



Vista Gold Australia Pty Ltd

Mt Todd Ecotox 2018

Ecotoxicological Assessment

April 2018

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1. Introduction

1.1 Background

As a requirement of Vista Gold's Waste Discharge Licence (WDL 175-05) for the Mt Todd Project Area (MTPA) and the approved Mt Todd Ecotoxicological Plan 2017 (GHD, 2017) this report presents the results of ecotoxicological assessment of water discharged from the MTPA. Ecotoxicological assessment of treated mine water from the MTPA is conducted to assess the potential impacts of mine water discharged to the Edith River and to meet the following conditions of WDL 175-05:

- Northern Territory (NT) Environmental Protection Authority (EPA) in accordance with Condition 35 of Waste Discharge Licence (WDL) 178-05.

ECOTOXICOLOGY PLAN

35. The licensee must prepare an Ecotoxicology Plan that describes the methods to:

35.1. verify level of species protection at SW4 during a discharge event when mixed with wastewater from RP3 (dilution verification) at least once per discharge season;

35.2 carry out whole effluent direct toxicity assessment of RP3 prior to the 2017/2018 discharge season;

35.3 ensure sampling and analyses are carried out with appropriate quality controls to ensure test water represents the quality of treated wastewater that will be discharged for the season;

35.4. ensure toxicity assessment is carried out using at least two test species that are known to be sensitive to the test waters;

35.5. ensure toxicity assessment is carried out at test water dilutions that span the point of a chronic endpoint response;

35.6. determine the dilution required to protect 80%, 90% and 95% species with 95% confidence using any new data and data produced from previous point estimate test results to populate the species sensitivity distribution, provided each data point can be justified; and to

35.7. ensure chemical analysis is concurrently carried out for the likely key contaminants, including sulfate, aluminium, cadmium, cobalt, copper, nickel, zinc and lead, for each of the toxicity assays.

1.2 Scope of work

To meet the requirements of WDL 178-05 the following work was conducted:

- Review and assessment of ecotoxicity testing results
- Review and assess water chemistry results
- Interpretation of ecotoxicity and chemistry results
- Reporting ecotoxicity to meet the WDL requirements

1.3 Objectives and limitations

This report has been developed to meet the specific requirements of WDL 175-05 as listed above and to comply with the approved Mt Todd Ecotoxicological Plan 2017

1.3.1 Limitations

This report has been prepared by GHD for Vista Gold Australia Pty Ltd (Vista Gold) and may only be used and relied on by Vista Gold, NT EPA and DPIR for the purpose agreed between GHD and Vista Gold as set out in Section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than Vista Gold arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer to Section 1.3). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Vista Gold and others (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.4 Assumptions

In assessment of the ecotoxicological results GHD assumes the following:

All samples collected by Vista Gold are representative of each of the specified sample sites and handled according to specified sample management detailed in the analysis laboratory quotation and sample requirements.

2. Methodology

2.1.1 Collection of samples

Vista Gold collected samples for ecotoxicity and water quality analysis on 20 February 2018, following standard methods for water sampling with all sample containers filled to the top (i.e. no air spaces). Ecotoxicity samples were collected, one treated pit water from Batman Pit for toxicity and chemistry assessment, one Edith River sample at the compliance point (SW4) during discharge for a screening and chemistry assessment, and one sample at the Edith River water upstream site at SW2 for screening and chemistry assessment. All samples were immediately chilled on ice then maintained at 4°C prior to transport to Ecotoxicology Services Australasia (ESA) where the samples were received on 22 February 2018.

2.1.2 Water quality analysis

All water samples for ecotox testing were analysed for the suite of analytes presented in the Ecotoxicological plan in GHD (2017, Table 2.6). Composite samples over a three day period were collected (consecutive days with sample dates 20-22 Feb 2018). Analysis were conducted by a NATA accredited laboratory and sampled according to Australian Standards for water quality sampling:

AS/NZS 5667.1:1998 – Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples

2.1.3 Direct toxicity assessment

Direct toxicity assessment (DTA) is a common method used to determine the toxicity of mixtures of compounds in ambient waters. The method provides an integrated measure of effects and accounts for interactions (synergistic, additive and ameliorative) within a mixture, therefore closely simulating the effects in the receiving waterway. To ensure a close simulation of the toxic effects of the discharge, site-specific testing was undertaken using species indigenous to, or representative of, the receiving ecosystem.

DTA involves exposing laboratory test species to a range of concentrations of sampled water for a specified exposure period. At the end of the exposure period, specific end points are assessed, such as species survival, reproduction or growth. Statistical analysis of the results provides the effect concentration of the discharge where 10% (EC10) and 50% (EC50) of test organisms exhibited an inhibition effect and the no observable effect concentration (NOEC) of the discharge, which represents the highest tested concentration that has no effect on the test organisms (when compared to the results of the control sample). DTA provides a better representation of natural environmental conditions than single chemical testing, and is therefore recommended by ANZECC (2000) for assessing the environmental impact from complex effluents.

DTA was applied for the treated Batman Pit sample using chronic bioassays with the species shown below.

Species used in the DTA program

The following freshwater species and test protocols were used to test the Batman Pit samples:

- 7-day Growth inhibition of the freshwater aquatic duckweed *Lemna aequinoctialis* (based on OECD method 221, 2006)
- 7 day reproductive impairment test using the freshwater cladoceran *Ceriodaphnia dubia* (based on USEPA 2002 and Bailey et al. 2000).

Concentrations tested

All samples were serially diluted with the appropriate diluent to achieve the following concentrations: 0%, 6.3%, 12.5%, 25%, 50% and 100%.

2.1.4 Diluent water

ANZECC (2000) recommends the use of water upstream of the pollutant source as the diluent in DTAs (section 8.3.6.7). However, previous monitoring has shown that upstream water (SW2) may adversely impact on *cladoceran* reproduction at low Batman Pit concentrations when SW2 is used as a diluent. To identify any confounding influence from SW2 the tests were conducted using SW2 water as a diluent together with a test using the laboratory dilution water.

2.1.5 Screening bioassays

Screening bioassays are used to assess the toxicity of natural waterways where the water quality is not expected to show toxicity. The screening bioassays use an undiluted water sample from each site for the assessment. The results of the screening bioassay are compared to an upstream sample and a laboratory control water sample. A result of >80% when compared to controls indicates that the water quality shows no significant toxicity. The screening results can also be used to compare water chemistry and toxicity spatially across a site and temporally if historical results are available. Both the 7 day *Ceriodaphnia dubia* reproduction bioassay (this is the most sensitive species as determined by previous studies) and the 7 day duckweed *Lemna aequinoctialis* growth bioassay were used in the screening bioassays. The organisms were exposed to 100% of SW4 water only (sampled during Batman Pit discharge). The screening bioassays were run concurrently with a laboratory control sample. Toxicity is observed if the difference between the test and the controls is >20%.

2.1.6 Quality assurance

All bioassays listed in Table 5-1 are NATA accredited and, as such, are regulated as to quality assurance. Each bioassay was conducted with a laboratory control (the water in which the organisms are grown), diluent control and a reference toxicant. All bioassays met the laboratory QA parameters.

3. Results and discussion

3.1 Water quality

The water quality results are presented in Table 3-1. Field parameters indicate that the background reference water at SW2 is very soft with a conductivity of only 16 µS/cm. Aluminium and iron concentrations are relatively high at SW2 compared to the remaining metals. Water quality of the treated Batman Pit discharge is characterised by high conductivity and sulfate with elevated concentrations of metals, including cadmium, cobalt, nickel and, particularly, zinc.

Water quality at the compliance point at SW4 contains considerably lower metal concentrations when compared to Batman Pit. The concentrations of metals at SW4 are compliant with the site specific trigger values (SSTVs) listed in WDL 178-05. The only exceedance is for magnesium. However, the screening toxicity tests using cladoceran reproduction and duckweed growth show that there is no toxicity in the sample when compared to laboratory controls.

Based on operating data provided by Vista Gold the current dilution for discharge is within the 1:33 to 1:57 range.

