**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 1** topics

**AND**

**IN THE MATTER** of the hearing of the submission by **WATERCARE SERVICES LIMITED** in relation to **BLOCK 1** topics

# STATEMENT OF EVIDENCE OF GARRETT JOHN HALL

## 1. INTRODUCTION

### Qualifications and experience

1.1 My full name is Garrett John Hall. I hold an MSc (Hons) in Environmental Science (Environmental Chemistry) (1999) and a BSc in Physical Geography (1997), both from the University of Auckland. I am a Certified Environmental Practitioner (CEnvP), an Associate Member of the New Zealand Planning Institute (Assoc.NZPI), a Practitioner Member of the Institute of Environmental Management and Assessment (PIEMA) and a member of the Resource Management Law Association.

1.2 I am Technical Director – Environments at Beca Ltd. I have 19 years' experience in my field of practice. My experience of particular relevance to Plan Change 1 ("PC1") includes advising on the effects of various infrastructure projects on water quality. I have provided technical advice to local authorities for the following municipal treated wastewater discharge consent projects in the Waikato Region:

(a) Pukekohe (including the areas of Pokeno and Tuakau);

(b) Te Awamutu;

(c) Hamilton;

(d) Otorohanga;

(e) Waihou;

(f) Huntly;

(g) Ngaruawahia;

(h) Meremere; and

(i) Te Kowhai.

**Involvement in Proposed Plan Change 1**

1.3 My involvement to date in the PC1 process has been to:

(a) Contribute to the submission process and further submission process for PC1 and Variation 1 to PC1 for Watercare Services Limited ("Watercare"); and

(b) Attend the Information Forum on Economic and Science Modelling in November 2018 on behalf of Watercare.

**Purpose and scope of evidence**

1.4 The purpose of this evidence is to provide water quality evidence to support Watercare's primary and further submissions on PC1.

1.5 My evidence addresses:

(a) Assimilative capacity of the Waikato and Waipā Rivers (Section 3);

(b) Water quality targets – Table 3.11-1 (Sections 4 to 7);

(c) The Officer's Report (Section 8); and

(d) My conclusions (Section 9).

1.6 A summary of my evidence is contained in Section 2.

**Expert Witness Code of Conduct**

1.7 I have read the Code of Conduct for Expert Witnesses, contained in the Environment Court Consolidated Practice Note (2014) and I agree to comply with it. I can 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 Consistent with Watercare's position, I am supportive of PC1 insofar as it:

(a) Seeks to reduce the amount of contaminants entering the Waikato River from the Waikato and Waipā catchments;

(b) Has been developed to achieve the Vision and Strategy; and

(c) Seeks to give effect to the NPS-FM.

2.2 However, it is my view that PC1 has a number of significant shortcomings that need to be addressed.

### Assimilative capacity

2.3 Assimilative capacity is the ability of a water body to dilute and subsequently incorporate/alter contaminants discharged to the water body. In my experience of consenting wastewater treatment plant ("WWTP") point source discharges to water bodies, a zone of reasonable mixing is always provided for and end-of-pipe limits are imposed in the knowledge that the concentration of the relevant contaminant will be measured in the water body after the zone of reasonable mixing.

2.4 While the provisions of PC1 refer to assimilative capacity, there is no reference to assimilative capacity in the objectives of PC1. Unless PC1 specifically addresses the matter, I am concerned that there is in potential for Objectives 1 and 3 to be interpreted in such a manner that the short and long term water quality targets / limits for nitrogen, phosphorus, sediment and microbial pathogens are required to be met at the end-of-pipe rather than after the zone of reasonable mixing which factors in the assimilative capacity of a water body.

2.5 Mr Scrafton addresses assimilative capacity further in his evidence and recommends amendments to PC1 in that regard.

### Water quality targets

2.6 There are number of shortcomings with the water quality targets contained within Table 3.11-1 which I address below.

2.7 The short and long term water quality targets / limits for ammonia provided for in PC1 are unrealistically low at numerous locations down the Waikato River. The targets / limits for ammonia are lower than required by Attribute State A in the National Policy Statement for Freshwater

Management and lower than required by the ANZECC (2000) Guidelines. Even the most modern state-of-the-art treatment plant could not achieve the target / limit after reasonable mixing.

2.8 I have recommended a revised set of limits for the mainstem of the Waikato River based on results reported from recent Waikato Regional Council ("WRC") monitoring and accepted principles for handling statistical datasets. Importantly, I agree with the concept of not allowing a degradation in these limits from their current state; however, the process of arriving at the current state values appears to me to be somewhat arbitrary.

