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Attention: Simon Berry

Dear Simon

AMBURY PROPERTIES LTD (APL) CONNECTION TO HUNTLY WWTP

You have requested technical advice from me regarding wastewater treatment options that would potentially enable APL to connect to the Huntly Wastewater treatment and discharge system prior to a major upgrade or rebuild of the Huntly WWTP happening. The following is my technical advice.

Introduction

1 My full name is John Milton Crawford.

2 I am currently employed by Beca Limited in the capacity of Technical Fellow – Wastewater Engineering. My technical speciality is in wastewater treatment systems, re-use and disposal schemes.

3 I hold the degree of Bachelor of Engineering (Hons) in Agriculture from the University of Canterbury (1986).

4 I am a Chartered Professional Engineer (NZ) and a UK Chartered Engineer. I am a Fellow of the Institution of Professional Engineers New Zealand. I am a member of Water New Zealand, the Institution of Civil Engineers (UK) and the Chartered Institution of Water and Environmental Management (UK).

5 I have 35 years' research and practical experience in the investigation, design and implementation of water and environmental engineering facilities including treatment and disposal systems for municipal and industrial wastewater. I have been responsible for investigations for resource consenting, implementation or trouble shooting of wastewater treatment and disposal schemes at some 54 wastewater treatment plants in New Zealand, Singapore, England and Fiji.

6 In the context of Te Ture Whaimana, and wastewater treatment in the lower Waikato Valley, I am currently involved with consenting or upgrading the wastewater treatment plants at Te Kauwhata, Pukete, Te Awamutu and Cambridge. I am also the treatment plants technical lead on the Hamilton to Auckland Corridor strategy study and the Metro Wastewater servicing strategy being developed jointly by Waikato District Council (WDC), Hamilton City and Waipa District Council.

Interests and Potential Conflicts

7 Beca has recently been assisting WDC and Watercare in the concept design of a new Te Kauwhata WWTP and have recently been working with them on both the Raglan and Meremere systems.

8 I was last involved with the Huntly WWTP during the HIF funding investigations in 2018.

9 In relation to the proposed plan change and associated developments, Beca has provided expert social impact advice as part of the s42A reporting team to the Hearings Panel.

10 It is my understanding the WDC are generally supportive of the plan change and associated developments proposed by Ambury properties Ltd (“APL”).

11 It is also my understanding that WDC and Watercare have no objection to me providing assistance to the Hearing Panel in this manner.

Involvement in the Ohinewai Project

12 I was engaged to assist APL in late November 2020, so my knowledge of specific numerical aspects relevant to the disposal of Ohinewai wastewater via Huntly WWTP is still limited. I am familiar with the Huntly WWTP site but have not visited it since 2018. I have not had an opportunity to visit the Huntly WWTP site since becoming involved with this current task. If there are further works associated with this engagement, I would intend to undertake a visit to the site.

13 Due to the time scale for preparation of these notes:

a. I have not yet received information that enables me to calculate the volumes of wastewater to be expected per day through the years of development of the site, and

b. My suggestions regarding wastewater treatment needs for the APL development have been shared with APL, and WDC and an early draft was shared (by BBO) with Watercare. So there could still be contextual error in what I present here. And what I say cannot be construed to represent the views of WDC or WaterCare. I have briefly discussed my suggestions with Mr Bradley, representing WDC. I understand that Mr Bradley may make comment separately.

Context

14 It is my understanding that:

14.1 APL will initially (Yr 0 – 2) develop its foam factory installation at Ohinewai, employing 50 staff and will provide wastewater treatment and disposal via an 'on-site' treatment and disposal system.

14.2 Subsequently (Yr 3 – 6), APL proposes to route raw wastewater to the Huntly municipal WWTP for treatment and discharge.

14.3 This activity could be either as a trade waste discharge or as a municipal waste from extended area of benefit, being the new stand-alone Ohinewai Precinct.