Table 3-1 Summary of water quality results

Analytes	Batman Pit		SW2		SW4		
	This study	long-term median	This study	long-term median	This study	long-term median	SSTV ¹
Physiochemical							
DO (%)	103	94	95	90	94	91	85-120
EC (µS/cm)	2792	2818	16	17	111	83	250
Temperature (°C)	31	32	29	29	29	29	
pH	6.7	7.2	6.4	6.2	6.1	6.2	6.0-8.0
Bicarbonate (mg/L)	18	34	<5	8	11	9	319
Chloride (mg/L)	8	7	<1	1	2	2	64
Magnesium (mg/L)	210	190	0.6	0.6	5.1	3.4	2.5
Sulphate (mg/L)	1800	1800	5	0.5	36	16	129
Total cyanide (mg/L)	NT	0.002	NT	0.002	<0.004	<0.004	7
Dissolved metals (µg/L)							
Aluminium	23	110	14	29	<10	12	150
Arsenic	NT	<1	NT	<1	NT	1	
Cadmium	22	23	<0.1	<0.1	0.4	0.1	0.8
Chromium	<1	<1	<1	<1	<1	<1	
Cobalt	28	83	<1	<1	<1	1	13
Copper	3	9	<1	<1	<1	1	2.5
Iron	<10	5	160	220	68	150	350
Lead	<1	<1	<1	<1	<1	<1	9.4
Manganese	270	700	5	7	27	40	3600
Nickel	150	200	<1	<1	3	2	17
Zinc	1300	480	1	1	30	10	31

¹ Based on WDL 175-05

Orange bold text denotes exceedances of the SSTV

3.2 Ecotoxicology results

The ecotoxicity assessment has been summarized together with the results from the 2015 ecotoxicity study in Tables 3-2 and 3-3. Results from the 2015 DTA (GHD 2015) have been included for comparative purposes. Table 3-4 shows how the bioassay and chemistry results meet the WDL175-05 requirements. The ESA ecotoxicity report is located in Appendix A.

Table 3-2 shows the screening results for SW2 and SW4 for 2015 and 2018. These results show that the SW2 was more toxic in 2018, thus the DTA results using the SW2 as a diluent were confounded and the results using the laboratory diluent show the toxicity of the treated mine water. The 2015 and 2018 screening bioassays conducted on SW4 show that there is no toxicity during the treated mine water discharge.

The DTA results shown in Table 3-3 confirm the confounding factor of using SW2 as the diluent for assessing Batman Pit treated mine water toxicity. The DTA results for SW4 using SW2 diluent show that a dilution factor of 1:7.6 (using SW2 water) will meet the EC10. This dilution factor is below that used by Vista Gold to manage the treated mine water discharge, therefore, the current discharge management regime provides a conservative dilution to protect the receiving ecosystems in the Edith River.

Table 3-2 Edith River screening results % of control

Bioassay	SW2 2015	SW4 2015	SW2 2018	SW4 2018
Ceriodaphnia reproduction	50%	102%	6%	98%
Ceriodaphnia survival	90%	100%	0%	100%
Duckweed growth	Not tested	Not tested	97%	97%

Table 3-3 Batman Pit DTA results (% Batman Pit water)

Bioassay	Diluent	2015 EC10 %	2018 EC10 %	2015 EC50 %	2018 EC50 %
Ceriodaphnia reproduction	SW2	25	13	30	20
Ceriodaphnia reproduction	Lab	-	27	-	37
Ceriodaphnia survival	SW2	>100	NA	>100	NA
Ceriodaphnia survival	Lab	-	33	-	35
Duckweed growth	SW2	11	>50	21	>100
Duckweed growth	Lab	-	53	-	>100

NA = Results confounded by SW2 toxicity

Table 3-4 Ecotoxicology summary to meet WDL175-05

Condition	Requirements	Justification	Results	Discussion
35.1	<p>Screening bioassays at SW4 (during discharge) and SW2 using:</p> <ul style="list-style-type: none"> 7 day <i>Ceriodaphnia dubia</i> reproduction bioassay 4 day <i>Lemna aequinoctialis</i> growth bioassay. 	Meets 35.1 and 35.4	<p>SW4 <i>C. dubia</i> (survival) No effects <i>C. dubia</i> (Reproduction) No effects <i>L. aequinoctialis</i> (Growth) No effects</p> <p>SW2 <i>C. dubia</i> (survival) Significant effects <i>C. dubia</i> (Reproduction) Significant effects <i>L. aequinoctialis</i> (Growth) No effects</p>	<p>Results confirm that no observable impact is occurring at SW4. Confirming that managing the treated discharge to meet the 80% species protection level is appropriate.</p> <p>SW2 has adversely affected the survival and reproduction of <i>C. dubia</i> due to low EC.</p> <p>Results show that both species are appropriate for use in the Plan as the cladoceran shows greater sensitivity to Edith River water.</p>
35.2	<p>Batman Pit – whole effluent serial dilution using:</p> <ul style="list-style-type: none"> 7 day <i>Ceriodaphnia dubia</i> reproduction bioassay 4 day <i>Lemna aequinoctialis</i> growth bioassay. <p>Both tests were conducted with two diluents:</p> <ul style="list-style-type: none"> SW2 (upstream water) Laboratory diluent 	Previous monitoring has shown that SW2 (upstream water) can adversely impact on cladoceran reproduction at low Batman Pit concentrations when used as diluent. Therefore, laboratory diluent is also used.	<p>Laboratory control as diluent <i>C. dubia</i> (survival) EC10 = 53% <i>C. dubia</i> (reproduction) EC10 = 27% <i>L. aequinoctialis</i> (growth) EC10 = 33%</p> <p>SW2 as diluent <i>C. dubia</i> (survival) Invalid EC10 <i>C. dubia</i> (reproduction) invalid EC10 <i>L. aequinoctialis</i> (growth) EC10 = >50%</p>	<p>The lowest EC10 is 27% for the <i>C. dubia</i> reproduction, indicating that a dilution factor of 1:3.7 would protect the receiving environment of any observable chronic impact</p> <p>The low EC at SW2 has affected the results of the <i>C. dubia</i> test using SW2 as diluent. Past results have shown that low conductivity can cause mortality and inhibit reproduction of <i>C. dubia</i>.</p>
35.3	Water quality will be tested to ensure that water tested at Batman Pit is representative of the quality of water discharged.	Ensures that Batman Pit water tested is representative of the quality of water discharged.	Current and historical water quality of Batman Pit is presented in Table 3-1 which includes long-term medians and SSTVs	Water quality of the Batman Pit water used in the bioassays was not statistically different from the historical median (P = 0.8514). Therefore, the sample collected in February 2018 is representative of historical Batman Pit water quality.
35.4	Cladoceran <i>Ceriodaphnia dubia</i> and duckweed <i>Lemna aequinoctialis</i> were used as the bioassays in the ecotoxicity assessment.	Both species have shown to be sensitive to the discharge.	Batman Pit concentrations of 50% and over are toxic for <i>C. dubia</i> Undiluted Batman Pit at 100% is toxic for <i>L. aequinoctialis</i>	Results confirm that <i>C. dubia</i> and <i>L. aequinoctialis</i> are sensitive to the treated mine water discharge at concentrations greater than 1:2 dilution
35.5	Concentrations to be tested for condition 34.2: 100, 50, 25, 12.5, 6.3 and 0% This will apply to both cladoceran and duckweed DTA	To provide an EC10 and EC50 data point for comparison to downstream toxicity	Concentrations have been tested as required. EC10 and EC50 have been calculated for both <i>C. dubia</i> (acute and chronic) and <i>L. aequinoctialis</i> tests	As discussed in condition 35.2
35.6	<p>Data from the cladoceran and duckweed bioassays will be compared against previous data to find significant differences in toxicity in samples with similar water chemistry.</p> <p>The algorithm will be updated if new data is significantly different.</p>	To provide an updated algorithm with the latest validated data, if required	<p>EC10 and water quality of previous investigations has been summarized in Error! Reference source not found. and Table 3-4 .</p> <p>The lowest EC10 in the current ecotoxicity assessment is 27%, which is noticeably less toxic than EC10 data points derived in previous investigations and used in the dilution algorithm (see above in condition 35.2)</p>	The algorithm does not need to be updated. Current algorithm has been derived with lower EC10 data points (more toxic), hence providing of an extra conservative layer than the current data.
35.7	Chemical analysis as per WDL requirements as detailed in Table 2-6 of the Ecotoxicology Plan	To ensure chemical analyses include the most likely key contaminants in the discharge	All chemical analytes detailed in the WDL have been analysed including the key contaminants in the discharge. Results are presented in Table 3-1	Chemistry indicates that the reference site is very low in conductivity and ionic strength. It notes the relatively high aluminium concentration and marginal concentration of remaining metals Batman Pit contains elevated metals, particularly zinc SW4 contains moderate to low metal concentrations, all compliant with the SSTVs (except for magnesium)

This document is in draft form. The contents, including any opinions, conclusions or recommendations contained in, or which may be implied from, this draft document must not be relied upon. GHD reserves the right, at any time, without notice, to modify or retract any part or all of the draft document. To the maximum extent permitted by law, GHD disclaims any responsibility or liability arising from or in connection with this draft document.

