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Technical Note

Project:	Covalent Lithium		
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Date:	29 January 2020	**To:**	Nicole Harry
Doc Ref:	1774_01	**CC:**	Mat Brook (GHD), Martin Lourey (BMT)
Subject:	Discharge of Covalent effluent to Water Corporation SDOOL pipeline		

1 Introduction

Covalent Lithium (Covalent) is proposing to construct and operate a lithium refinery in Kwinana. A component of the lithium refinery process will be to discharge the refinery process water and the treated effluent from the wastewater treatment plant (WWTP) to Water Corporation's Sepia Depression Ocean Outfall Landline (SDOOL). Covalent are proposing to tap into the SDOOL via the Kwinana Water Reclamation Plant (KWRP) discharge line (or nearby), as the refinery will be located directly north of the KWRP.

Covalent have been in negotiations with Water Corporation in the past 12 months for approval to discharge wastewater to the SDOOL. Covalent received a letter from Water Corporation in December 2019 stating that Water Corporation will, in principle, enter into an Effluent Services Agreement with Covalent Lithium for the disposal of wastewater to the SDOOL subject to:

1. The Covalent effluent will conform to the wastewater specifications previously provided to and agreed to by Water Corporation and comply with Environmental Protection Authority (EPA) requirement Ministerial Statement (MS) 665:9-1. Which states that:

   "*The proponent (the Corporation) shall only accept and convey effluent from the industry participants to the Sepia Depression where industrial toxicant loads to be discharged do not exceed those authorised for discharge in Cockburn Sound by the relevant individual industry Environmental Protection Act Part V licences*"

2. Covalent will obtain any licences to ensure compliance with EPA requirement MS 665:9-2. Which states that:

   "*The proponent shall not accept discharges which are not licenced under Part V of the Environmental Protection Act 1986 into the Sepia Depression Ocean Outlet Landline for disposal to Sepia Depression*"

The discharge of treated wastewater (TWW) via the SDOOL is regulated by the EPA under MS 665 and the associated amendments granted to Water Corporation. Water Corporation is required, under MS 665, to refer new industrial discharges to the EPA.

2 SDOOL approvals and requirements

2.1 Sepia Depression Ocean Outlet

TWW discharged to the Sepia Depression ocean outlet comes from the Woodman Point Water Resource Recovery Facility (WRRF), East Rockingham WRRF, Kwinana WRRF, Point Peron WWTP, the Kwinana Water Reclamation Plant (KWRP) and selected industrial participants (Figure 2.1). The Woodman Point WRRF services southern Perth metropolitan area and receives predominantly domestic wastewater (from kitchen, bathroom, toilet and laundry uses), with ~8% received from light industrial wastewater. Most TWW discharged to the Sepia Depression is secondary TWW from the Woodman Point WRRF. However, a small fraction is primary TWW from the Point Peron WWTP, located downstream of the Woodman Point WRRF. The KWRP processes secondary TWW from the Woodman Point WRRF to a quality suitable for use as high-grade industrial processing water by industries in the Kwinana industrial area. This high-grade industrial water is supplied to industry participants to reduce consumption of potable scheme water. The KWRP process concentrate is disposed of via the SDOOL.

The Sepia Depression ocean outlet is a subsea diffuser located on the seabed approximately 3.5 km offshore from Woodman Point (Figure 2.2).