2.9 The long term water quality targets included in PC1 do not reflect a gradual deterioration of water quality down the Waikato River arising from cumulative effects of discharges. Instead they would result in a stepped decrease in water quality with significant steps between some areas. I have recommended these limits be revised to remove arbitrary geographical boundaries.

2.10 There is a variation in seasonal effects of treated wastewater discharges between the summer and winter seasons due to:

(a) Greater flows during winter that are available to dilute contaminants compared to the summer low flows that significantly reduce the dilution factor; and

(b) The differing algal growth rates in the Waikato River between summer and winter.

2.11 Neither the short term nor long term water quality targets / limits in PC1 contain any recognition of this seasonal variation. This is an important consideration for the discharge of municipal wastewater which has been recognised in the Pukekohe Wastewater Treatment Plant ("PWWTP") discharge consent and others throughout the Waikato Region. The potential (indeed, likelihood) therefore arises for the PC1 limits to be directly imposed on resource consents without the crucial recognition of the differing seasonal effects of treated wastewater discharges.

2.12 As part of reviewing the Table 3.11-1, I have also investigated the breakdown of the long-term Total Nitrogen (TN) target between ammonia, nitrate and TN. At three sites on the Waikato River (Waipapa, Huntly, and Mercer), the long-term nitrate targets are greater than the equivalent TN targets. This is simply not possible and would appear to be an error. Given

this, there is a need to review both the nitrate and TN limits for sites downstream of Whakamaru, for both the accuracy of the concentration value and the relative proportion of nitrogen species.

**Comments on the Officers' Report**

2.13 For the reasons outlined in this statement, I disagree with the Officers' Report that the provisions of PC1 adequately address seasonality effects. I consider that amendments to the policies of PC1 are required to address seasonality effects. I have nevertheless addressed seasonality effects in this evidence in response to comments on the matter in the Officers' Report.

2.14 By reference to Watercare's submission, the Officers' Report (Section 587) states that it is unclear what the 'artificial boundaries' between upper and lower catchments are, as the water quality targets for each FMU are based on improvement from current state data. I have provided a further explanation on those boundaries in Section 6 of my evidence.

## 3. ASSIMILATIVE CAPACITY OF THE WAIKATO AND WAIPĀ RIVERS

3.1 PC1 recognises the assimilative capacity of the Waikato and Waipā Rivers in the use value 'Economic or Commercial Development' (3.11.1.2) which states that:

> *"Fresh water is used for industrial and municipal process, which rely on the assimilative capacity for discharges to surface water bodies."*

3.2 This use value also states that:

- *"The rivers provide assimilative capacity for wastewater disposal, flood and stormwater."*

3.3 Assimilative capacity is the ability of a water body to dilute and subsequently incorporate/alter contaminants discharged to the water body. In the context of a point source WWTP discharge to water, dilution occurs in what has long been recognised as "the zone of reasonable mixing". Monitoring for compliance with consent limits is undertaken at the edge of the zone.

3.4 The Waikato and Waipā Rivers have significant assimilative capacity. For example, the dilution provided by the Waikato River near Tuakau at the location of the Pukekohe WWTP ("PWWTP") discharge is 736 fold (projected at the end of the granted 35 year consent) during summer low flow and

much greater than that during winter flows[1]. This means that contaminants are rapidly diluted within a short distance to much lower levels than at the discharge point.

3.5 In my experience of WWTP point source discharges to water bodies, a zone of reasonable mixing is always applied and the end-of-pipe limits are imposed knowing what the concentration of a contaminant will then be in the water body after the zone of reasonable mixing. These end-of-pipe limits are typically based on a worst case assessment of environmental effects, which usually involves minimal dilutions at times of summer low flows in the receiving waters.

3.6 While the provisions I have quoted above refer to assimilative capacity, the objectives of PC1 do not contain any reference to assimilative capacity at all. Unless PC1 specifically addresses the matter, I am concerned that there is potential for Objectives 1 and 3 to be interpreted in such a manner that the short and long term water quality targets / limits for nitrogen, phosphorus, sediment and microbial pathogens are required to be met at the end-of-pipe rather than after the zone of reasonable mixing.

3.7 Table 3.11-1 sets out the short and long term water quality targets / limits. The explanatory note in Section 3.11.6 of PC1 states the following regarding the targets / limits in Table 3.11-1:

> "*Within the Waikato and Waipa River catchments, these targets are used in decision-making processes guided by the objectives in Chapter 3.11 and for future monitoring of changes in the state of water quality within the catchments. With regard to consent applications for diffuse discharges or point source discharges of nitrogen, phosphorus, sediment and microbial pathogens, it is not intended, nor is it in the nature of water quality targets, that they be used directly as receiving water compliance limits/standards.* "
>
> (Underlining mine.)