4. Conclusions and Recommendations

4.1 Conclusions

The current ecotoxicological investigation has demonstrated that the treated mine water discharged from Batman Pit is not toxic for any of the species tested at a dilution rate of 1:3.7. The current dilution of the treated mine water managed using a considerably higher dilution rate, in the order of 1:33 (as a minimum), based on operating data provided by Vista Gold. This indicates that the current dilution is averting any environmental harm in the receiving waters of Edith River. The chemistry results and the screening tests conducted on the SW4 water during discharge have confirmed the absence of toxicity. Jointly, these results validate the safety of the current dilution rate and treated mine water management for the protection of the receiving environment.

The current investigation suggests that the low conductivity observed at the upstream site (SW2), is affecting the results of the cladoceran test. This species has been reported to be sensitive to low conductivity. This is confirmed with current results showing no observed effects in cladoceran survival or reproduction when reference water was diluted with 6.5% of discharge effluent and conductivity raised above 100 $\mu\text{S}/\text{cm}$.

The comparison with historic toxicity results confirms the decreasing trend in both the metal concentrations and the toxicity of the discharge effluent, indicating that the current treatment of the mine water is successfully reducing the metal concentrations and its toxicity.

Magnesium is the only chemical element that has exceeded the SSTV in the discharge point water. This exceedance is not associated with any risk of detrimental effects in the receiving environment as has been validated by the absence of toxicity in the receiving water at SW4.

In conclusion, the ecotoxicological assessment, undertaken according to the WDL 175-05 requirements and the approved Ecotoxicological Plan, has shown that discharge of treated mine water from Batman Pit at the current conservative estimation of dilution rate of 1:33 does not pose any risk for the aquatic communities living in Edith River downstream the discharge point.

4.2 Recommendations

It is recommended to remove DTA from the ecotoxicology monitoring program. Future ecotoxicity assessments should be conducted using screening bioassays (cladoceran and duckweed) only for SW4 during treated mine water discharge. This will provide information on the potential impacts to the Edith River from the discharge of the mine water

It is recommended to review the SSTV of the magnesium to reflect more realistically the potential concentration that might be harmful for the environment.

5. References

GHD (2013). Vista Gold Australia Pty Ltd. Mt Todd Discharge Treated Retention Pond 3 Ecotoxicological Report. Report 43/21801/35. 22pp

GHD (2015) Mt Todd Waste Discharge Licence Algorithm Validation Report. Report 43/22187 April 2015. 121pp.

GHD (2017) Vista Gold Australia Pty Ltd. Mt Todd Ecotoxicological Plan. Report 43/22187.35pp.

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Appendices

Appendix A –Ecotoxicology assessment results

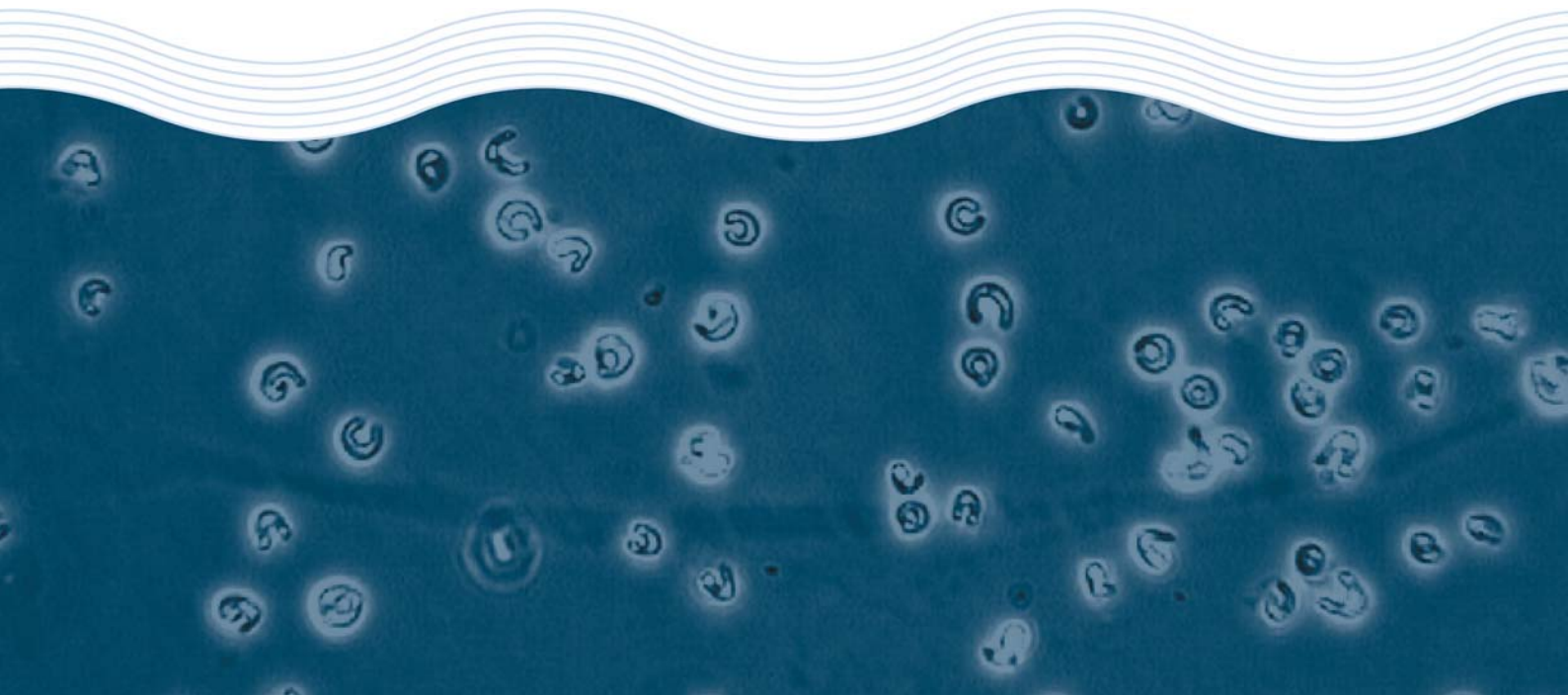
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Ecotoxicity Testing of Kirkland Lake Gold Discharge Samples

GHD

Test Report

March 2018



Toxicity Test Report: TR1543/1

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Accredited for compliance with ISO/IEC 17025

Client:	GHD Pty Ltd Level 2, 102 Cameron Street Launceston Tas 7250	ESA Job #:	PR1543
Attention:	Jill Woodworth	Date Sampled:	20 February 2018
Client Ref:	Not applicable	Date Received:	22 February 2018
		Sampled By:	Client
		ESA Quote #:	PR1543 01

Lab ID No.:	Sample Name:	Sample Description:
8528	SW4	Aqueous sample, pH 7.0, conductivity 103µS/cm, total ammonia <2.0mg/L. Sample received at 11 °C in apparent good condition.
8529	SW2	Aqueous sample, pH 7.4, conductivity 24 µS/cm, total ammonia <2.0 mg/L. Sample received at 11 °C in apparent good condition.
8530	RP3	Aqueous sample, pH 7.6, conductivity 2810 µS/cm, total ammonia <2.0mg/L. Sample received at 11°C in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	Partial life-cycle toxicity test using the freshwater cladoceran <i>Ceriodaphnia cf dubia</i>
Test Protocol:	ESA SOP 102 (ESA 2016), based on USEPA (2002) and Bailey <i>et al.</i> (2000)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	Sample SW4 (Lab ID 8528) and sample SW2 (Lab ID 8529) were tested at 100%. Sample RP3 (lab ID 8530) was serially diluted with Dilute Mineral Water (DMW) and with SW2 (Lab ID 8529) to achieve the test concentrations. A DMW control was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	23 February 2018 at 1800h

