IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of **PROPOSED PLAN CHANGE 1** to the Waikato Regional Plan – hearing of **BLOCK 2** topics
AND	
IN THE MATTER	of the hearing of the further submission by **WAIKATO REGION TERRITORIAL LOCAL AUTHORITIES COMPRISING THE WARTA GROUP** in relation to **BLOCK 2** topics

STATEMENT OF EVIDENCE OF ZHUO CHEN

1. INTRODUCTION

1.1 My name is Zhuo Chen and I am a Senior Environmental Engineer at GHD Limited (**GHD**) based in Auckland. Prior to joining GHD in June 2018, I was a Principal Environmental Engineer at AECOM New Zealand Limited (**AECOM**).

Qualifications and experience

1.2 I have a BE in Chemical Engineering (Nanjing University of Science and Technology 1997), an MSc in Environmental Science (Nanjing University 2000), and a PhD in Civil & Environmental Engineering (University of Iowa, 2006). I have over ten years of working experience in environmental consultancy within New Zealand (at URS New Zealand Ltd and AECOM New Zealand Ltd), focusing on aquatic chemistry, water/wastewater treatment, assessment of environmental effects, assessment of public health risks, and consenting.

1.3 My previous academic background prior to consultancy involved undertaking research projects aimed at improving water/wastewater treatment technologies, understanding the fate and transport of

environmental pollutants, and quantifying public health risks associated with treated wastewater discharge.

1.4 I have prepared assessments of environmental effects for a number of wastewater treatment plant (**WWTP**) consent applications and renewals, and have been the technical lead in various WWTP discharge water quality assessment/reporting projects (e.g. Waihi Beach WWTP, Matata WWTP, etc.). I have also reviewed or assessed various wastewater treatment processes and provided process design solutions for a number of WWTP upgrade projects (e.g. Te Puke WWTP, Taipa WWTP, Dungog WWTP, Mangere WWTP, etc.).

Involvement in Proposed Plan Change 1

1.5 I was engaged by WARTA to provide evidence relevant to Policy 11 of Plan Change 1 (**PC1**) regarding offsetting. I was not involved in the preparation of any of the individual councils' original submissions or the WARTA further submission.

Purpose and scope of evidence

1.6 The purpose of this evidence is to provide an evaluation of Policy 11 of PC1 and, specifically, the offset mitigation parameters allowed for by this policy for point source discharges. I do this by reference to a case study I recently led to develop offsetting options for managing wastewater discharges from Waipa District Council's Cambridge WWTP.

1.7 My evidence is structured as follows:

(a) Cambridge WWTP case study (Section 3).

(b) Lessons learned from Cambridge WWTP case study (Section 4).

(c) Recommendations on Policy 11 of PC1 based on lessons learned from the Cambridge WWTP case study (Section 5).

1.8 A summary of my evidence is contained in Section 2 below.

Expert Witness Code of Conduct

1.9 I have read and I agree to comply with the Code of Conduct for Expert Witnesses contained in the Environment Court Consolidated Practice Note (2014). I confirm that the issues addressed in this statement are within my area of expertise and that in preparing my evidence I have not omitted

to consider material facts known to me that might alter or detract from the opinions expressed.

2. SUMMARY OF EVIDENCE

2.1 In December 2011, the Waipa District Council (**Council**) lodged a resource consent application for a costly (in the order of $27M, 2011 figures) upgrade to the Cambridge WWTP. The application has been on hold while the Council explores potential alternative options for the upgrade of Cambridge WWTP that would be less costly but still result in less contaminants being discharged to the Waikato River. One of those options is to rely on the provisions of Policy 11 of Plan Change 1 (**PC1**) relating to offset mitigation.

2.2 GHD carried out a preliminary offset investigation and as part of that investigation identified land management options, which, when combined with some upgrades to the WWTP, may deliver a better economic, social and environmental outcome than the costly WWTP upgrade option applied for in 2011 which may not provide significant value in terms of environmental betterment in any event.

2.3 The investigation was based on international best practice.The offsetting option that was identified for further investigation is riparian planting and fencing along 45 kilometres of rivers and streams that feed into the Waikato River from the Karapiro hill country sub-catchment. The investigation indicates that there would be significant savings from a combination of the offsetting and some upgrades to the Cambridge WWTP by comparison with the costly upgrade proposed in the 2011 application.