2.2 Key Requirements

2.2.1 Nitrogen loads

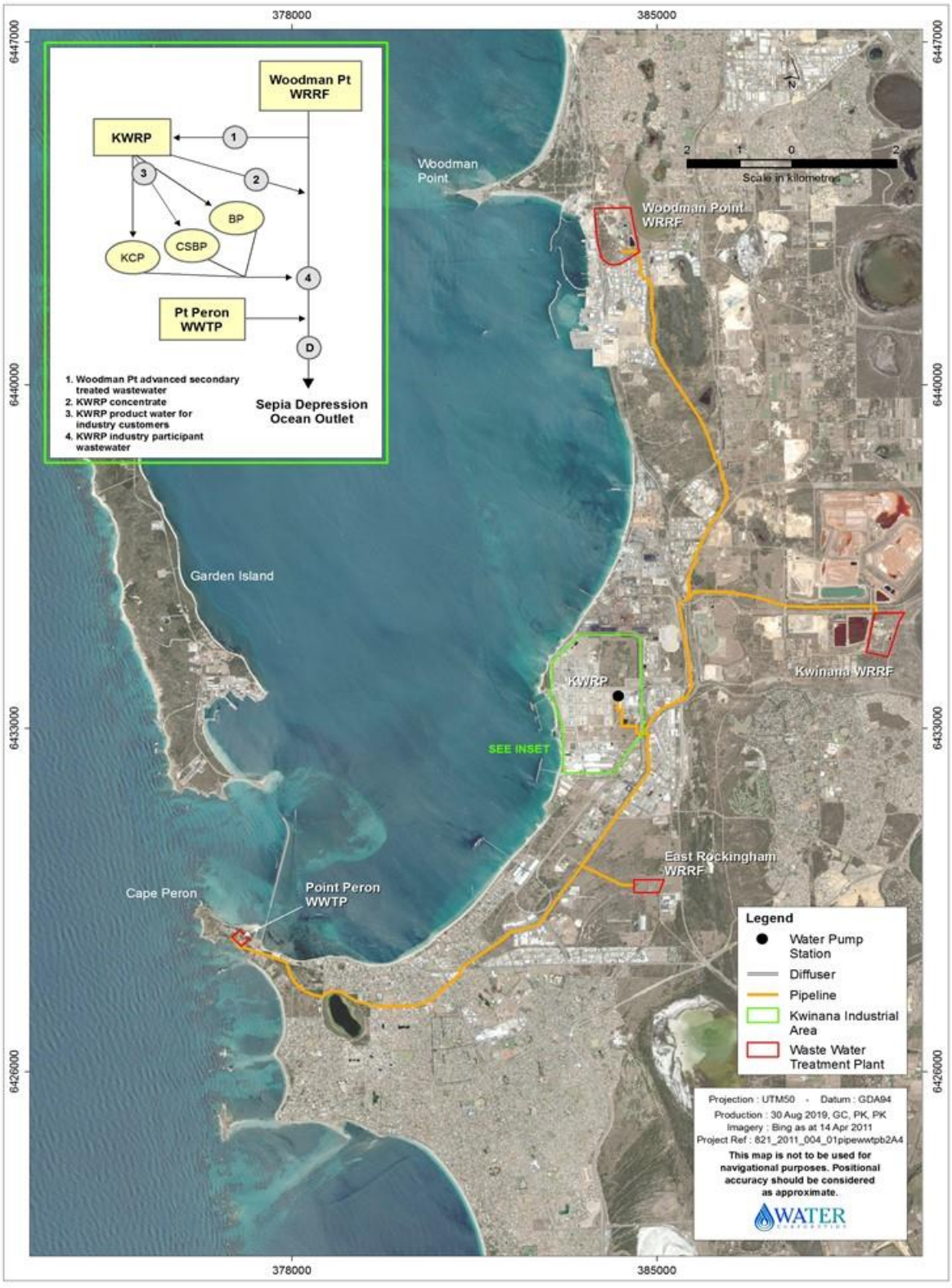
Primary productivity in Perth's coastal waters is primarily limited by the availability of nitrogen, and elevated nitrogen concentrations may lead to algal blooms and other potentially negative impacts so Water Corporation is required to operate the SDOOL so that the total annual nitrogen load to the Sepia Depression does not exceed 1,778 tonnes.

2.2.2 Contaminants, nutrients and pathogens

The treated wastewater stream is monitored quarterly by Water Corporation to characterise the concentration of metals, organics, nutrients and bacteria. Comprehensive treated wastewater characterisation, involving an expanded suite of contaminants, is conducted annually (refer Section 3).

Quarterly wastewater sampling determines concentrations of ammonia and filtered (bioavailable) metal (copper and zinc) concentrations in the treated wastewater as part of routine testing undertaken by Water Corporation. Following the introduction of new industrial facilities to the wastewater outlet, the Water Corporation also undertakes regular screening/analysis of treated wastewater inputs, including for new non-negligible contaminants.

The requirements for all sampling, guidelines and calculation methods are detailed in the EPA approved Sepia Depression Ocean Outlet – Monitoring and Management Plan (MMP) (BMT Oceanica 2014).