3.8 It is unclear what is meant by the statement "…it is not intended, nor it is in the nature of water quality targets, that they be used directly as receiving water compliance/standards." It may be that it is linked to the need to take into account assimilative capacity and the zone of reasonable mixing. Despite the explanatory note, and in the absence of amendments to PC1 to specifically identify the need to consider assimilative capacity, in my view there is a risk that these targets / limits will be applied in the context of future municipal discharge consenting projects to assess the effects of discharges on receiving waters at the end-of-pipe and, as a

[1] The discharge from the PWWTP is to a small tributary of the Waikato River, the Parker Lane Stream, which at low summer flows provides minimal dilution. The dilution quoted here is for full mixing of the discharge flow with the Waikato River.

result, not take into account the assimilative capacity of the Waikato and Waipā Rivers.

3.9 I comment in Section 5 of my evidence on the implications of this for the municipal treated wastewater discharge from the PWWTP in relation to the assessment of environmental effects under worst case conditions.

3.10 Mr Scrafton also addresses this issue in his evidence and proposes amendments to PC1 to address the issue.

## 4. SEASONALITY EFFECTS

4.1 At the Information Forum for PC1 held on Economic and Science modelling, it was recognised (in response to questions) that the modelling undertaken for PC1 on nitrogen/phosphorus and its relationship to algal biomass concentrations in the Waikato River did not account for seasonality effects. This was recognised by the NIWA experts presenting the model as an area for 'further work' over the term of implementing PC1.

4.2 I agree that further technical work on the water quality modelling should account for seasonality effects.

### Pukekohe WWTP TN and TP seasonality limits

4.3 The seasonality effects of discharges, i.e., differentiating between summer and winter effects and related consent limits, are recognised in several discharge consents in the Waikato River catchment. However, such effects are not currently recognised or provided for in the objectives for PC1.

4.4 For example, Watercare's discharge consent for the PWWTP has different TN and total phosphorus (TP) mass load limits depending on the time of year. In that respect, the pre-upgrade limits are set out in Condition 28, which states the following:

> *"Up to four years from the date of commencement of this resource consent (stage 1 discharge) the consent holder shall ensure that the treated wastewater leaving the treatment plant does not exceed the following limits:*
>
> *…*
>
> *(d) The median summer (December to May inclusive) total nitrogen (TN) load shall not exceed 88 kilograms per day;*
>
> *(e) The median winter (June to November inclusive) TN load shall not exceed 185 kilograms per day;*

*(f) The median (December to May inclusive) total phosphorus (TP) load shall not exceed 36 kilograms per day;*

*(g) The median winter (June to November inclusive) TP load shall not exceed 85 kilograms per day; and*

*…"*

4.5 The post upgrade limits are in Condition 29, which states the following:

*"From commencement of the Stage 2 discharge and for the remaining duration of this resource consent (Stage 2 discharge), the consent holder shall ensure that the quality of the treated wastewater discharge at the discharge point does not exceed the following limits:*

*…*

*(d) The median summer (December to May inclusive) total nitrogen (TN) load shall not exceed 88 kilograms per day;*

*(e) The median winter (June to November) TN load shall not exceed 185 kilograms per day;*

*(f) The median summer (December to May inclusive) total phosphorus (TP) load shall not exceed 22 kilograms per day;*

*(g) The median winter (June to November inclusive) TP load shall not exceed 85 kilograms per day; and*

*…"*

4.6 The higher load limits for TN and TP from June to November in the above conditions recognise a number of environmental conditions that affect the environmental effects of the discharge differently between summer and winter. In that regard, I note that:

(a) The significantly greater flows in the Waikato River during winter that are available to dilute contaminants compared to the summer low flows that do not have as much dilution. The different limits in the above conditions are recognition of the assimilative capacity of the Waikato River in the zone of reasonable mixing for the discharge from the PWWTP.

(b) Algae does not grow (to any significant extent) during winter conditions within the Waikato River and the river is less susceptible to inputs of TN and TP from point source discharges at these times. Consequently, mass load limits for TN and TP are stricter in summer and more permissive in winter, to respond to these environmental effects.