14.4 The WDC Huntly WWTP is currently (or was at its last compliance report) non-compliant with WRC Discharge consent 119647, which expires in 2029. Parameters of non-compliance include the final effluent concentrations (mg/l) of suspended solids (TSS) and Ammonia nitrogen (NH_4-N);

14.5 The current 2020 monitoring data (to June 2020) indicates that the situation with TSS is worsening and that there have also been contraventions of Total Nitrogen (TN) concentrations.

14.6 The flow and load based consent conditions are easily met by the treatment plant because flows are significantly lower than the consented amounts.

14.7 WDC and Watercare intend to undertake a replacement or major upgrading of Huntly WWTP prior to the 2029 consent expiry date. Watercare have advised that upgrading is likely to start in 2024/25 and be completed by 2027/28 based on WDC funding constraints.

14.8 The Huntly WWTP, which is based on an oxidation pond system, has accumulated a significant volume of sludge. Removal of this is intended to be a first step in the renewal or upgrading process.

Understanding

15 The situation with TSS will be cyclical with algal blooms and sludge accumulation both contributing to elevated effluent TSS. High summer (warm water) conditions will make this the worst time of year. However, even through winter (low algae period), the TSS has been significantly elevated at >60mg/l.

16 The oxidation ponds are followed by a wetland system prior to effluent disinfection. Constructed and densely vegetated wetlands typically provide a significant amount of filtration to oxidation pond effluent. The highly elevated final effluent TSS at Huntly WWTP indicates to me that sludge carry over has happened on a significant scale into the wetlands and now permeates right through those, thus significantly affecting the final effluent TSS result. Unless that is, the wetlands have been bypassed and effluent is tracking from the oxidation ponds to the pumps and back to the UV system.

17 Apart from normal pond loading from influent Total Kjeldahl Nitrogen (TKN), the significant quantity of sludge accumulated in the ponds will be digesting and releasing nitrogen and phosphorus, in soluble form, back into the water column. Thus, effluent ammonia will be higher than it should otherwise be when pond sludge levels are kept below a reasonable 30 (ish) percent.

18 In my opinion, there are two main options (with sub-options) available to improve the performance of Huntly WWTP or render the APL contribution negligible in terms of effects on consent compliance performance. One involves improvements to the Huntly WWTP; the other, pre-treatment on the Ohinewai site.

Potential Improvements to the Huntly WWTP

Short terms works

19 Watercare has advised that the Huntly WWTP oxidation ponds desludging will be commenced in February 2021 and be completed by December 2021. The Huntly WWTP is understood to be constrained by a lack of power supply capacity. It is understood that a supply capacity upgrade is intended, but the timing is less certain.

20 Removing sludge from the pond is likely to result in a reduction in effluent TSS, This will also result in a reduction in effluent TN/TKN through the removal of particulate, organic nitrogen, i.e the organic matter in the solids will be 8 – 9% nitrogen. Therefore, if the summer TSS is reduced from 110 mg/l to 50 mg/l, that will likely result in a TN reduction of 4 to 5mg/l.

21 The same basic calculation cannot be applied to the likely reduction in ammonia realised by removing the sludge as it is not possible to accurately quantify the amount of digestion activity that is actually occurring.

22 If the wetlands have become heavily polluted or congested with sludge carrying over from the ponds (and as stated above I have not yet had the opportunity to visit and observe) , without completely cleaning these out and replanting, the benefits of desludging may possibly not be seen for several years.

Installation of a membrane aerated biofilm reactor

23 Watercare has suggested (in the latest annual compliance report) the installation of an MABR (membrane aerated biofilm reactor) in the interim to deal with the ammonia. I consider that this is a reasonable suggestion in terms of operational principles but I am unaware of it having been practically applied in the context of an oxidation pond. I have not yet developed a firm view on the physical configuration that would be applied.