Notes:

1. WWTP = wastewater treatment plant; WRRP = Water Resource Recovery Facility; KWRP = Kwinana Water Reclamation Plant; BP = BP Refinery; KCP = Kwinana Cogeneration Plant; CSBP = CSBP Limited
2. Point D is the composite treated wastewater sample point prior to discharge

Figure 2.1 Location of the Sepia Depression ocean outlet relative to the SDOOL contributors

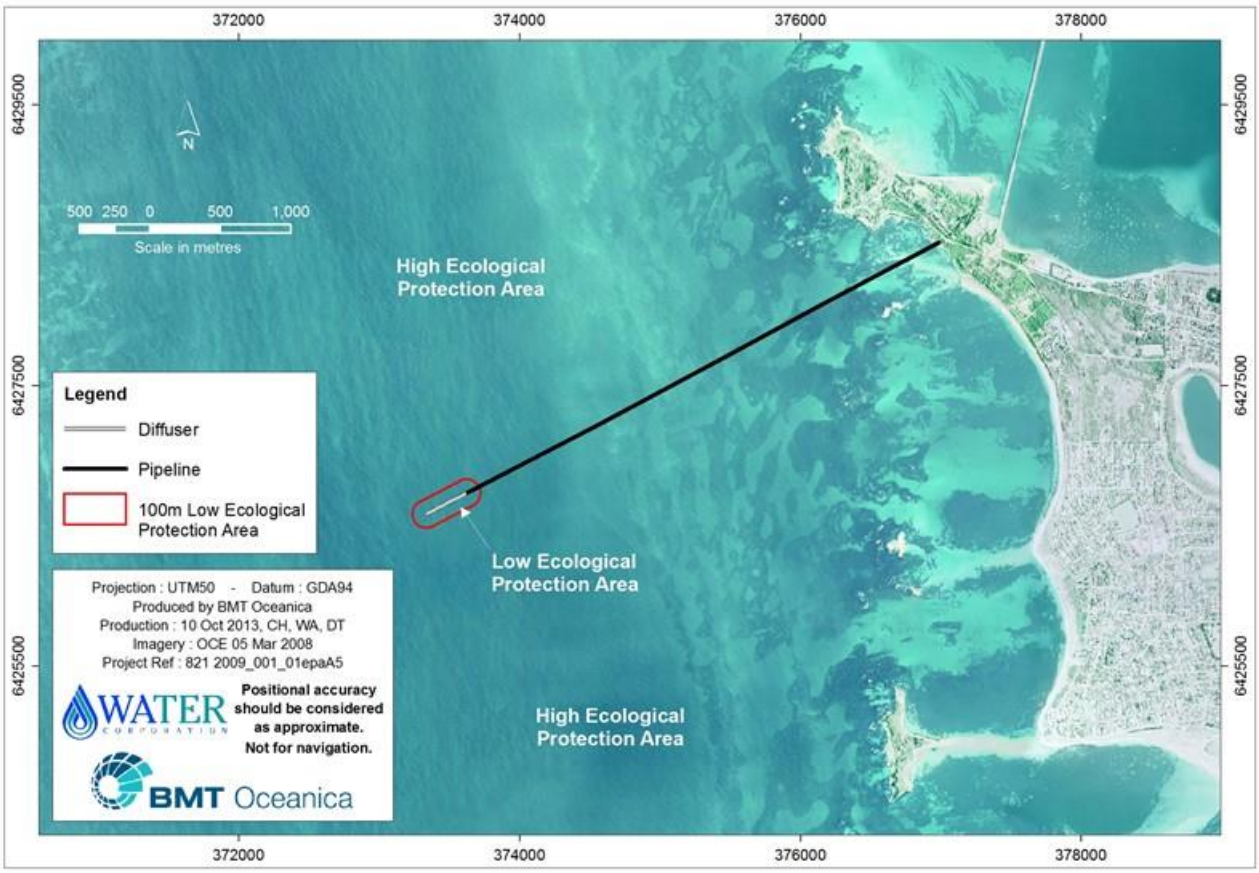


Figure 2.2 Sepia Depression ocean outlet location and low ecological protection boundary

3 Recent relevant results

3.1 Nitrogen Loads

The recent works by Water Corporation to upgrade the Woodman Point WWTP have led to a reduction in Total Nitrogen load to Sepia Depression, with the predicted load to the end of June 2020 being 1450 tpa (Water Corporation, pers. comm.), 328 tpa below the 1778 tpa licence limit.

3.2 Nutrients and toxicant concentrations

The most recent annual report (BMT 2019) is available on Water Corporation's website. The toxicant and nutrients results are relevant to Covalent's proposal (the Covalent discharge will not add pathogens).