Sample SW4 (Lab ID 8528) and SW2 (Lab ID 8529)		Sample SW4 (Lab ID 8528) and SW2 (Lab ID 8529)	
Concentration (%)	% Unaffected at 7 days (Mean ± SD)	Concentration (%)	Number of Young (Mean ± SD)
DMW Control	100 ± 0.0	DMW Control	16.0 ± 1.5
SW4	100 ± 0.0	SW4	15.6 ± 2.6
SW2	0.0 ± 0.0	SW2	1.0 ± 0.9 *

*Significantly lower number of young compared with the DMW Control (Homoscedastic t-test, 1-tailed, P=0.05)

Toxicity Test Report: TR1543/1

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Sample RP3 (Lab ID 8530) diluted with DMW media:		Sample RP3 (Lab ID 8530) diluted with DMW media:	
Concentration (%)	% Unaffected at 7 days (Mean ± SD)	Concentration (%)	Number of Young (Mean ± SD)
DMW Control	100 ± 0.0	DMW Control	16.0 ± 1.5
6.3	100 ± 0.0	6.3	16.4 ± 1.2
12.5	100 ± 0.0	12.5	15.6 ± 2.2
25	100 ± 0.0	25	15.8 ± 1.2
50	0.0 ± 0.0	50	0.0 ± 0.0
100	0.0 ± 0.0	100	0.0 ± 0.0
7 day IC10 (unaffected) = 32.6%*		7 day IC10 (reproduction) = 26.8 (25.40-27.50)%	
7 day EC50 (unaffected) = 35.4 (25-50)%		7 day IC50 (reproduction) = 37.1 (36.33-37.50)%	
NOEC = 25%		NOEC = 25%	
LOEC = 50%		LOEC = 50%	

*95% Confidence limits not available

Sample RP3 (Lab ID 8530) diluted with sample SW2 (Lab ID 8529):		Sample RP3 (Lab ID 8530) diluted with sample SW2 (Lab ID 8529):	
Concentration (%)	% Unaffected at 7 days (Mean ± SD)	Concentration (%)	Number of Young (Mean ± SD)
DMW Control	100 ± 0.0	DMW Control	16.0 ± 1.5
SW2	0.0 ± 0.0	SW2	1.0 ± 0.9 **
6.3	100 ± 0.0	6.3	16.6 ± 1.2
12.5	100 ± 0.0	12.5	14.9 ± 1.0
25	30.0 ± 48.3	25	1.7 ± 1.7 **
50	0.0 ± 0.0	50	0.0 ± 0.0
7 day EC10 (unaffected) = %*		7 day IC10 (reproduction) = 12.7 (10.53-13.43)%	
7 day EC50 (unaffected) = %*		7 day IC50 (reproduction) = 19.9 (19.12-20.72)%	
NOEC = %*		NOEC = 25%	
LOEC = %*		LOEC = 50%	

*Endpoints not available due to the total mortality observed in the SW2 sample (Lab ID 8529)

**Significantly lower number of young compared with the DMW Control (homoscedastic t-test, 1-tailed, P=0.05)

QA/QC Parameter	Criterion	This Test	Criterion met?
Control mean % unaffected	≥80.0%	100%	Yes
Control mean number of young per surviving adult	≥15.0	16.0	Yes
Reference Toxicant within cusum chart limits	188.3-245.8 mgKCl/L	224.5 mgKCl/L	Yes



Toxicity Test Report: TR1543/1

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Test Report Authorised by:

Dr Rick Krassoi, Director on 4 April 2018

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

NATA Accredited Laboratory Number: 14709

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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 (2016) ESA SOP 102 – *Acute Toxicity Test Using Ceriodaphnia dubia*. Issue No 11. Ecotox Services Australasia, Sydney, NSW.

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

Toxicity Test Report: TR1543/1

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Performed in compliance with ISO/IEC 17025

Client:	GHD Pty Ltd Level 2, 102 Cameron Street Launceston Tas 7250	ESA Job #:	PR1543
Attention:	Jill Woodworth	Date Sampled:	20 February 2018
Client Ref:	Not applicable	Date Received:	22 February 2018
		Sampled By:	Client
		ESA Quote #:	PR1543_01

Lab ID No.:	Sample Name:	Sample Description:
8528	SW4	Aqueous sample, pH 7.0, conductivity 103µS/cm, total ammonia <2.0mg/L. Sample received at 11 °C in apparent good condition.
8529	SW2	Aqueous sample, pH 7.4, conductivity 24 µS/cm, total ammonia <2.0 mg/L. Sample received at 11 °C in apparent good condition.
8530	RP3	Aqueous sample, pH 7.6, conductivity 2810 µS/cm, total ammonia <2.0mg/L. Sample received at 11°C in apparent good condition.

Test Performed:	96-hr Growth inhibition of the freshwater aquatic duckweed <i>Lemna aequinoctialis</i>
Test Protocol:	ESA SOP 112 (ESA 2016), based on ASTM (2012)
Test Temperature:	The test was performed at 29±2°C.
Deviations from Protocol:	Test volume reduced from 100ml to 15ml; Fronds per replicate reduced from 12-16 to 6; Replicates per treatment increased from 3 to 4.
Comments on Solution Preparation:	Sample SW4 (Lab ID 8528) and sample SW2 (Lab ID 8529) were tested at 100%. Sample RP3 (lab ID 8530) was serially diluted with CAAC media and with SW2 (Lab ID 8529) to achieve the test concentrations. A CAAC control was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	23 February 2018 at 1900h

Sample SW4 (Lab ID 8528) and SW2 (Lab ID 8529)		Sample RP3 (Lab ID 8530) diluted with CAAC media:		Sample RP3 (Lab ID 8530) diluted with sample SW2 (Lab ID 8529):	
Concentration (%)	Specific Growth Rate (Mean ± SD)	Concentration (%)	Specific Growth Rate (Mean ± SD)	Concentration (%)	Specific Growth Rate (Mean ± SD)
CAAC Control	0.34 ± 0.02	CAAC Control	0.34 ± 0.02	SW2	0.33 ± 0.01
SW4	0.33 ± 0.02	6.3	0.31 ± 0.03	6.3	0.31 ± 0.02
SW2	0.33 ± 0.01	12.5	0.31 ± 0.03	12.5	0.32 ± 0.02
		25	0.33 ± 0.03	25	0.31 ± 0.02
		50	0.31 ± 0.03	50	0.34 ± 0.05
		100	0.17 ± 0.06 *		
		96-hr IC10 = 52.5%**		96-hr IC10 = >50%	
		96-hr IC50 = >100%		96-hr IC50 = >50%	
		NOEC = 50%		NOEC = 50%	
		LOEC = 100%		LOEC = >50%	

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

**95% Confidence Limits not reliable

Toxicity Test Report: TR1543/1

(Page 2 of 2)

QA/QC Parameter	Criterion	This Test	Criterion met?
Control Specific Growth rate	>0.231	0.34	Yes
Reference Toxicant within cusum chart limits	5.51-59.3mg Mg/L	14.9mg Mg/L	Yes

Test Report Authorised by:



Dr Rick Krasso, Director on 4 April 2018

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

Citations:

ESA (2016) *SOP 112 – Duckweed Growth Inhibition Test*. Issue No. 7. 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



Chain-of-Custody Documentation

Sample Receipt Notification

Attention : Jill Woodworth

Client : GHD Pty Ltd
Level 2, 102 Cameron Street
Launceston TAS 7250

Email : jill.woodworth@ghd.com
Telephone : (03) 6332 5532
Facsimile :

Date : 23/02/2018

Re : Receipt of Samples

Pages : 4

ESA Project : PR1543

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 : 22/02/2018

Time samples received : 10:30

No. of samples received : 3

Sample matrix : Aqueous

Sample temperature : 11-15°C

Comments : Samples received in apparent good condition

Contact Details

Director: Rick Krassoi
Telephone : 61 2 9420 9481
Facsimile : 61 2 9420 9484
Email : rkrassoi@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 95 619 426 201
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: 15 July 2014

Customer: Vista Gold GHD Ship To: Ecotox Services Australasia
 Contact Name: Jill Woodward Attention:
 Phone: 08 8982 0127 Email: jill.woodward@ghd.com (please provide an email address for sample receipt notification)
 Sampled by: Robbie Friel, John Nakata