24 This technology is new and has only been in full scale use around the world for approximately 5 years. Last year I visited the 13MLD MABR that Suez designed and built at Yorkville just outside Chicago. That was the largest of its type in the world. That unit was installed to reduce the ammonia loading within an activated sludge plant.

25 At the time, I made a general enquiry to Suez, and they could not see any reason why the MABR cassettes could not be installed to perform the same role in oxidation ponds. I made this inquiry because effluent ammonia levels, from oxidation ponds, are an extremely common problem in New Zealand and the currently available solutions are expensive to both implement and operate. A new process solution would be extremely welcome in the NZ wastewater industry.

26 Suez are one of the membrane technology suppliers currently working with Watercare to introduce membrane technology into other plants controlled by Watercare, including Te Kauwhata. The MABR option would be suitable because it would not require a large amount of additional supporting infrastructure and the membranes themselves could be removed and used elsewhere when the main plant upgrade is undertaken.

27 It should be noted, however, that while it is a membrane technology, MABR does not act to provide solids filtration the way more conventional membranes (e.g MBR) do. Instead the membranes diffuse molecular oxygen out through the membrane from the hollow centre of the fibre, to supply biofilm organisms growing on the exterior of the membrane fibre.

Install a dissolved air flotation system

28 Another possibility for mitigating high TSS and or phosphorus and / or E.coli from the ponds or wetlands is to install a dissolved air flotation (DAF) system prior to the Huntly UV unit. Compared to lamella based clarifiers, DAF works well with oxidation pond effluent as the neutrally buoyant algal cells tend to float easily rather than sink. There are currently DAF systems working well on oxidation pond systems at Pahiatua and Waihi and a further unit is shortly planned for Waipawa in the Central Hawkes Bay.

29 The DAF system removes the solids by flotation, P by coagulation and flotation and assists in disinfection by clarifying the effluent significantly and allowing the UV system to do its job better.

30 DAF will not improve the ammonia-N situation to any measurable extent as that is fully soluble. However, it would be valuable if solids (TSS) continue to be problematic after sludge removal.

Options for Pre-Treatment at Ohinewai

31 I consider that there are interim ‘on-site’ treatment measures that could be implemented at Ohinewai to assist to achieve compliance pending the full upgrade.

32 These ‘on-site’ measures include:

a. A removable package MBR plant that would treat all of the APL wastewater to a very high standard, e.g TSS<5mg/l, NH_4-N<2mg/l, TP <7mg/l and e.coli<14cfu/100ml.

   The effluent from this system (with the appearance of drinking water) would be piped to Huntly and introduced at an appropriate location within the Huntly WWTP prior to the discharge. This would entail building a package style MBR plant very similar to that currently being installed by Watercare for WDC as a sidestream process at Meremere. As with Meremere, this would achieve dilution of the effluent coming through from the oxidation pond system. A 0.25MLD MBR plant (approximately 330 lots) packaged for future removal would likely cost of the order of $4 - $5M

b. If the actual occupancy was expected to be comparatively modest within the time envisaged, APL could consider increasing the number of small on-site WWTPs and associated disposal fields used. For example, further Biocycle or Innoflow plants. These would achieve a lower standard of treatment than an MBR system. They would also exceed (as will the year 0 – 2 system) the WRC permitted activity rule and would require discharge consents.

33 In theory, only a very modest side-stream treatment, at either the Huntly (given adequate power supply) or at the Ohinewai site, would be required to achieve compliance in terms of ammonia. Currently (to June 2020) numerically, the median and 90th%ile values are 8.5 and 21 g/m^3 respectively. If a side-

stream or on-site WWTP was to produce effluent at ammonia-N at 2g/m^3 (which is very achievable), then the minimum throughput required to return the effluent to 20mg/l as a 90%ile is only 61m^3/day (assuming a mean Huntly WWTP outflow of 1,100 m^3/d). This is based on a mass balance calculation [(61m^3 x 2g/m^3)+(1100m^3 x 21g/m^3)]/[1100 + 61] = 20 g/m^3 which is the compliance limit.