2.4 Overall, I am supportive of the intent of Policy 11 of PC1. Based on the Cambridge WWTP case study findings, I consider that this policy, if applied appropriately, can provide opportunities to improve water quality within the Waikato and Waipa River catchments.

2.5 However, throughout the process of the case study, I noted some deficiencies in the policy which need to be addressed in order for the intent of PC1 to be better achieved. In that regard, it is my view that Policy 11 needs to be amended to provide for offset of different parameters (e.g. N for P and vice versa) as there are likely to be site-specific circumstances in which that will achieve a better water quality outcome for the Waikato River. I also consider that Policy 11 should provide for offsetting to improve ecological habitat as that is a key component of achieving the Vision and Strategy, but it is currently not provided for in Policy 11. This will provide

flexibility for offset option development and facilitate finding catchment-specific solutions for net environmental improvement.

2.6 Policy 11 of PC1 is a very high level policy only at this stage. In my view, it is critical to develop a robust offset mechanism or methodology with clear objectives and principles before it can be applied within the region.

2.7 The offset methodology should be developed based on a well-calibrated catchment nutrient release and impact model; and provide a suite of acceptable offset options, land management options in particular, with the respective offset capacity calculation formula. This will ensure that all future nutrient offset schemes are developed with consistency and transparency, and the verification of the offset objectives may be simplified.

3. CAMBRIDGE WWTP CASE STUDY

3.1 I have **attached** as **Appendix 1** of my evidence the GHD report titled *Cambridge WWTP – Option 3 Offsetting Options for Managing Wastewater Discharge from Cambridge WWTP*, April 2019. I refer to this in my evidence as "the report". I was the lead author for the report.

Application for consent for continued operation and upgrading of Cambridge WWTP

3.2 A consent application was lodged by the Council in December 2011 to cover the consent approvals required for a major plant upgrade that would have cost in the order of $27M (2011 figure, which is very likely to have increased by 2019, with significantly higher population connection projected when compared to 2011).

3.3 The application has been on hold since that time while the Council has put continuous effort into finding alternative, more cost effective ways to meet expected final effluent quality. This included a significant NIWA trial at Cambridge WWTP to test the effectiveness of high rate algae ponds to replace the current WWTP. I understand that whilst the trial itself was successful, it was deemed an unrealistic solution given the scale of plant needed to service the current and future Cambridge population growth.

Introduction of PC 1

3.4 With the introduction of the policy provisions for offset mitigation for point source discharges in Plan Change 1, Council considered that an alternate option using offsetting for maximising its environmental return on

investment was worth exploring. As a result, GHD was engaged by the Council to prepare the report.

Overview of the report

3.5 The report recognises that:

(a) the Cambridge WWTP effluent discharges have a low contribution to the Waikato River in regards to nutrient and pathogen loads (as noted in 2011 AEE); and

(b) an upgrade to the Cambridge WWTP to achieve nutrient removal in line with what was proposed in the 2011 application requires significant capital investment and is unlikely to result in a commensurate improvement in water quality in the receiving environment.

3.6 It was therefore considered that nutrient offset mitigation measures in the wider catchment alongside some level of WWTP upgrade may support an overall betterment of the wider catchment environment at a lower cost to the Waipa community. The report investigated the feasibility of implementing a nutrient offset scheme for Cambridge WWTP. The key objective of this investigation was to identify a list of plausible offset mitigation options in conjunction with necessary WWTP upgrades to reduce contaminant loading into the receiving environment and achieve economic, social, and environmental targets.

Use of international best practice

3.7 As Policy 11 of Plan Change 1 was still at the submission stage, and its offset mitigation framework is largely undeveloped and untested, the general principles for offsetting option development and assessment were developed as part of this study, based on international practice, specifically:

(a) Deliver net environmental benefit compared to actions that would otherwise be required.

(b) Be cost effective in addressing the potential adverse environmental impact.

(c) Not facilitate or reward poor environmental management practices.