Sample Date <small>(day/month/year)</small>	Sample Time	Sample Name <small>(exactly as written on the sample vessel)</small>	Sample Method <small>(eg. Grab, composite etc.)</small>	Number and Volume of Containers <small>(eg 2 x 1L)</small>	Tests Requested <small>(See reverse for guidance)</small>						Comments / Instructions
					Chronic Cerio Screening	Duckweed La Screening	Chronic Cerio (Lab Diluent)	Chronic Cerio (SW2 Diluent)	Duckweed La (Lab Diluent)	Duckweed La (SW2 Diluent)	
											Note that testing will be delayed if an incomplete chain of custody is received <ul style="list-style-type: none"> 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 <u>1543</u>
8528	20/2/18 09:37	SW4	Grab	1 x 5L	X	X					
8524	20/2/18 08:55	SW2	Grab	1 x 5L	X	X					
8530	20/2/18 11:00	RP3	Grab	2 x 5L			X	X	X	X	

1) Released By: <u>Vista Gold</u> Date: <u>21/2/18</u>	2) Received By: <u>[Signature]</u> Date: <u>22/2/18</u>	3) Released By:	Date:	4) Received By:	Date:
Of: <u>[Signature]</u> Time: <u>11:00am</u>	Of: <u>ESA</u> Time: <u>10:30</u>	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 3-
brood Partial Life Cycle Test with
*Ceriodaphnia dubia***

Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date: 23/02/2018 18:00	Test ID: PR1543/02	Sample ID: SW4, SW2
End Date: 2/03/2018 18:00	Lab ID: 8528,29	Sample Type: AQ-Aqueous
Sample Date:	Protocol: ESA 102	Test Species: CD-Ceriodaphnia dubia

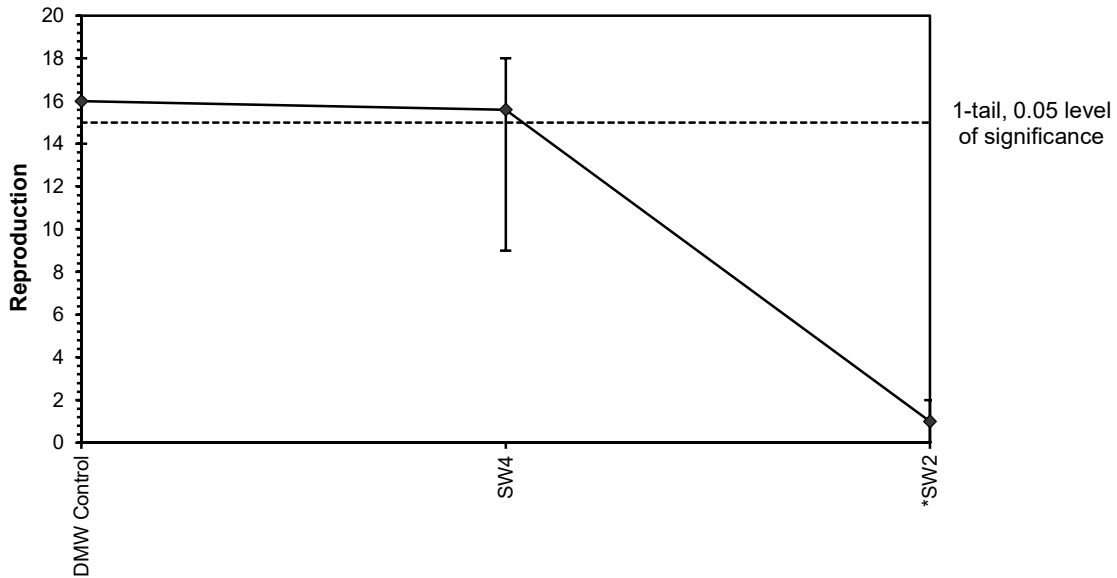
Comments:

Conc-%	1	2	3	4	5	6	7	8	9	10
DMW Control	17.000	14.000	15.000	16.000	18.000	17.000	14.000	18.000	15.000	16.000
SW4	16.000	17.000	16.000	9.000	17.000	18.000	16.000	14.000	16.000	17.000
SW2	1.000	2.000	2.000	1.000	2.000	0.000	0.000	0.000	2.000	0.000

Conc-%	Mean	N-Mean	Transform: Untransformed					t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%	N			
DMW Control	16.000	1.0000	16.000	14.000	18.000	9.317	10			
SW4	15.600	0.9750	15.600	9.000	18.000	16.329	10	0.429	1.734	1.618
*SW2	1.000	0.0625	1.000	0.000	2.000	94.281	10	26.893	1.734	0.967

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.05)	0.844021	0.927	-1.93462	6.339251		
Bartlett's Test indicates equal variances (p = 0.02)	8.050188	9.21034				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Homoscedastic t Test indicates significant differences	0.967214	0.060451	730.5333	3.2	1.2E-17	2, 27
Treatments vs DMW Control						

Dose-Response Plot



Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date: 23/02/2018 18:00 Test ID: PR1543/02 Sample ID: SW4, SW2
End Date: 2/03/2018 18:00 Lab ID: 8528,29 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	16.00	14.00	18.00	1.49	7.63	10
SW4		15.60	9.00	18.00	2.55	10.23	10
SW2		1.00	0.00	2.00	0.94	97.10	10
DMW Control	% unaffected	100.00	100.00	100.00	0.00	0.00	10
SW4		100.00	100.00	100.00	0.00	0.00	10
SW2		0.00	0.00	0.00	0.00	0.00	10
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
SW4		7.00	7.00	7.00	0.00	0.00	1
SW2		7.40	7.40	7.40	0.00	0.00	1
DMW Control	DO %	100.40	100.40	100.40	0.00	0.00	1
SW4		99.60	99.60	99.60	0.00	0.00	1
SW2		101.20	101.20	101.20	0.00	0.00	1
DMW Control	Cond uS/cm	184.00	184.00	184.00	0.00	0.00	1
SW4		103.00	103.00	103.00	0.00	0.00	1
SW2		24.00	24.00	24.00	0.00	0.00	1

Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date:	23/02/2018 18:00	Test ID:	PR1543/04	Sample ID:	RP3 (SW2)
End Date:	2/03/2018 18:00	Lab ID:	8530 (SW2)	Sample Type:	AQ-Aqueous
Sample Date:		Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia

Comments:

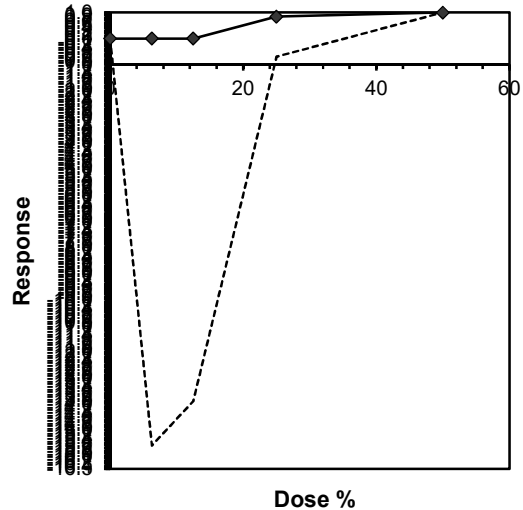
Conc-%	1	2	3	4	5	6	7	8	9	10
DMW Control	17.000	14.000	15.000	16.000	18.000	17.000	14.000	18.000	15.000	16.000
SW2	1.000	2.000	2.000	1.000	2.000	0.000	0.000	0.000	2.000	0.000
6.3	17.000	14.000	18.000	16.000	16.000	18.000	17.000	16.000	17.000	
12.5	16.000	16.000	14.000	16.000	14.000	16.000	15.000	14.000	14.000	14.000
25	0.000	1.000	2.000	0.000	4.000	3.000	0.000	3.000	4.000	0.000
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Conc-%	Transform: Untransformed							t-Stat	1-Tailed Critical	MSD	Isotonic	
	Mean	N-Mean	Mean	Min	Max	CV%	N				Mean	N-Mean
DMW Control	16.000	16.0000	16.000	14.000	18.000	9.317	10					
SW2	1.000	1.0000	1.000	0.000	2.000	94.281	10	*			10.819	1.0000
6.3	16.556	16.5556	16.556	14.000	18.000	7.466	9	-26.953	2.215	1.279	10.819	1.0000
12.5	14.900	14.9000	14.900	14.000	16.000	6.674	10	-24.744	2.215	1.244	10.819	1.0000
25	1.700	1.7000	1.700	0.000	4.000	100.173	10	-1.246	2.215	1.244	1.700	0.1571
50	0.000	0.0000	0.000	0.000	0.000	0.000	10				0.000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.947652	0.939	-0.0075	-0.85539
Bartlett's Test indicates equal variances (p = 0.27)	3.959246	11.34487		
The control means are significantly different (p = 5.51E-16)	26.89264	2.100922		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	25	50	35.35534	4	1.244485	1.244485	672.4815	1.577778	1.3E-27	3, 35
Treatments vs SW2										