34 Obviously some growth and contingency/safety factor would need to be provided for in sizing an actual plant. The table below provides an indication of the likely levels of improvement that could be achieved to the Huntly effluent ammonia concentration. In this regard, having the sidestream process stationed at Huntly may be more beneficial as the necessary flows could be guaranteed to be available to process through it rather than waiting for a minimum level of development to happen at Ohinewai to produce these flows.

Sidestream (NH_4-N = 2g/m^3) (m^3/d)	H-WWTP (21mg/l) (m^3/d)	Blended NH_4-N (mg/l)
0	1100	21
61	1100	20
100	1100	19
200	1100	18
250	1100	17.5

35 To assess a design size for each of these measures, careful assessment would need to be undertaken of the actual rate of completion and occupancy of the buildings and activities contributing wastewater. The efficacy / affordability of plants for the Ohinewai site will be very much dependent on this. For example, a current estimate for a permanent 0.5MLD WWTP (600 lots x 3 persons x 0.25 m^3/hd/d) is of the order of $6M (includes design but excludes project management consultants, client and land costs), based on recent tenders.

Theoretical Solutions

36 As noted, a range of options are available to ensure that municipal wastewater derived from the APL site/s to be managed through the Huntly WWTP without exacerbating non-compliance at Huntly. To illustrate, one combination of options and the ballpark costings associated with them would comprise the following:

36.1 Install a small, removable packaged/containerised MBR WWTP at Ohinewai to treat likely flows out until commissioning of the upgraded Huntly WWTP. 'Removable' so that in the medium to long term all treatment is done in a single plant and the containerised plant can be on-sold. Targetting 1-2mg/l effluent ammonia, less than 5mg/l TSS and less than 50 cfu/100ml indicator bacteria. Discharge just upstream of the Huntly UV disinfection system;

36.2 At Huntly, interim corrective measures to the existing system:

a. Desludge the oxidation pond system;
b. To the extent possible, remove accumulated sludge from the wetland system;
c. Review and remove any wetland short-circuiting and replant areas as necessary;
d. Review pond loading and provide supplementary aeration as necessary;
e. Electrical supply and mechanical maintenance and upgrading to make sure that the plant can function reliably and at capacity.

36.3 The interim strategy discussed in 36.1 and 36.2 above relies on a minimum flow from the MBR and the underlying treatment conditions at Huntly WWTP not worsening significantly. An alternative would be to install the packaged MBR at the Huntly WWTP site where the availability of flow to match the MBR capacity is guaranteed from day one. Watercare has indicated that they are not in favour of installing an interim sidestream MBR at Huntly.

37 I consider that this package of measures is entirely feasible from a technical perspective.

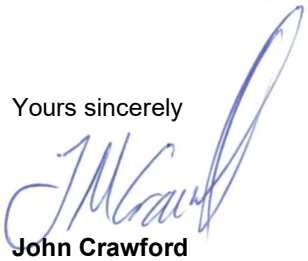
Summary

38 Due to the current marginal performance, the Huntly WWTP rebuild or major upgrade would ideally be undertaken prior to the discharge consent renewal process that culminates in 2029. However, that advanced time frame may still not be sufficient to match the rate of development of the APL site/s.

39 As discussed above, I consider that there are interventions available (in addition to the proposed desludging of the Huntly Oxidation Ponds) that would enable municipal wastewater derived from occupancy of the APL site/s to be managed through the Huntly WWTP without exacerbating any non-compliance there; in fact, a number of the interventions, particularly if applied at the Huntly site, would result in improved effluent outcomes.

40 The measures that would need to be implemented include high rate side stream treatment (e.g MBR or MABR), removal of sludge from the ponds and wetlands and making sure that the ponds have sufficient BOD processing capacity for the loads that they actually receive.

Yours sincerely



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on behalf of

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