3.8 In light of the principles above, the objective of the investigation was not intended to be a substitute for good environmental practices (e.g. significant upgrade of treatment works is still needed to achieve high levels of nutrient removal etc.). Rather, the environmental offset options explored were intended to be one component of an overall strategy to ensure the best economic, social, and environmental outcome.

Overview of report findings

3.9 The assessment in the report was a high level assessment of the potential for Council to apply a nutrient offset approach, along with upgrades to some treatment processes at the Cambridge WWTP, as an alternative to the very costly upgrade of the Cambridge WWTP. The assessment findings have shown that there is potentially a viable and affordable option; I briefly summarise this below.

3.10 The offset options considered included both point source and diffuse land use management offset options. The report found that a combination of fencing and riparian planting was likely to be the most practicable to apply.

3.11 Sub-catchment-level offset location options were identified in the report and a multi-criteria analysis (MCA) framework was used to compare identified fencing and riparian planting options.

3.12 Based on the preliminary MCA findings, Option 3B, involving fencing and riparian planting within the Karapiro hill country sub-catchment, and a suite of optimisation/upgrade works at the plant, was found to provide adequate nutrient removal capacity that met the nutrient offset target identified in the report. The Karapiro hill country sub-catchment is within the same FMU as the WWTP discharge but a different sub-catchment (upstream). The fencing and riparian planting of native trees and shrubs would comprise 45 kilometres of fencing and 20 metre wide riparian planting along the rivers or streams in the Karapiro hill country sub-catchment that discharge into the Waikato River.

3.13 An outline of the total cost comparison between Option 3B and Option 1 is provided in Table 3-1 below. Detailed assumptions and calculation methods are provided in Appendix 1 of my evidence and are not repeated here. It was considered that Option 3B would result in significant total cost saving over a period of 25 years. This is also manifested in the calculated nitrogen removal unit cost as shown in Table 3-1.

Table 3-1 Cost Comparison Between Option 3B and Option 1

Items	Unit	Option 3B	Option 1
Fencing Cost	$/km	$8,000	-
Riparian planting cost	$/ha	$30,000	-
Offset Average Capital Cost	$	$4,250,000	-
WWTP Upgrade Cost	$	$14,756,000	$26,600,000
Total Capital Cost	$	$19,006,000	$26,600,000
Operational Cost	$/yr	$1,457,920	$1,862,000
NPV Operational Cost	$	$20,547,844	$26,242,925
Interest Rate	%	5%	5%
Total Cost over 25 years	$	$39,554,000	$52,843,000
Nitrogen removal unit cost	$/kg/d	$108,692	$170,461

3.14 The target identified was based on achieving a level of nitrogen reduction over the 25 year consent term period initially sought in the 2011 major plant upgrade consent application (referred to as Option 1 in the report). Pending further confirmation, this level of nutrients discharged from the site was assessed as having minimal adverse effects on the receiving environment in the AEE produced for the Option 1 proposal.

3.15 Refinement and confirmation of the option assessment framework and methodology and refinement of the offset option development still needs to be undertaken to confirm that a net environmental benefit can be achieved. Recommendations are included in the report to progress this. A Business Case evaluation, which involves input from key stakeholders including iwi and WRC, is now underway to select a preferred option to progress for the long term consent renewal for the Cambridge WWTP.

4. LESSONS FROM THE CAMBRIDGE WORK THAT ARE RELEVANT TO THIS HEARING

4.1 In carrying out the work for the Council, I relied heavily on the research findings completed both internationally and nationally. There are limited local data available, so the information gap is significant, particularly in terms of assessing nutrient loading potentials in small land scale within the region and estimating the nutrient removal capacity readily achievable by various land management options. Consequently, the report adopted very conservative approaches to account for potential uncertainties.

4.2 Comparing against some developed nutrient offset frameworks internationally, it is my view that a nominated nutrient leaching model for the catchment and nutrient offset calculation model for various acceptable land management options should be made available for practitioners. This will ensure that all nutrient offset option development works in the future are carried out consistently and transparently. I understand that NIWA has developed such a model for the Waikato Region that needs to be verified and calibrated.