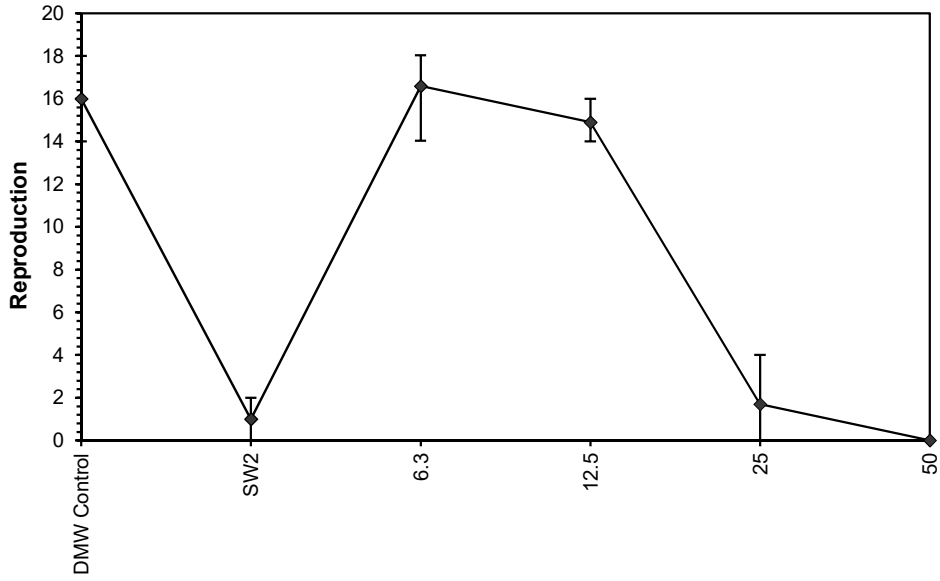
Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL		Skew
IC05	13.242	0.043	13.162	13.322	0.0927
IC10	13.983	0.087	13.824	14.143	0.0927
IC15	14.725	0.130	14.487	14.965	0.0927
IC20	15.466	0.173	15.149	15.787	0.0927
IC25	16.208	0.217	15.811	16.609	0.0927
IC40	18.432	0.347	17.798	19.074	0.0927
IC50	19.915	0.434	19.122	20.717	0.0927



Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date: 23/02/2018 18:00 Test ID: PR1543/04 Sample ID: RP3 (SW2)
End Date: 2/03/2018 18:00 Lab ID: 8530 (SW2) 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:	23/02/2018 18:00	Test ID:	PR1543/04	Sample ID:	RP3 (SW2)
End Date:	2/03/2018 18:00	Lab ID:	8530 (SW2)	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	16.00	14.00	18.00	1.49	7.63	10
SW2		1.00	0.00	2.00	0.94	97.10	10
6.3		16.56	14.00	18.00	1.24	6.72	9
12.5		14.90	14.00	16.00	0.99	6.69	10
25		1.70	0.00	4.00	1.70	76.76	10
50		0.00	0.00	0.00	0.00		10
DMW Control	% unaffected	100.00	100.00	100.00	0.00	0.00	10
SW2		0.00	0.00	0.00	0.00		10
6.3		100.00	100.00	100.00	0.00	0.00	10
12.5		100.00	100.00	100.00	0.00	0.00	10
25		30.00	0.00	100.00	48.30	23.17	10
50		0.00	0.00	0.00	0.00		10
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
SW2		7.40	7.40	7.40	0.00	0.00	1
6.3		6.90	6.90	6.90	0.00	0.00	1
12.5		6.90	6.90	6.90	0.00	0.00	1
25		7.00	7.00	7.00	0.00	0.00	1
50		7.30	7.30	7.30	0.00	0.00	1
DMW Control	DO %	100.40	100.40	100.40	0.00	0.00	1
SW2		101.20	101.20	101.20	0.00	0.00	1
6.3		98.90	98.90	98.90	0.00	0.00	1
12.5		97.60	97.60	97.60	0.00	0.00	1
25		99.50	99.50	99.50	0.00	0.00	1
50		98.90	98.90	98.90	0.00	0.00	1
DMW Control	Cond uS/cm	184.00	184.00	184.00	0.00	0.00	1
SW2		24.00	24.00	24.00	0.00	0.00	1
6.3		282.00	282.00	282.00	0.00	0.00	1
12.5		437.00	437.00	437.00	0.00	0.00	1
25		900.00	900.00	900.00	0.00	0.00	1
50		1586.00	1586.00	1586.00	0.00	0.00	1

Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date: 23/02/2018 18:00	Test ID: PR1543/03	Sample ID: RP3 (DMW)
End Date: 2/03/2018 18:00	Lab ID: 8530 (DMW)	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	17.000	14.000	15.000	16.000	18.000	17.000	14.000	18.000	15.000	16.000
6.3	17.000	17.000	16.000	17.000	14.000	17.000	17.000	16.000	18.000	15.000
12.5	18.000	14.000	14.000	18.000	14.000	18.000	15.000	12.000	16.000	17.000
25	18.000	14.000	16.000	15.000	15.000	16.000	16.000	15.000	17.000	
50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

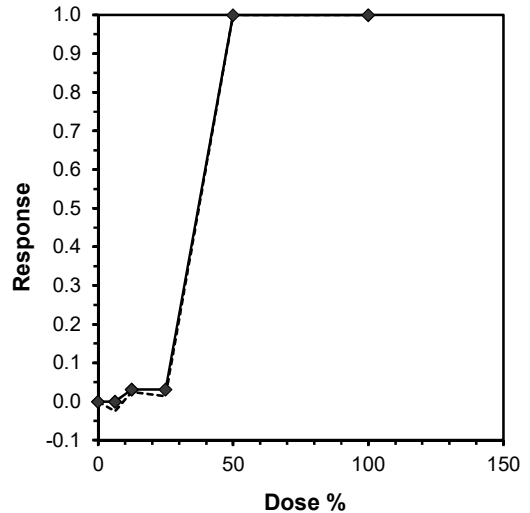
Conc-%	Mean	N-Mean	Transform: Untransformed					t-Stat	1-Tailed Critical	MSD	Isotonic	
			Mean	Min	Max	CV%	N				Mean	N-Mean
DMW Control	16.000	1.0000	16.000	14.000	18.000	9.317	10				16.200	1.0000
6.3	16.400	1.0250	16.400	14.000	18.000	7.157	10	-0.576	2.215	1.538	16.200	1.0000
12.5	15.600	0.9750	15.600	12.000	18.000	13.581	10	0.576	2.215	1.538	15.689	0.9684
25	15.778	0.9861	15.778	14.000	18.000	7.617	9	0.312	2.215	1.580	15.689	0.9684
50	0.000	0.0000	0.000	0.000	0.000	0.000	10				0.000	0.0000
100	0.000	0.0000	0.000	0.000	0.000	0.000	10				0.000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.967966	0.939	-0.17274	-0.49327
Bartlett's Test indicates equal variances (p = 0.25)	4.067931	11.34487		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Bonferroni t Test	25	50	35.35534	4	1.580266	0.098767	1.180627	2.410159	0.691579	3, 35
Treatments vs DMW Control										

Linear Interpolation (200 Resamples)

