12/13 / 9/12/13  
Date of Preliminary Report: None Issued  
NATA accreditation number 2901. This document shall not be reproduced except in full.  
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with \*.**

**Results Approved By:**



---

Jacinta Hurst  
Laboratory Manager



HM in water - dissolved			
Our Reference:	UNITS	101665-1	101665-2
Your Reference	-----	SW2	RP3
Date Sampled	-----	25/11/2013	25/11/2013
Type of sample		Water	Water
Date prepared	-	03/12/2013	03/12/2013
Date analysed	-	03/12/2013	03/12/2013
Aluminium-Dissolved	µg/L	<10	<10
Cadmium-Dissolved	µg/L	<0.1	51
Cobalt-Dissolved	µg/L	<1	510
Chromium-Dissolved	µg/L	<1	<1
Copper-Dissolved	µg/L	<1	<1
Iron-Dissolved	µg/L	110	<10
Manganese-Dissolved	µg/L	<5	6,000
Nickel-Dissolved	µg/L	<1	500
Lead-Dissolved	µg/L	<1	<1
Mercury-Dissolved	µg/L	<0.05	<0.05
Zinc-Dissolved	µg/L	1	4,400

Miscellaneous Inorganics			
Our Reference:	UNITS	101665-1	101665-2
Your Reference	-----	SW2	RP3
Date Sampled	-----	25/11/2013	25/11/2013
Type of sample		Water	Water
Date prepared	-	03/12/2013	03/12/2013
Date analysed	-	03/12/2013	03/12/2013
pH	pH Units	6.7	7.6
Dissolved Oxygen*	mg/L	6.2	8.5
Electrical Conductivity	µS/cm	19	2,700
Sulphate, SO4	mg/L	<1	1,900

Cations in water Dissolved			
Our Reference:	UNITS	101665-1	101665-2
Your Reference	-----	SW2	RP3
Date Sampled	-----	25/11/2013	25/11/2013
Type of sample		Water	Water
Date digested	-	03/12/2013	03/12/2013
Date analysed	-	03/12/2013	03/12/2013
Calcium - Dissolved	mg/L	<0.5	480
Magnesium - Dissolved	mg/L	<0.5	210

MethodID	Methodology Summary
Metals-022 ICP-MS	Determination of various metals by ICP-MS.
Metals-021 CV-AAS	Determination of Mercury by Cold Vapour AAS.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 22nd ED, 4500-H+.
Inorg-112	Dissolved Oxygen using membrane electrode. The method is based upon APHA 4500-O G. Note this analysis should ideally be carried out immediately after sampling.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA 22nd ED 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 22nd ED, 4110 -B.
Metals-020 ICP-AES	Determination of various metals by ICP-AES.

Client Reference: PR1108

QUALITY CONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
HM in water - dissolved						Base    Duplicate    %RPD		
Date prepared	-			03/12/2013	101665-1	03/12/2013    03/12/2013	LCS-W1	03/12/2013
Date analysed	-			03/12/2013	101665-1	03/12/2013    03/12/2013	LCS-W1	03/12/2013
Aluminium-Dissolved	µg/L	10	Metals-022 ICP-MS	<10	101665-1	<10    [N/T]	LCS-W1	104%
Cadmium-Dissolved	µg/L	0.1	Metals-022 ICP-MS	<0.1	101665-1	<0.1    [N/T]	LCS-W1	100%
Cobalt-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	101665-1	<1    [N/T]	LCS-W1	94%
Chromium-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	101665-1	<1    [N/T]	LCS-W1	93%
Copper-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	101665-1	<1    [N/T]	LCS-W1	97%
Iron-Dissolved	µg/L	10	Metals-022 ICP-MS	<10	101665-1	110    [N/T]	LCS-W1	100%
Manganese-Dissolved	µg/L	5	Metals-022 ICP-MS	<5	101665-1	<5    [N/T]	LCS-W1	98%
Nickel-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	101665-1	<1    [N/T]	LCS-W1	95%
Lead-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	101665-1	<1    [N/T]	LCS-W1	101%
Mercury-Dissolved	µg/L	0.05	Metals-021 CV-AAS	<0.05	101665-1	<0.05    <0.05	LCS-W1	92%
Zinc-Dissolved	µg/L	1	Metals-022 ICP-MS	<1	101665-1	1    [N/T]	LCS-W1	99%

**Client Reference: PR1108**

QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Miscellaneous Inorganics						Base II Duplicate II %RPD		
Date prepared	-			03/12/2013	[NT]	[NT]	LCS-W1	03/12/2013
Date analysed	-			03/12/2013	[NT]	[NT]	LCS-W1	03/12/2013
pH	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-W1	100%
Dissolved Oxygen*	mg/L	0.1	Inorg-112	<0.1	[NT]	[NT]	LCS-W1	105%
Electrical Conductivity	µS/cm	1	Inorg-002	<1	[NT]	[NT]	[NR]	[NR]
Sulphate, SO4	mg/L	1	Inorg-081	<1	[NT]	[NT]	LCS-W1	117%
QUALITYCONTROL	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results	Spike Sm#	Spike % Recovery
Cations in water Dissolved						Base II Duplicate II %RPD		
Date digested	-			03/12/2013	[NT]	[NT]	LCS-W1	03/12/2013
Date analysed	-			03/12/2013	[NT]	[NT]	LCS-W1	03/12/2013
Calcium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	[NT]	[NT]	LCS-W1	104%
Magnesium - Dissolved	mg/L	0.5	Metals-020 ICP-AES	<0.5	[NT]	[NT]	LCS-W1	105%
QUALITYCONTROL	UNITS	Dup. Sm#		Duplicate Base + Duplicate + %RPD		Spike Sm#	Spike % Recovery	
HM in water - dissolved								
Date prepared	-		[NT]		[NT]	101665-2	03/12/2013	
Date analysed	-		[NT]		[NT]	101665-2	03/12/2013	
Aluminium-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Cadmium-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Cobalt-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Chromium-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Copper-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Iron-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Manganese-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Nickel-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Lead-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	
Mercury-Dissolved	µg/L		[NT]		[NT]	101665-2	96%	
Zinc-Dissolved	µg/L		[NT]		[NT]	[NR]	[NR]	

**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 and 10-140% for SVOC 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.

GHD

Level 5, 66 Smith Street Darwin NT 0800

GPO Box 351 Darwin NT 0801

T: (08) 8982 0100 F: (08) 8981 1075 E: drwmail@ghd.com.au

© GHD 2013

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

G:\43\21801\WP\33474.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J.Woodworth	G.Metcalf	<i>G Metcalfe*</i>	G.Metcalf	<i>G Metcalfe*</i>	24/12/2013
1	J.Woodworth	G.Metcalf	<i>G Metcalfe*</i>	G.Metcalf	<i>G Metcalfe*</i>	06/01/2014



[www.ghd.com](http://www.ghd.com)

