

**Coastal Habitats  
UPL Chemical Spill:  
Preliminary Results of Water Toxicity from Platforms and PCD  
Draft Ver 1.5  
19 April 2022**

Please note that this report is an update on the draft report of the 16 April version 1.2 to include the Embryo-larval development test as well as overarching conclusions and recommendations

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## **1 PREFACE**

This report is submitted as a stand-alone document focussed on toxicity and interpretation of water collected around the UPL Warehouse and adjacent platforms as well as the PCD and inflowing water at Outlet 1 (PCD inlet from the platform). This version of the report only deals with the results of the toxicity analyses as the analytical chemistry results are not yet available. The information contained in this report will be included in the full MER Status Report ver. 2.0 (in prep) which covers all the aspects investigated by MER on this project.

## **2 INTRODUCTION**

MER sampled water at various sites on the UPL and adjacent platforms at around midday on the 11 April. At the time of sampling approximately 175 mm of rain had fallen since the 8/4/22. Seven sites were sampled (Figure 1-1). They were sent to CSIR for standard Whole Effluent Testing (WET) using sea urchin fertilisation and embryo-larval development testing and to V&M Analytical Toxicological Services Laboratory for metals and pesticide analysis.

## **3 RESULTS AND DISCUSSION**

Preliminary<sup>1</sup> results from the first acute fertilization test from the seven sites was all rated Highly Toxic in the raw undiluted form (Table 1-1-1) with the exception of the roof runoff which was Not Toxic. The major findings from the dilution testing indicated that any water coming off hard surfaces, such as the retailability section roof (PL-N/RR) and the destroyed loading bays (PLN/LB), is quickly rendered Not Toxic by a 1:5 or 1:10 dilution (Table 1-1). However, it seems evident that the water that comes into contact with soil which is also rated Highly Toxic in its undiluted form requires more dilution to render it Not Toxic.

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<sup>1</sup> Please note that this report is an update on the 14 April version with slight wording changes and will be updated again later today with the embryo-larval development results and MER recommendations.



Figure 1-1 Sites sampled on the 11 April 2022

From a natural environment perspective all sites are rated as Slightly Toxic or Not Toxic once a 1:40 dilution is reached, and this includes the water within the PCD. These figures are to be fed into the hydrology/dilution model which GroundTruth are producing to indicate the dilution that was achieved in the tributary during the overflow and also to guide thinking going forward for the potential release of the water to the tributary.

The results from the next testing phase, the Embryo-Larval development test appear at first glance to be much more positive than the fertilisation test results of the 13 April 2022 (Table 1-1). However, CSIR has indicated that this is likely a false positive and recommended that more reliance is placed on the fertilisation test for *in situ* management purposes.

The reasons for this include that some delayed development stages (prism, gastrula, blastula, and eggs) were not identified in the samples. The reasons for this cannot be determined from the results and include 1) they were not present (*i.e.* had passed this stage of development by the time of test termination), 2) had died and degraded by the time the test was terminated in response to toxicity and so were not detected, or (3) were present but not distinguished amongst the particulate matter. CSIR indicate further (see Appendix 2) that they do not believe point 1) is relevant considering the degree of toxicity evident in the same samples tested using the sea urchin fertilisation test (test report issued on 13 April 2022).

Table 1-1 Toxicity results of water collected on the 11 April 2022 using the sea urchin fertilization test (table after the CSIR certificate attached).

| Treatment      | PL-S/N2          | PL2          | PL-N/RR   | PL-N/LB          | PL3              | PCD/I          | PCD            |
|----------------|------------------|--------------|-----------|------------------|------------------|----------------|----------------|
| Raw            | Highly Toxic     | Highly Toxic | Not Toxic | Highly Toxic     | Highly Toxic     | Highly Toxic   | Highly Toxic   |
| 1:5 Dilution   | Highly Toxic     | Highly Toxic | Not Toxic | Moderately Toxic | Highly Toxic     | Highly Toxic   | Highly Toxic   |
| 1:10 Dilution  | Highly Toxic     | Highly Toxic | Not Toxic | Not Toxic        | Highly Toxic     | Highly Toxic   | Highly Toxic   |
| 1:20 Dilution  | Highly Toxic     | Highly Toxic | Not Toxic | Not Toxic        | Moderately Toxic | Slightly Toxic | Highly Toxic   |
| 1:40 Dilution  | Marginally Toxic | Not Toxic    | Not Toxic | Not Toxic        | Not Toxic        | Not Toxic      | Slightly Toxic |
| 1:100 dilution | Not Toxic        | Not Toxic    | Not Toxic | Not Toxic        | Not Toxic        | Not Toxic      | Not Toxic      |
| 1:200 dilution | Not Toxic        | Not Toxic    | Not Toxic | Not Toxic        | Not Toxic        | Not Toxic      | Not Toxic      |
| 1:400 Dilution | Not Toxic        | Not Toxic    | Not Toxic | Not Toxic        | Not Toxic        | Not Toxic      | Not Toxic      |