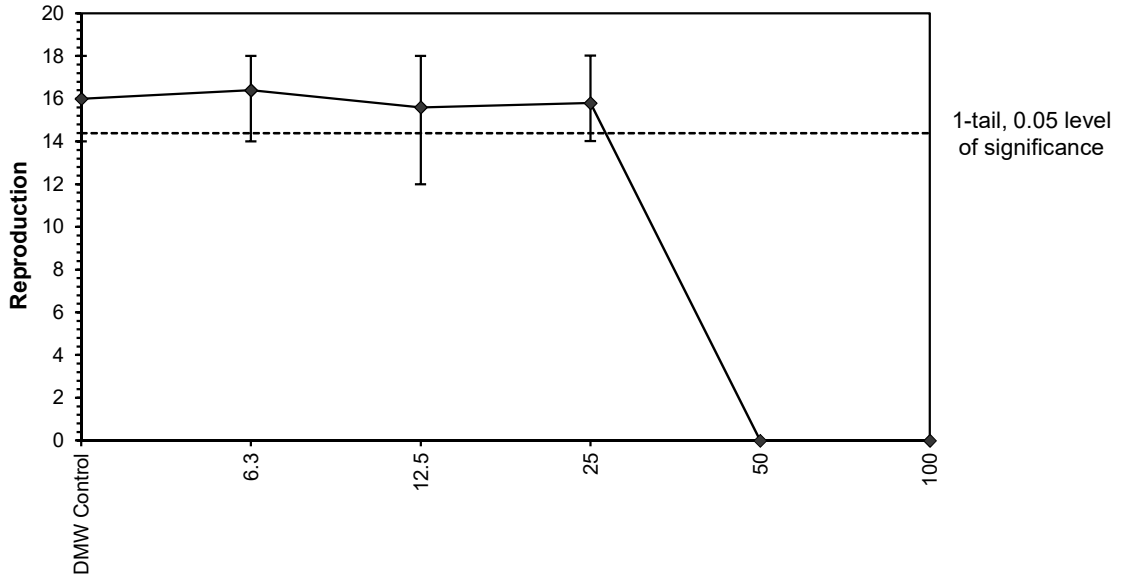
Point	%	SD	95% CL		Skew
IC05	25.476	6.412	9.192	26.250	-1.0690
IC10	26.767	1.610	25.402	27.500	-8.1704
IC15	28.058	0.567	26.768	28.750	-0.4546
IC20	29.348	0.534	28.135	30.000	-0.4546
IC25	30.639	0.500	29.501	31.250	-0.4546
IC40	34.511	0.400	33.601	35.000	-0.4546
IC50	37.093	0.333	36.334	37.500	-0.4546



Ceriodaphnia Partial Life-Cycle Test-Reproduction

Start Date: 23/02/2018 18:00 Test ID: PR1543/03 Sample ID: RP3 (DMW)
End Date: 2/03/2018 18:00 Lab ID: 8530 (DMW) 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: 23/02/2018 18:00	Test ID: PR1543/03	Sample ID: RP3 (DMW)
End Date: 2/03/2018 18:00	Lab ID: 8530 (DMW)	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	16.00	14.00	18.00	1.49	7.63	10
6.3		16.40	14.00	18.00	1.17	6.61	10
12.5		15.60	12.00	18.00	2.12	9.33	10
25		14.20	0.00	18.00	5.12	15.93	10
50		0.00	0.00	0.00	0.00		10
100		0.00	0.00	0.00	0.00		10
DMW Control	% unaffected	100.00	100.00	100.00	0.00	0.00	10
6.3		100.00	100.00	100.00	0.00	0.00	10
12.5		100.00	100.00	100.00	0.00	0.00	10
25		100.00	100.00	100.00	0.00	0.00	10
50		0.00	0.00	0.00	0.00		10
100		0.00	0.00	0.00	0.00		10
DMW Control	pH	8.10	8.10	8.10	0.00	0.00	1
6.3		8.10	8.10	8.10	0.00	0.00	1
12.5		8.10	8.10	8.10	0.00	0.00	1
25		8.00	8.00	8.00	0.00	0.00	1
50		7.90	7.90	7.90	0.00	0.00	1
100		7.60	7.60	7.60	0.00	0.00	1
DMW Control	DO %	100.40	100.40	100.40	0.00	0.00	1
6.3		99.90	99.90	99.90	0.00	0.00	1
12.5		98.70	98.70	98.70	0.00	0.00	1
25		96.90	96.90	96.90	0.00	0.00	1
50		98.50	98.50	98.50	0.00	0.00	1
100		99.90	99.90	99.90	0.00	0.00	1
DMW Control	Cond uS/cm	184.00	184.00	184.00	0.00	0.00	1
6.3		412.00	412.00	412.00	0.00	0.00	1
12.5		426.00	426.00	426.00	0.00	0.00	1
25		627.00	627.00	627.00	0.00	0.00	1
50		1676.00	1676.00	1676.00	0.00	0.00	1
100		2800.00	2800.00	2800.00	0.00	0.00	1

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

Duckweed Growth Inhibition Test-Specific Growth Rate

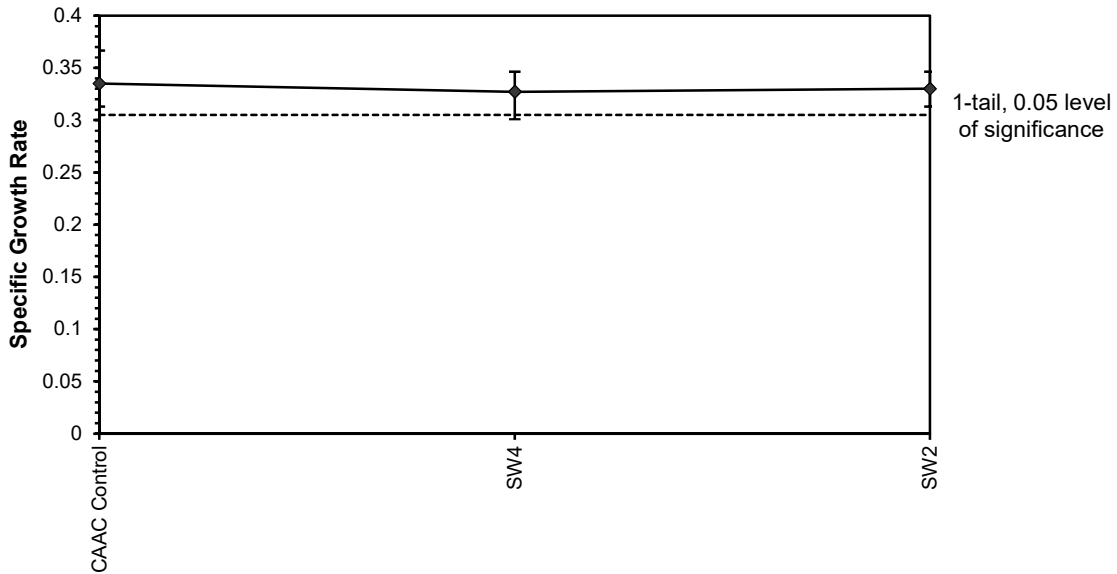
Start Date: 23/02/2018 19:00	Test ID: PR1543/02	Sample ID: SW4,SW2
End Date: 27/02/2018 19:00	Lab ID: 8528,29	Sample Type: AQ-Aqueous
Sample Date:	Protocol: ESA 112	Test Species: LA-Lemna aequinoctialis

Conc-%	1	2	3	4
CAAC Control	0.3132	0.3359	0.3666	0.3248
SW4	0.3248	0.3359	0.3010	0.3466
SW2	0.3248	0.3132	0.3466	0.3359

Conc-%	Mean	N-Mean	Transform: Untransformed				N	t-Stat	1-Tailed Critical	MSD
			Mean	Min	Max	CV%				
CAAC Control	0.3351	1.0000	0.3351	0.3132	0.3666	6.843	4			
SW4	0.3271	0.9760	0.3271	0.3010	0.3466	5.970	4	0.591	2.180	0.0297
SW2	0.3301	0.9851	0.3301	0.3132	0.3466	4.352	4	0.367	2.180	0.0297

Auxiliary Tests	Statistic	Critical	Skew	Kurt		
Shapiro-Wilk's Test indicates normal distribution ($p > 0.05$)	0.981799	0.859	0.194195	-0.62919		
Bartlett's Test indicates equal variances ($p = 0.76$)	0.553132	9.21034				
Hypothesis Test (1-tail, 0.05)	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test indicates no significant differences Treatments vs CAAC Control	0.029699	0.08862	6.61E-05	0.000371	0.839747	2, 9

Dose-Response Plot



Duckweed Growth Inhibition Test-Specific Growth Rate

Start Date: 23/02/2018 19:00 Test ID: PR1543/02 Sample ID: SW4,SW2
End Date: 27/02/2018 19:00 Lab ID: 8528,29 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	0.34	0.31	0.37	0.02	45.19	4
SW4		0.33	0.30	0.35	0.02	42.72	4
SW2		0.33	0.31	0.35	0.01	36.31	4
CAAC Control	pH	6.10	6.10	6.10	0.00	0.00	1
SW4		7.00	7.00	7.00	0.00	0.00	1
SW2		7.40	7.40	7.40	0.00	0.00	1
CAAC Control	Cond uS/cm	39.00	39.00	39.00	0.00	0.00	1
SW4		102.00	102.00	102.00	0.00	0.00	1
SW2		24.00	24.00	24.00	0.00	0.00	1

