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Dear Skefos

## **PER: Response to NRETAS' Request for Additional Information (PWC October 2012) Technical Review**

### **Introduction**

In 2011 Power and Water Corporation (PWC) prepared a Public Environment Report (PER) providing information on a proposed duplicate effluent rising main at East Point. This pipe would extend from the Ludmilla Wastewater Treatment Plant (WWTP) to a terminal manhole at the landward end of the East Point Outfall (EPO). GHD understands that the upgrade of the actual outfall is a separate project with its own environmental assessment process.

The PER was made available for public review between 12 November 2011 and 12 December 2011. A supplementary report, "*Supplementary Public Environment Report: Duplication of the East Point Rising Main. Power and Water Corporation. February 2011*", was prepared by PWC to address questions, concerns, comments and suggestions received during the public review period.

Following receipt of the Supplementary PER, the (former) Department of Natural Resources Environment the Arts and Sport (NRETAS) (now Department of Lands, Planning and Environment (DLPE)) requested further information on the potential impacts that may result from the additional effluent discharge at the existing EPO. In response PWC's consultants prepared a document entitled '*Public Environment Report: Response to NRETAS' Request for Additional Information, Power and Water Corporation, October 2012*', henceforth referred to as PWC (October 2012).

PWC has requested that GHD technically review this document to determine if it adequately responds to the 14 items in NRETAS's request for further information.

This letter summarises this review and briefly discusses the short and long term potential impacts to the environment from the effluent discharged from the EPO.

### **1 Technical Review**

This section provides a summary of the technical review of PWC (October 2012) with specific assessment of the adequacy of the document against each NRETAS information request described in Table 1.

In general the additional information provided in the PWC (October 2012) adequately answers NRETAS' requests for information. However, in GHD's opinion a few sections require minor corrections or additions to provide a scientifically justified report.

The most important omission in PWC (October 2012) is the lack of differentiation between total and dissolved metals. The metal results for effluent and water quality throughout the document are not identified as either total or dissolved. The ANZECC & ARMCANZ (2000) trigger values for 95% species protection should be compared to the bioavailable metals found as dissolved in a 0.45 µm filtered sample. By comparing the trigger values to the total metal concentrations the impact of the discharge will be overestimated. The bioavailability of metals in the discharge has not been adequately discussed in PWC (October 2012).

This also relates to the metals detected in the sediment. There is no indication if the metal results shown in the tables are total. The physical and chemical characteristics of the sediments will determine the bioavailability of contaminants within the sediments. Discussion on the bioavailability is less crucial for sediments than within the water column at this stage because metal concentrations in the sediments are below ANZECC & ARMCANZ (2000) interim sediment quality guidelines (ISQGs).

**Table 1. Technical Review by GHD of PWC (October 2012)**

Item	Information Requirement	Technical Review of PWC (October 2012)
1	Provide a list of known contaminants being discharged at East Point. Include at a minimum toxicants listed in Table 3.4.1 of the ANZECC Guidelines for Fresh and Marine Water Quality.	Section 2.1 and Tables 2-1 – 2-5 adequately addresses this comment. To provide clarity in this section the following issues could have been addressed: <ul style="list-style-type: none"> <li>Value for ammonia - Table 2.1. ANZECC has an ionised ammonia trigger value. The water quality objective for Darwin Harbour is unionised. This should have been clarified.</li> <li>Units for both TRH sections should be mg/L.</li> </ul>
2	Determine loads (kg/annum) of contaminants of those toxicants listed in (1).	Section 2.2 and Tables 2-9 – 2-11 adequately address this comment. To provide clarity in this section the following discrepancies could have been addressed: <ul style="list-style-type: none"> <li>The zinc value in Table 2-11 is inconsistent with that shown in Table 2-2.</li> <li>Oil and grease are not mentioned in any discussion throughout the document but are listed in Table 2-11.</li> </ul>
3	Discuss the capacity of the Ludmilla WWTP to remove toxicants	Section 2.3 adequately addresses this comment.