The annual report found that the EPA's EQG for bioaccumulating and non-bioaccumulating toxicants in treated wastewater were all met as per Table 3.1. Quarterly analysis also found that the bioaccumulating toxicants cadmium and mercury met the 80% species protection guidelines (36 µg/L and 1.4 µg/L, respectively) in the TWW stream prior to dilution on each sample. Contaminants measured quarterly in the Sepia Depression TWW were all below their respective waste stream triggers based on the ANZECC/ARMCANZ (2000) 99% species protection after being scaled for dilution expected at the Low Ecological Protection Area (LEPA) boundary as per the MMP.

Table 3.1 Toxicants in the Sepia Depression TWW stream compared with relevant trigger levels (BMT 2019)

Toxicant	Sepia Depression TWW concentration (µg/L)	Waste stream trigger (µg/L)
Ammonia-N	21 000	154 537
Cadmium*	<0.1	36
Chromium*	<1	43
Copper*	5.1	68
Lead*	<1	679
Mercury*	<0.1	1.4
Nickel*	4.5	2016
Silver*	<0.8	248
Zinc*	60	2124
Chloropyrifos	<20	0.16
Endrin	<20	1.24
Endosulfan sulfate	<20	1.55
Benzene	<1	110 890
Naphthalene	0.01	15 485
Benzo(g,h,i)perylene	<0.01	15 485

Notes:

1. ANZECC/ARMCANZ (2000) guidelines used as per SDOOL MMP (BMT Oceanica 2014). Assessment against ANZECC/ARMCANZ (2000) 99% species protection guideline values was undertaken only for those toxicants where trigger levels were available.
2. ANZECC/ARMCAMZ (2000) scaled based on 5th percentile dilution at the LEPA boundary.
3. TWW = Treated wastewater.
4. Trigger values from Table 3.4.1 in ANZECC/ARMCANZ (2000). The EPA has provided advice that in WA waters where a high level of protection applies, 99% species protection levels should be used (EPA 2016).
5. The bioaccumulating toxicants cadmium and mercury must meet the 80% species protection guidelines at the diffuser (i.e. prior to initial dilution), and therefore a diluted concentration was not calculated.
6. Analytical limits for Chloropyrifos were not low enough to confirm exceedance of, or compliance with, the ANZECC/ARMCANZ (2000) guidelines. Until detection limits required for direct comparison can be attained by commercial laboratories, WET testing will provide a test of the toxicity of the wastewater stream.
7. Trigger values are for endosulfan, not endosulfan sulfate (Table 3.4.1; ANZECC/ARMCANZ 2000).
8. *= dissolved metals 0.45 µm filtered.

4 Covalent Effluent Characteristics

4.1 Process plant

The Covalent Lithium refinery is designed to produce 45,400 tpa of battery quality lithium hydroxide monohydrate. Sodium sulphate, refinery filtered aluminosilicate (RFA), refinery dewatered cake (RDC) are produced as co-products in addition to a liquid effluent stream. The refinery uses technology common in the spodumene processing industry, including the following components:

- Two trains of pyrometallurgical processing consisting of preheating cyclones, direct-fired rotary kiln calciner, rotary coolers and indirect-fired sulfation kilns
- Water leaching to solubilise lithium sulphate from the spodumene
- Impurity removal including oxidation, pH adjustment, filtration and ion exchange
- Sodium hydroxide direct causticisation
- Sodium sulphate removal and co-product generation through Glauber's salt (sodium sulphate decahydrate) and sodium sulphate anhydrous crystallisation stages
- Two-stage lithium hydroxide crystallisation
- Product and co-product drying and storage
- Reagents and utilities required for the process.

The refinery process flow diagram pertaining to wastewater production is shown in Figure 4.1.

The effluent discharge to SDOOL will comprise the waste process water from the plant and a non-residential domestic type treated wastewater from the plant toilets, showers, washbasins and lunchroom facilities. The forecast maximum total flows into SDOOL are provided in Table 4.1.