Duckweed Growth Inhibition Test-Specific Growth Rate

Start Date: 23/02/2018 19:00	Test ID: PR1543/03	Sample ID: RP3(CAAC))
End Date: 27/02/2018 19:00	Lab ID: 8530 (CAAC)	Sample Type: AQ-Aqueous
Sample Date:	Protocol: ESA 112	Test Species: LA-Lemna aequinoctialis

Conc-%	1	2	3	4
CAAC Control	0.3132	0.3359	0.3666	0.3248
6.3	0.2882	0.3466	0.3010	0.3132
12.5	0.3248	0.2747	0.3359	0.2882
25	0.3248	0.3666	0.3010	0.3359
50	0.2747	0.3248	0.2882	0.3466
100	0.1014	0.1515	0.2452	0.1733

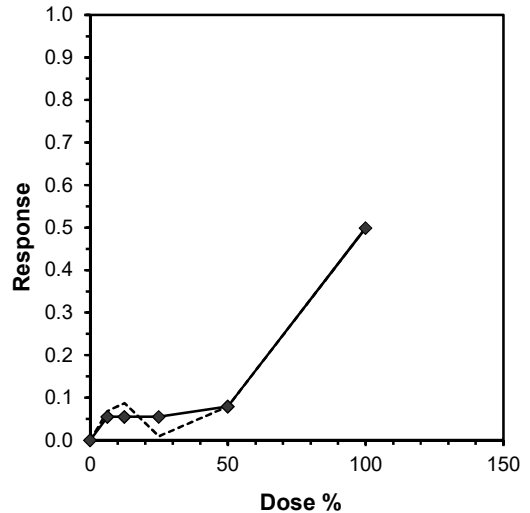
Conc-%	Transform: Untransformed							t-Stat	1-Tailed Critical	MSD	Isotonic	
	Mean	N-Mean	Mean	Min	Max	CV%	N				Mean	N-Mean
CAAC Control	0.3351	1.0000	0.3351	0.3132	0.3666	6.843	4				0.3351	1.0000
6.3	0.3122	0.9317	0.3122	0.2882	0.3466	8.029	4	0.922	2.410	0.0599	0.3167	0.9451
12.5	0.3059	0.9128	0.3059	0.2747	0.3359	9.532	4	1.177	2.410	0.0599	0.3167	0.9451
25	0.3321	0.9909	0.3321	0.3010	0.3666	8.200	4	0.123	2.410	0.0599	0.3167	0.9451
50	0.3086	0.9207	0.3086	0.2747	0.3466	10.708	4	1.070	2.410	0.0599	0.3086	0.9207
*100	0.1678	0.5008	0.1678	0.1014	0.2452	35.581	4	6.734	2.410	0.0599	0.1678	0.5008

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.05)	0.970569	0.916	0.363251	0.583562
Bartlett's Test indicates equal variances (p = 0.56)	3.90661	15.08627		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	50	100	70.71068	2	0.059865	0.178631	0.015793	0.001234	2.1E-05	5, 18

Linear Interpolation (200 Resamples)					
Point	%	SD	95% CL(Exp)	Skew	
IC05*	5.739	20.445	0.899	82.410	0.3947
IC10	52.464	14.553	0.000	64.462	-1.7543
IC15	58.419	6.564	31.670	71.203	-2.4996
IC20	64.373	5.104	47.513	78.781	0.0500
IC25	70.328	5.508	55.689	88.852	0.4906
IC40	88.191				
IC50	>100				

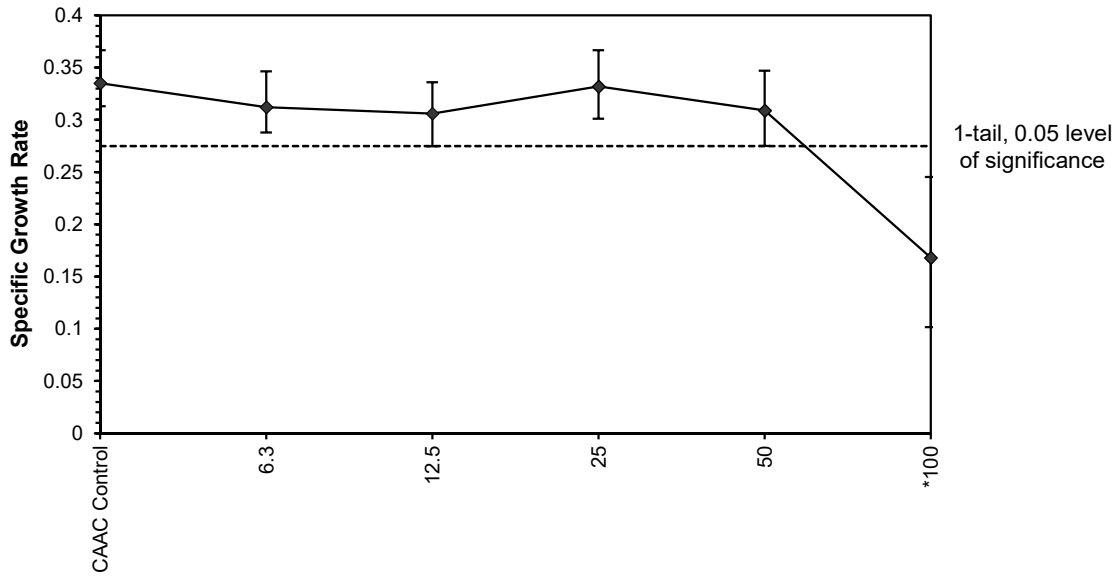
* indicates IC estimate less than the lowest concentration



Duckweed Growth Inhibition Test-Specific Growth Rate

Start Date: 23/02/2018 19:00 Test ID: PR1543/03 Sample ID: RP3(CAAC))
End Date: 27/02/2018 19:00 Lab ID: 8530 (CAAC) 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: 23/02/2018 19:00 Test ID: PR1543/03 Sample ID: RP3(CAAC))
 End Date: 27/02/2018 19:00 Lab ID: 8530 (CAAC) Sample Type: AQ-Aqueous
 Sample Date: Protocol: ESA 112 Test Species: LA-Lemna aequinoctialis
 Comments:

Auxiliary Data Summary

Conc-%	Parameter	Auxiliary Data Summary					
		Mean	Min	Max	SD	CV%	N
CAAC Control	Specific growth rate	0.34	0.31	0.37	0.02	45.19	4
6.3		0.31	0.29	0.35	0.03	50.71	4
12.5		0.31	0.27	0.34	0.03	55.82	4
25		0.33	0.30	0.37	0.03	49.69	4
50		0.31	0.27	0.35	0.03	58.91	4
100		0.17	0.10	0.25	0.06	145.60	4
CAAC Control	pH	6.10	6.10	6.10	0.00	0.00	1
6.3		6.30	6.30	6.30	0.00	0.00	1
12.5		6.90	6.90	6.90	0.00	0.00	1
25		7.00	7.00	7.00	0.00	0.00	1
50		7.30	7.30	7.30	0.00	0.00	1
100		7.60	7.60	7.60	0.00	0.00	1
CAAC Control	Cond uS/cm	39.00	39.00	39.00	0.00	0.00	1
6.3		297.00	297.00	297.00	0.00	0.00	1
12.5		470.00	470.00	470.00	0.00	0.00	1
25		912.00	912.00	912.00	0.00	0.00	1
50		1590.00	1590.00	1590.00	0.00	0.00	1
100		2810.00	2810.00	2810.00	0.00	0.00	1

DRAFT

GHD

Level 7

24 Mitchell Street

T: 61 8 8982 0100 F: 61 8 8981 1075 E: drwmail@ghd.com



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369/[https://projects.ghd.com/oc/NorthernTerritory/mttoddwdlecotox/Delivery/Documents/Ecotox Report 2018.docx](https://projects.ghd.com/oc/NorthernTerritory/mttoddwdlecotox/Delivery/Documents/EcotoxReport2018.docx)

Document Status

Revision	Authors	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Rev A	James Hill and Victor Perez-Landa	Jill Woodworth		Jill Woodworth		10/04/2018

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