While CSIR is unable to provide an indication of whether (2) or (3) or a combination of both is influencing the toxicity they are of the strong opinion that point (2) is more likely since they have not previously seen samples showing the level of toxicity as evident in these samples through the sea urchin fertilisation test and then not encountered one or more of the prism, gastrula, blastula, or embryo stages at test termination. Samples were also ‘diluted’ at test termination to aid in the identification

of developmental stages. Regardless of the precise reason, this accounts for the lower magnitude of toxicity in the second test compared to the fertilisation test.

Table 1-2 Toxicity results from the sea urchin fertilization test (after the CSIR certificate attached).

| Treatment      | PL-S/N2        | PL2          | PL-N/RR   | PL-N/LB        | PL3          | PCD/I          | PCD            |
|----------------|----------------|--------------|-----------|----------------|--------------|----------------|----------------|
| Raw            | Highly Toxic   | Highly Toxic | Not Toxic | Slightly Toxic | Highly Toxic | Slightly Toxic | Highly Toxic   |
| 1:5 Dilution   | Slightly Toxic | Not Toxic    | Not Toxic | Not Toxic      | Not Toxic    | Not Toxic      | Slightly Toxic |
| 1:10 Dilution  | Not Toxic      | Not Toxic    | Not Toxic | Not Toxic      | Not Toxic    | Not Toxic      | Not Toxic      |
| 1:20 Dilution  | Not Toxic      | Not Toxic    | Not Toxic | Not Toxic      | Not Toxic    | Not Toxic      | Not Toxic      |
| 1:40 Dilution  | Not Toxic      | Not Toxic    | Not Toxic | Not Toxic      | Not Toxic    | Not Toxic      | Not Toxic      |
| 1:100 dilution | Not Toxic      | Not Toxic    | Not Toxic | Not Toxic      | Not Toxic    | Not Toxic      | Not Toxic      |
| 1:200 dilution | Not Toxic      | Not Toxic    | Not Toxic | Not Toxic      | Not Toxic    | Not Toxic      | Not Toxic      |
| 1:400 Dilution | Not Toxic      | Not Toxic    | Not Toxic | Not Toxic      | Not Toxic    | Not Toxic      | Not Toxic      |

There is the possibility that the particulates within the samples are in themselves exacerbating the toxicity levels in the samples which have suspended material. For this reason, we will check this with another round of samples from these same sites during the Easter weekend along with some additional background (or non-UPL impacted) sites to see if there is an inherent toxicity and within the tributary and estuary.

## 4 CONCLUSIONS AND RECOMMENDATIONS

The essence of the test based on the effect(s) of toxins on the fertilisation and embryonic development of sea urchin *Tripneustes gratilla* eggs and larvae is that it allows an assessment of the effects of such substances on these processes and thereby an assessment of the environmental significance. A measure of the efficacy of any biocide is critical to its use to deal with “pest” species and it would typically also be tested in terms of its effect on non-target organisms. Many of these biocides are extremely toxic and remain effective at concentrations below the limits of analytical

detection. This statement regarding high toxicity levels is supported by the recorded deaths of rock lobster *Panulirus homarus* in the sea north of the estuary mouth. A further complication is that in the present context it is not a matter of addressing the effects of a single compound released into the environment but a cocktail of substances with arguably significant synergistic effects. Again, in the present context, samples taken in the vicinity of the warehouse site and downstream as far as the PCD have incorporated high levels of fine suspended solids added to whatever dissolved solids may be present. This in no way discredits the tests as the samples remain representative of the local aquatic environment to which the biota is exposed.