Item	Information Requirement	Technical Review of PWC (October 2012)
4	Calculate projected loads associated with the effluent for the life of the facility	Section 2.2 and Tables 2-9 – 2-11 address this comment.
5	Provide justification why improved bathymetric data (LiDAR) was not used	Section 3.1 addresses this comment.
6	The potential for impacts at the current outfall, including the most recent information	Section 3.2 does address this comment. More information on the bioavailability of contaminants and the toxic impacts of metals on marine species would provide clarity.
7	Discuss differences between modelling results and data provided in Appendix M.	<p>Section 3.3 addresses this comment. Additional information could have been provided to better address this comment. Information required could include:</p> <ul style="list-style-type: none"> <li>• The modelling used a data set from 1 July 2010 – November 2011. The data presented in Appendix M is a smaller data set (February - December 2011). Therefore, the data set used in the modelling provides a greater degree of confidence to the model results.</li> <li>• Additional discussion on how the data in Appendix M relates to the mixing zone modelled</li> </ul>
8	Demonstrate whether or not high levels of contaminants in samples outside mixing zones are derived from effluent discharges or are background derived	<p>Section 3.4 and 3.5 requires further information.</p> <p>Figure 3-2 partly addresses this comment. The concentrations of Total Phosphate (TP) at the outfall monitoring sites are not identified in PWC (October 2012). However, Figure 3-2 does provide an indication that there are external sources of TP (and presumably other associated nutrients).</p> <p>The use of water quality data from Appendix M could be used to support statements eg. TP is reduced from 610 µg/L at the outfall to background at SLUEP02.</p>
9	Discuss the appropriateness of the location of the reference monitoring site in light of results of (8).	Section 3.6 does adequately address this comment.

Item	Information Requirement	Technical Review of PWC (October 2012)
10	Provide improved graphical representation of mixing zones in relation to habitat and bathymetry	Section 3.6 does adequately address this comment.
11	Discuss fate (partitioning to sediments, degradation rates, volatilisation, bioaccumulation, etc.) of identified effluent constituents in marine environments.	<p>Section 4.1 and Tables 4-1 – 4-6 adequately address the NRETAS comment and the following minor issues could have been addressed to provide clarity.</p> <p>Copper, nickel and zinc exceed trigger values. Are these total concentrations? If so, discussion could be included on filtered concentrations and bioavailability. Discussion could also be included on how high dissolved organic carbon (DOC) can also limit the bioavailability of metals in the water column particularly in light of the high sediment loads in the Darwin Harbour during the wet season</p> <p>Concentrations at site SLUEP03 are elevated and do not seem to be related to the outfall. This could be discussed and may support Question 8.</p>
12	Discuss the expected pathways that describe the fate of nutrients and toxicants	<p>Section 4.2 does adequately address the NRETAS comment. Several issues could be addressed to provide clarity. These issues could include:</p> <ul style="list-style-type: none"> <li>• Discussion of levels of Chlorophyll-a in order to give indication of amount of algae present at the outfall and inside and outside of the mixing zone.</li> <li>• Discuss if metals in the water column are bioavailable as this is the most important issue affecting uptake by biota through the water column. Are algae in sufficient numbers to impact metal bioaccumulation in the food chain?</li> </ul>
13	Identify and discuss the potential impacts of contaminants in the water and sediments.	Section 4.3 does not fully discuss the potential impacts as the bioavailability of contaminants is not addressed. Based on data to date Section 2 of this document (below) contains information that addresses this comment in addition to information provided in Section 4.3 of PWC (October 2012). A detailed assessment of this issue will be investigated in future after sufficient monitoring has been conducted.

Item	Information Requirement	Technical Review of PWC (October 2012)
14	Demonstrate that no listed species or their habitats will be significantly impacted.	Section 5.1 does address the NRETAS comment.
15	Please review the Draft Water, Sediment and biota Monitoring Plan provided at Appendix Q of the PER in light of any impacts that have arisen through the provision of the above information request.	Section 6 does address NRETAS' comments.

## 2 Potential Impacts from the East Point Outfall (Item 13)

In addition to the Technical Review of Item 13 in Table 1, GHD has added the following conclusions.

### 2.1 Contaminants of Concern

From the information presented in PWC (October 2012) the key contaminants of concern are copper and zinc. Copper and zinc may exceed the ANZECC & ARMCANZ (2000) 95% species protection trigger values at the end of pipe and within the mixing zone, but are met at the edge of the mixing zone as shown in Figures 3.3 and 3.4 in PWC (October 2012).