4.3 As part of the outcomes of this case study, I found that nitrogen was relatively easier to offset via land management options than phosphorus. In this regard, it was necessary to include a combination of treatment at source and offsetting elsewhere to deal with both contaminants associated with the discharge effects of this WWTP operation. This is likely to be a similar scenario with other WWTP discharges (P being the most difficult to offset by land management options) and, within the confines of PC1 as it stands, will result in the need to provide additional plant upgrades to reduce P loads.

4.4 Different receiving environments or locations may have varying sensitivity to different contaminants. For instance, the plankton production limitation within a single river may change from nitrogen-limiting to phosphorus-limiting at various sub-catchment locations. It is therefore often practised internationally that various contaminants are allowed to offset interchangeably. This, in my opinion, will provide flexibility of nutrient offset option development and allow resolving specific catchment or sub-catchment issues. This is, however, currently not allowed under the notified Policy 11 of PC1.

4.5 Further to this matter, it is my view that an effective offsetting scheme, where appropriate, should provide for opportunities to deliver other less quantifiable environmental improvements linked to achieving the Vision and Strategy. This may include ecological habitat improvement (e.g. shading from riparian planting providing better control of stream water temperature, riparian buffer providing habitat for birdlife and other fauna improving biodiversity of the region, etc.).

4.6 As mentioned above, PC 1 has a requirement to only offset "like for like" parameters (i.e. P for P, N for N, etc.). Even though it is not explored in the Cambridge WWTP case study due to the current constraints of PC1, in my view the benefits of investigating those less-quantifiable or aligned parameters are considered relevant for Cambridge WWTP and other similar

point source discharges in the region. This is because no direct or measurable environmental adverse effects can be attributed to the discharge from the site, even in the current state of non-compliance. With this in mind, investment into improvement activities may be better focused on biodiversity outcomes.

4.7 To enable this to occur, the evidence of WARTA planner, Mary O'Callahan, has developed amendments to Policy 11 to enable consideration of biodiversity outcomes. I support the amendments proposed.

4.8 Downstream offset options were constrained by virtue of the policy which limits offsetting to locations within the same Freshwater Management Unit ("FMU") or an upstream FMU only. As with the approach above, this can limit what can be achieved in terms of catchment wide improvement and overall progress towards achieving the Vision and Strategy for the River. Although I agree that offset options are ideally focused in the vicinity of the point-source discharge locations, it is my opinion that wider areas (e.g. downstream sub-catchment, etc.) should be allowed to be considered.

5. RECOMMENDATIONS FOR POLICY 11

5.1 Policy 11 of PC1 provides a useful and important mechanism to address potential environmental adverse effects in the wider Waikato and Waipa River catchments. Based on the lessons learned from the Cambridge WWTP case study, it is my opinion that further development of the offset framework is needed and some of my key recommendations are summarised in this section.

5.2 Policy 11 of PC1 is a very high level policy only at this stage. In my view, it is critical to develop a robust offset mechanism or methodology with clear objectives and principles before it can be applied within the region.

5.3 The offset methodology should be developed based on a well-calibrated catchment nutrient release and impact model; and provide a suite of acceptable offset options, land management options in particular, with the respective offset capacity calculation formula. This will ensure that all future nutrient offset schemes are developed with consistency and transparency, and the verification of the offset objectives may be simplified.

5.4 In my opinion, the offset policy should be amended to provide more flexibility in terms of acceptable locations (i.e., downstream) and contaminants interchangeability. Pending the specific site assessment or

the catchment model, various parameters should be allowed to offset against each other. Also, there should be a pathway or mechanism to allow for consideration of ecological habitat indices in the offset policy.

5.5 In addition, Policy 11(a) (the requirement to avoid significant toxic effects at the discharge location) only relates to toxicity. I consider that it should relate to any significant adverse effects. In that respect, ammonia is considered the only parameter that may lead to fish toxicity, but in terms of human health the key parameters are microbial pathogens. While those parameters are both important, nutrients are the key environmental concern in the Waikato and Waipa Rivers. It is therefore my opinion that clause (a) of Policy 11 should be amended as follows:

"Primary discharge does not result in any significant ~~toxic~~ adverse environmental effect at the point source discharge location; and"

Zhuo Chen
3 May 2019