Based on the above it should be clear that the test does not and is not intended to identify specific toxic substances but rather to assess the overall toxicity levels in a water or sediment sample. This is done by exposing the test organism or process, in this case sea urchin egg fertilisation and embryo-larval development, to the water or sediment elutriate sample. Toxicity levels are then further investigated by repeating the test using increasing degrees of dilution until the condition is attained where there are no apparent effects on fertilisation or larval development. This would allow comparison of toxicity levels at different sites in a stream or changes over time at any one site and would also be useful for management purposes in terms of the levels of dilution required to render a pollutant of no effect.

CSIR's suggestion that the fertilisation test is used as the standard for the assessment of the water is supported by MER. This applies a precautionary principle for the assessment of the overflow event and also the safe dilution and discharge of the water to the tributary from the platform areas and PCD which were tested during this sample event.

The summary conclusions and recommendations therefore are as follows

1. The assessment of the PCD overflow event (please note this was not a breach as referred to in the press and elsewhere) which occurred on the 10 and 11 April 2022 should be carried out using the fertilisation results. This means that the modelling from Groundtruth needs to check what dilutions could have been achieved in the tributary and downstream to provide an indication of environmental damage using the dilution results from the test.

2. Going forward, the same precautionary principle applies as described in point 1. The fertilisation test must be the yardstick against which any future release of PCD or platform water is assessed. This holds in the absence of the anticipated results from V&M on the organic and metal concentrations. These results will add important information to the interpretation of the toxicity of this water and are anticipated around the 23/24 April. discharge to the tributary of all platform water (with the exception of the evaporation ponds) the dilution which is needed to release to the tributary is a 1:40 dilution.
3. All discharges should be rendered Not Toxic by dilution or prior to release and released to the tributary to assist flushing and scrubbing. The discharge to the N2 is not supported for any of the platform water release.
4. MER's earlier recommendation/request to the freshwater team (MER 2021, email 17/8/21 to whole team) for urgent implementation of real time probes to monitor key parameters such as pH and other physico-chemical parameters is reiterated.
5. Further tests are recommended to unpack the reasons for the toxicity which is being indicated by these results.
6. Interpretation will be updates once the analytical results are received and can be integrated with the toxicity results.

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Report will only be signed off when final

Nicolette Forbes

**APPENDIX 1: FERTILISATION TOXICITY CERTIFICATE**



15 April 2022

Ms Nicolette Forbes  
Managing Director  
Marine and Estuarine Research  
Durban

Dear Ms Forbes,

**Results: Toxicity testing of water samples submitted to the CSIR (Emergency Survey – Sea Urchin Laval Development Test)**

Marine and Estuarine Research submitted seven water samples to the Coastal Systems research group of the CSIR for toxicity testing on 11 April 2022. The purpose of this letter is to provide you with the results of the toxicity testing. The samples were tested using the sea urchin embryo-larval test, a chronic toxicity testing procedure. Water samples were tested as received apart from salinity adjustments and were diluted with seawater from Vetches Beach, Durban. The results of the toxicity testing, including water quality measurements, are provided on pages after this letter. A summary of the results is provided below.

**Results Summary**

| Medium | Treatment       | Sample ID         | Toxicity Designation |
|--------|-----------------|-------------------|----------------------|
| WATER  | Raw             | PCD/1 (UPL21/21)  | slightly toxic       |
| WATER  | 1:5 Dilution    | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:10 Dilution   | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:20 Dilution   | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:40 Dilution   | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:100 Dilution  | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:200 Dilution  | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:400 Dilution  | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:1000 Dilution | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | Raw             | PCD (UPL21/21)    | highly toxic         |
| WATER  | 1:5 Dilution    | PCD (UPL21/21)    | slightly toxic       |
| WATER  | 1:10 Dilution   | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:20 Dilution   | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:40 Dilution   | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:100 Dilution  | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:200 Dilution  | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:400 Dilution  | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:1000 Dilution | PCD (UPL21/21)    | not toxic            |
| WATER  | Raw             | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:5 Dilution    | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:10 Dilution   | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:20 Dilution   | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:40 Dilution   | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:100 Dilution  | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:200 Dilution  | PLN/RR (UPL21/21) | not toxic            |