Total nitrogen and total phosphorus are above the Darwin Harbour Water Quality Objectives and may have the potential to contribute to plant growth in the outfall mixing zone. According to the data presented, organics are not contributing to contaminants entering the Harbour from the EPO (PWC October 2012).

### 2.2 Bioavailability of Metals

GHD has made the assumption that all water quality and sediment metal data are presented as total concentrations as this is not stated within PWC (October 2012). By comparing the total metals to the ANZECC & ARMCANZ (2000) 95% species protection trigger values for marine ecosystems, the number and magnitude of exceedences will be increased. This has implications for assessing the potential impacts on exposed biota as the impacts will be overestimated. However, using the total concentrations will provide a conservative level of impact as the bioavailable concentrations in the environment will be lower.

## **2.3 Potential Impacts from Increased Volume from the East Point Outfall (EPO)**

### **2.3.1 Metals**

As discussed in PWC (October 2012) the combined outfall mixing zone is primarily sand with low bioturbation. Figure 3-3 in PWC (October 2012) shows that the closest habitat to the EPO is the oyster intertidal reef approximately 500 m from the outfall. This reef will be exposed to copper concentrations over the 95% species protection trigger value approximately 10% of the time. It is unlikely that this type of intermittent exposure will adversely impact organisms living on the reef as pulse exposures are less toxic than continuous exposures. Copper concentrations at the site (2 – 4 µg/L) are not sufficient to cause acute or sublethal effects in exposed organisms (ANZECC & ARMCANZ 2000). It is also unlikely that intermittent exposure to nickel and zinc concentrations above 95% species protection trigger values will cause adverse effects on exposed organisms at the site. NOTE: the ANZECC & ARMCANZ (2000) 95% species protection trigger values will protect 95% of the exposed species from a 10% reduction in growth or reproduction.

As discussed in Section 3.2 of PWC (October 2012), the EPO discharges over a sandy sediment in the intertidal zone. PWC (October 2012) provides sediment quality data that indicates no evidence of elevated contaminants within the mixing zone that can be directly attributed to the outfall. Further, all sediment metal concentrations are below the ANZECC & ARMCANZ (2000) interim sediment quality guidelines (ISQGs). As the metal concentrations at the site are within Darwin Harbour background levels, it is not possible to determine impacts from this site against naturally occurring metal levels. Therefore, metal levels within the sediments at the EPO are unlikely to cause adverse effects on exposed biota and the likelihood of bioaccumulation by turtles, dugongs and cetaceans is low.

As the load of metals discharged from the EPO will increase from the combined Ludmilla and Larrakeyah effluents continued monitoring of the sediments will need to be conducted to provide information on the ability of the sediment to retain metals. Currently available data indicates that the Darwin Harbour sandy sediments have a low affinity for binding metals.

### **2.3.2 Nutrients**

Nutrient (total nitrogen and total phosphorous) concentrations of the combined effluents pre-WWTP upgrade are an order of magnitude higher than the Darwin Harbour Water Quality Objectives. However, nutrient concentrations in sediments at the EPO at present are within background levels (Table 4-6 in PWC (October 2012) with no evidence of an anoxic layer in the vicinity of the EPO. It is unlikely that nutrients are currently adversely impacting the sediments at the EPO. Continued monitoring of the sediments will need to be conducted to determine the ability of the sediments to retain nutrients.

There is potential for increased growth of unicellular algae from exposure to elevated nutrients within the water column around the outfall. Due to water movement at the outfall, excess microalgal growth is not expected. This is supported by the median chlorophyll-a results to date which show that algal growth at sampling point SLUEP02 is equivalent to background levels at SLUEP11.

## **2.4 Conclusion**

Future monitoring will provide information that can be used to inform the discussion on the impacts from the outfall on the receiving environment.

Please do not hesitate to contact me if you require further information or clarification of any point in this Technical Review.

Regards

A handwritten signature in blue ink, appearing to read 'J Woodworth', with a long horizontal flourish extending to the right.

**Dr Jill Woodworth**

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