Table 4.1 Covalent effluent flows

Element	Annual flow (m^3 pa)
Treatment of refinery process wastewater (liquid effluent and water treatment salt) via reverse osmosis, prior to disposal to the SDOOL	252,288
Wastewater treatment plant for treatment of sewage from onsite ablutions, prior to disposal via SDOOL.	3,066
Total	255,354

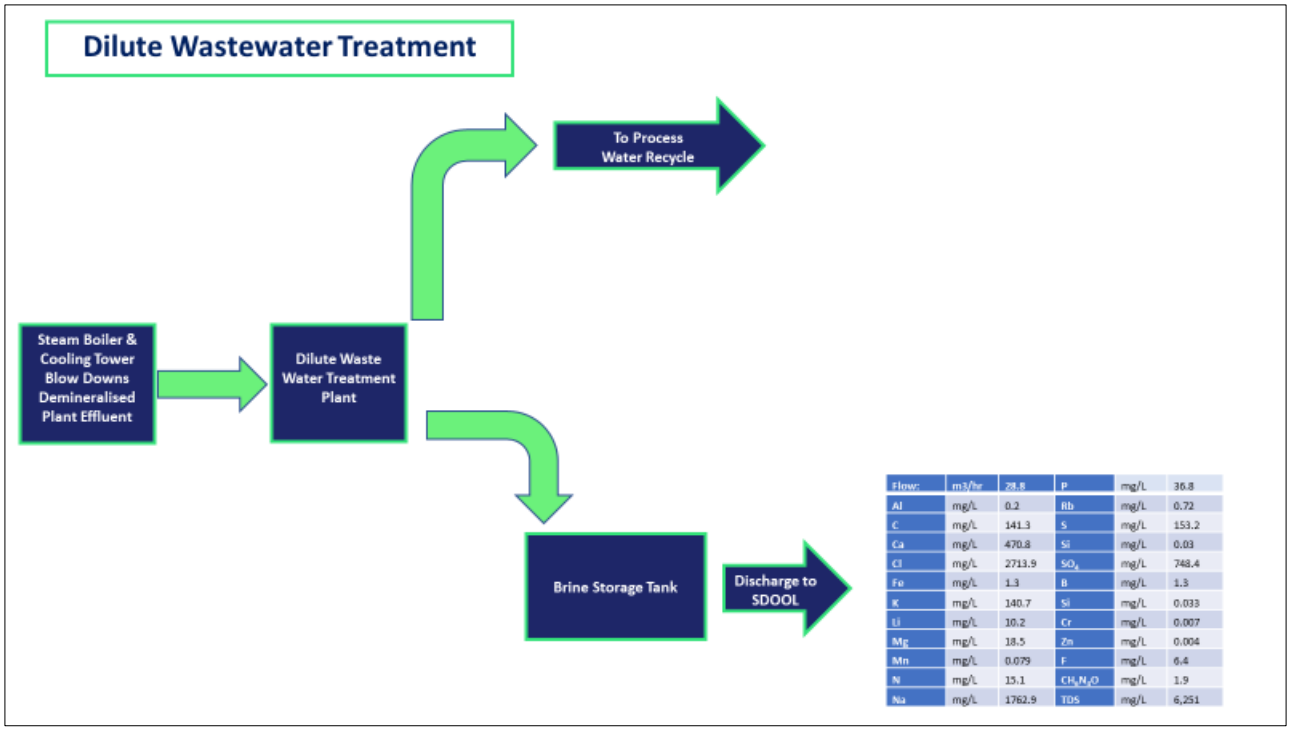


Figure 4.1 Covalent Lithium process diagram showing effluent stream.

4.2 Effluent Quality

The predicted effluent quality is provided in Table 4.1, the majority (>90%) of the dissolved salt concentration in the refinery effluent stream is directly attributed to the incoming dissolved salt load of the feedwater source. Changes in the feedwater quality will be reflected in the quality of refinery effluent.

The predicted flow and concentrations are annualised averages based on steady state operation.

Table 4.2 Forecast plant effluent water quality including total annual flow and nitrogen load

Parameter	Units	Value	Notes
Flow	m^3/hr	28.8	Annual average flow 252,288 m^3
Al	mg/L	0.2	
C	mg/L	141.3	
Ca	mg/L	470.8	
Cl	mg/L	2713.9	99.5% of the total Cl contribution in the ionic chloride form. 0.5% of the total Cl is contributed from Cl species present in the cooling tower biocide program (13.6 mg/L).
Fe	mg/L	1.3	
K	mg/L	140.7	
Li	mg/L	10.2	
Mg	mg/L	18.5	
Mn	mg/L	0.079	
N	mg/L	15.1	Annual load average 38.1 tpa
Na	mg/L	1762.9	
P	mg/L	36.8	
Rb	mg/L	0.72	
S	mg/L	153.2	
Si	mg/L	0.03	
SO_4	mg/L	748.4	
B	mg/L	1.3	
Si	mg/L	0.033	
Cr	mg/L	0.007	
Zn	mg/L	0.004	
F	mg/L	6.4	
CH_6N_4O	mg/L	1.9	
TDS	mg/L	6,251	

5 Assessment of risk to meeting SDOOL requirements

Covalent effluent discharged to the SDOOL will be managed under Water Corporation's existing MMP (BMT Oceanica 2014). Due to the significant effort required by Water Corporation (as the SDOOL asset owner and proponent) to obtain approvals for increases in any parameter values in SDOOL discharge to Sepia Depression, it is important for Water Corporation that this project sits within the requirements and limits of the current MMP.