| Medium | Treatment       | Sample ID         | Toxicity Designation |
|--------|-----------------|-------------------|----------------------|
| WATER  | 1:400 Dilution  | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:1000 Dilution | PLN/RR (UPL21/21) | not toxic            |
| WATER  | Raw             | PLN/LB (UPL21/21) | slightly toxic       |
| WATER  | 1:5 Dilution    | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:10 Dilution   | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:20 Dilution   | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:40 Dilution   | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:100 Dilution  | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:200 Dilution  | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:400 Dilution  | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:1000 Dilution | PLN/LB (UPL21/21) | not toxic            |
| WATER  | Raw             | PLS/MD (UPL21/21) | highly toxic         |
| WATER  | 1:5 Dilution    | PLS/MD (UPL21/21) | slightly toxic       |
| WATER  | 1:10 Dilution   | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:20 Dilution   | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:40 Dilution   | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:100 Dilution  | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:200 Dilution  | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:400 Dilution  | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:1000 Dilution | PLS/MD (UPL21/21) | not toxic            |
| WATER  | Raw             | PL2 (UPL21/21)    | highly toxic         |
| WATER  | 1:5 Dilution    | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:10 Dilution   | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:20 Dilution   | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:40 Dilution   | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:100 Dilution  | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:200 Dilution  | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:400 Dilution  | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:1000 Dilution | PL2 (UPL21/21)    | not toxic            |
| WATER  | Raw             | PL3 (UPL21/21)    | highly toxic         |
| WATER  | 1:5 Dilution    | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:10 Dilution   | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:20 Dilution   | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:40 Dilution   | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:100 Dilution  | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:200 Dilution  | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:400 Dilution  | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:1000 Dilution | PL3 (UPL21/21)    | not toxic            |

Some delayed development stages (prism, gastrula, blastula, and eggs) were not identified in the samples. This may be because they were (1) not present (*i.e.* had passed this stage of development by the time of test termination), (2) had died and degraded by the time the test was terminated and so could not be detected, or (3) were present but not be distinguished amongst the large amount of settled particulate matter. We do not believe point (1) is relevant considering the degree of toxicity evident in the same samples tested using the sea urchin fertilisation test (test report issued on 13 April 2022). We are unable to determine which of points (2) and (3) is more relevant. However, we believe point (2) is more relevant since we have not previously tested samples showing the level of toxicity as evident in these samples through the sea urchin fertilisation test and then never encountered one or more of the prism, gastrula, blastula, or embryo stages at test termination. We also ‘diluted’ the samples at test termination to aid in the identification of developmental stages. Regardless of the precise reason, this accounts for the lower magnitude of toxicity compared to the toxicity evident in the same samples when tested using the sea urchin fertilisation test.

We recommend, therefore, that more reliance be placed on the findings of the sea urchin fertilisation test for management purposes.

Please do not hesitate to contact me for any additional information.

Yours sincerely,

*Brent Newman*

Brent Newman

Principal Scientist

**APPENDIX 2: EMBRYO-LARVAL DEVELOPMENT TOXICITY TEST  
CERTIFICATE**

13 April 2022

Ms Nicolette Forbes  
Managing Director  
Marine and Estuarine Research  
Durban

Dear Ms Forbes,

**Results: Toxicity testing of water samples submitted to the CSIR (Emergency Survey - Fertilisation Test)**

Marine and Estuarine Research submitted seven water samples to the Coastal Systems research group of the CSIR for toxicity testing on 11 April 2022. The purpose of this letter is to provide you with the results of the toxicity testing. The samples were tested using the sea urchin fertilisation test, an acute toxicity testing procedure. Water samples were tested as received apart from salinity adjustments. Samples were diluted with seawater from Vetches Beach, Durban. The results of the toxicity testing, including water quality measurements, are provided on pages after this letter. A summary of the results is provided below.