5.1 Nitrogen loads

The recent works by Water Corporation to upgrade Woodman Point WWTP led to a reduction in nitrogen load to Sepia Depression, with the predicted load to the end of June 2020 being 1450 tpa (Water Corporation, pers. comm., January 2020) which is 328 tpa below the 1778 tpa licence limit. This level of nitrogen loading is now expected to be typical for the foreseeable future.

The predicted worst-case additional load from the Covalent refinery is 38.1 tpa, which is 11.6% of the difference between the current load and the limit. As such, the risk of the Covalent refinery adding sufficient nitrogen to cause the licence limit to be exceeded under current operating conditions is negligible.

5.2 Toxicants

The Covalent flows are diluted into the SDOOL flows before discharge to the ocean. The SDOOL flows are typically 140 ML/day, while the Covalent flows are predicted to be approximately 0.7 ML/day, therefore the Covalent flows will be diluted approximately 200-fold after entering the SDOOL pipeline before discharge, following discharge the TWW then typically dilutes a further 200-fold with ambient seawater within the initial mixing zone (BMT Oceanica 2014). None of the supplied predicted toxicant concentrations provided by Covalent will exceed EPA triggers or Low Reliability Values (LRV) after dilution into SDOOL and then subsequently via ocean discharge.

However, the full set of concentration predictions is not available at this stage to allow assessment against the EPA's toxicants triggers and with known contaminants of concern in the SDOOL discharge (e.g. copper; ammonia and zinc), the process is not expected to discharge significant concentrations and the risk of any EPA trigger being exceeded after discharge to Sepia Depression is negligible. Recommendations regarding analysis are made in Section 6.

5.3 Qualifications

This memo has been prepared solely on the basis of information supplied by Covalent in relation to predicted concentrations and loads and published reports relating to Water Corporation's SDOOL pipeline.

BMT has only assessed risk in relation to approved discharge to marine environment at Sepia Depression, not assessing risk to asset or the operation of the asset (e.g. hydraulic capacity of the SDOOL, potential corrosion, flow variability etc) this is expected to have been undertaken by Water Corporation.

A full set of contaminant concentrations for assessment is not available at his stage of the assessment and sampling and testing should be undertaken after commissioning to confirm the assessment.

6 Comments on monitoring & management

It is expected the that Covalent will need to prepare a draft Environmental Management Plan (EMP) for the project as part of the EPA's approval process.

It is suggested that in relation to the discharge to SDOOL that:

1. The sampling and reporting is aligned with relevant requirements of the Water Corporation's MMP (BMT Oceanica 2014) and to the satisfaction of Water Corporation.
2. It is recommended that immediately post-commissioning there is least one comprehensive TWW characterisation sampling and analysis followed by at least quarterly TWW characterisation in context of Water Corporation's requirements.
3. The concentrations of the toxicants post-commissioning should be assessed in relation to Water Corporation's requirements to confirm the conclusions of the assessment regarding risk.
4. There should be at monthly sampling and analysis for the key contaminants of concern identified in the EMP and that assessment against any Covalent license limits relating to the discharge should be based on the annual averaging of these monthly results.

7 References

ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 1: The Guidelines. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT, October 2000

BMT Oceanica (2014) Sepia Depression Ocean Outlet – Monitoring and Management Plan. Prepared for Water Corporation by BMT Oceanica Pty Ltd, Report No.821_001/1_Rev5, Perth, Western Australia, April 2014

BMT (2019) Perth Long Term Ocean Outlet Monitoring (PLOOM) Program, 2019 Summer Water Quality Surveys. August 2019.

BMT (2019) Sepia Depression Ocean Outlet Landline (SDOOL) & Perth Long Term Ocean Outlet Monitoring Program (PLOOM), 2018–2019 Annual Report. September 2019.

EPA (2016) Technical Guidance - Protecting the Quality of Western Australia's Marine Environment. EPA, Western Australia, December 2016.