**Results Summary**

| Medium | Treatment       | Sample ID         | Toxicity Designation |
|--------|-----------------|-------------------|----------------------|
| WATER  | Raw             | PCD/1 (UPL21/21)  | highly toxic         |
| WATER  | 1:5 Dilution    | PCD/1 (UPL21/21)  | highly toxic         |
| WATER  | 1:10 Dilution   | PCD/1 (UPL21/21)  | highly toxic         |
| WATER  | 1:20 Dilution   | PCD/1 (UPL21/21)  | slightly toxic       |
| WATER  | 1:40 Dilution   | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:100 Dilution  | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:200 Dilution  | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:400 Dilution  | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | 1:1000 Dilution | PCD/1 (UPL21/21)  | not toxic            |
| WATER  | Raw             | PCD (UPL21/21)    | highly toxic         |
| WATER  | 1:5 Dilution    | PCD (UPL21/21)    | highly toxic         |
| WATER  | 1:10 Dilution   | PCD (UPL21/21)    | highly toxic         |
| WATER  | 1:20 Dilution   | PCD (UPL21/21)    | highly toxic         |
| WATER  | 1:40 Dilution   | PCD (UPL21/21)    | slightly toxic       |
| WATER  | 1:100 Dilution  | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:200 Dilution  | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:400 Dilution  | PCD (UPL21/21)    | not toxic            |
| WATER  | 1:1000 Dilution | PCD (UPL21/21)    | not toxic            |
| WATER  | Raw             | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:5 Dilution    | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:10 Dilution   | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:20 Dilution   | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:40 Dilution   | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:100 Dilution  | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:200 Dilution  | PLN/RR (UPL21/21) | not toxic            |
| WATER  | 1:400 Dilution  | PLN/RR (UPL21/21) | not toxic            |

| Medium | Treatment       | Sample ID         | Toxicity Designation |
|--------|-----------------|-------------------|----------------------|
| WATER  | 1:1000 Dilution | PLN/RR (UPL21/21) | not toxic            |
| WATER  | Raw             | PLN/LB (UPL21/21) | highly toxic         |
| WATER  | 1:5 Dilution    | PLN/LB (UPL21/21) | moderately toxic     |
| WATER  | 1:10 Dilution   | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:20 Dilution   | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:40 Dilution   | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:100 Dilution  | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:200 Dilution  | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:400 Dilution  | PLN/LB (UPL21/21) | not toxic            |
| WATER  | 1:1000 Dilution | PLN/LB (UPL21/21) | not toxic            |
| WATER  | Raw             | PLS/MD (UPL21/21) | highly toxic         |
| WATER  | 1:5 Dilution    | PLS/MD (UPL21/21) | highly toxic         |
| WATER  | 1:10 Dilution   | PLS/MD (UPL21/21) | highly toxic         |
| WATER  | 1:20 Dilution   | PLS/MD (UPL21/21) | highly toxic         |
| WATER  | 1:40 Dilution   | PLS/MD (UPL21/21) | marginally toxic     |
| WATER  | 1:100 Dilution  | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:200 Dilution  | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:400 Dilution  | PLS/MD (UPL21/21) | not toxic            |
| WATER  | 1:1000 Dilution | PLS/MD (UPL21/21) | not toxic            |
| WATER  | Raw             | PL2 (UPL21/21)    | highly toxic         |
| WATER  | 1:5 Dilution    | PL2 (UPL21/21)    | highly toxic         |
| WATER  | 1:10 Dilution   | PL2 (UPL21/21)    | highly toxic         |
| WATER  | 1:20 Dilution   | PL2 (UPL21/21)    | highly toxic         |
| WATER  | 1:40 Dilution   | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:100 Dilution  | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:200 Dilution  | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:400 Dilution  | PL2 (UPL21/21)    | not toxic            |
| WATER  | 1:1000 Dilution | PL2 (UPL21/21)    | not toxic            |
| WATER  | Raw             | PL3 (UPL21/21)    | highly toxic         |
| WATER  | 1:5 Dilution    | PL3 (UPL21/21)    | highly toxic         |
| WATER  | 1:10 Dilution   | PL3 (UPL21/21)    | highly toxic         |
| WATER  | 1:20 Dilution   | PL3 (UPL21/21)    | moderately toxic     |
| WATER  | 1:40 Dilution   | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:100 Dilution  | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:200 Dilution  | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:400 Dilution  | PL3 (UPL21/21)    | not toxic            |
| WATER  | 1:1000 Dilution | PL3 (UPL21/21)    | not toxic            |

Please do not hesitate to contact me for any additional information.

Yours sincerely,



Brent Newman  
Principal Scientist