**PC1 recognition of seasonality**

4.7 The explanatory note in Section 3.11.6 of PC1 states the following in relation to seasonality:

> *"The achievement of the attribute targets in Table 3.11-1 will be determined through analysis of 5-yearly monitoring data. The variability in water quality (such as due to seasonal and climatic events) and variable response times of the system to implementation of mitigations may mean that targets are not observed for every attribute at all sites in the short term"*

4.8 I consider this to be an acceptable method to account for seasonal variation between years; however, it does not account for variation between summer and winter within a single year, as is provided for in many discharge consents, including the PWWTP consent. If the PC1 5-yearly targets are applied to winter discharge scenarios, for example, then this would:

(a) Not accurately assess environmental effects – as discussed earlier algae grows to a much greater extent in summer conditions and much lesser extent in winter; and point source discharges have greater influence in low flow (summer) conditions when rainfall/runoff from land use is much less;

(b) Potentially require WWTP's to achieve low winter nutrient limits that are not justified on an environmental effects basis – with subsequent significant capital and operating cost implications. This is because biological wastewater treatment processes take much more energy and inputs (i.e. chemicals) to work efficiently in low temperatures during winter conditions.

4.9 For the reason just outlined, I consider that amendments should be made to the policies of PC1 to include a mechanism which recognises and provides for the seasonality effects of municipal wastewater treatment plant discharges (between summer and winter) to ensure the short and long term water quality targets are not applied to assess winter scenarios in an inappropriate way. While amendments to policies are a Block 2 matter, I have addressed it in this evidence in response to the comments in the Officers' Report for the Block 1 hearings – see Section 8 below.

## 5. WATER QUALITY TARGETS FOR TOTAL AMMONIACAL-NITROGEN

5.1 Table 3.11-1 contains short and long term water quality targets for annual median and annual maximum ammonia measured as $NH_4$-N (called total

ammoniacal nitrogen). In Figure 1, I have graphed the following for each of the sites on the mainstem of the Waikato River:

(a) Current state – referenced from the Section 32 Report for PC1 (section D.4 Appendices). These current states are listed as between 2010-2014;

(b) Five-year median value reported in the Waikato River Monitoring Report: Data Report 2016[2]; and

(c) The short term (10 year) and long term (80 year) water quality targets.

5.2 Figure 1 also shows the current laboratory detection limit for the method used to test for ammonia, reported as less than 0.01 mg/L in the Waikato Regional Council Data Report 2016[3].

5.3 Figure 1 also shows the value of 0.005mg/L, being the commonly accepted statistical practice of halving any non-detect values, as a way of handling these values for statistical analysis. For example, if two ammonia samples were reported in the raw data as having values of <0.01 mg/L (i.e. below the limit of detection for the laboratory method) and one sample as having a value of 0.02 mg/L, then to average these values the average would be taken of 0.005 mg/L, 0.005 mg/L and 0.02 mg/L. The average for the three samples would then be reported as 0.01 mg/L.

5.4 Examination of Figure 1 reveals several issues with the ammonia targets, which are addressed further below.

**First issue – targets less than half the detection limit**

5.5 The first issue is that the short and long term targets are less than half the detection limit at several sites including Ohaaki (0.002 mg/L), Ohakuri (0.003 mg/L), Whakamaru (0.003 mg/L), Mercer (0.003 mg/L) and Tuakau (0.003 mg/L).

5.6 The 2016 Data Report 5-year median is reported as less than 0.01 mg/L at these sites (which defaults to 0.005 mg/L for data handling purposes). Given this, it is not clear how these short and long term targets were arrived at.

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[2] Waikato River Water Quality Monitoring Programme: Data Report 2016. Waikato Regional Council Technical Report 2017/14.

[3] Raw data summary – page 22.

5.7 These targets are unusually low and certainly well below any relevant toxicity guideline value included in the National Policy Statement for Freshwater Management (Attribute State Value A annual median is less than 0.03 mg/L).

5.8 The targets are also below what ANZECC (2000) identifies as a default trigger value for physical and chemical stressors at 0.021 mg/L for New Zealand freshwaters[4].

**Second issue – apparent inconsistency in data**

5.9 The second issue is that, for several sites, the WRC Data Report 2016 reports 5-year median values much higher than the current state reported in the Section 32 report. This includes sites at Waipapa, Narrows and Huntly. The 2016 Data Report value for Horotiu is only slightly different to the Section 32 current state value.

**Implication for WWTP discharges**

5.10 Such low target values in Table 3.11-1 would cause problems in that municipal wastewater treatment plants contain relatively elevated concentrations of ammonia in their treated wastewater discharge. Whilst wastewater treatment technology is improving all the time, even the PWWTP (which is a modern state-of-the-art treatment plant) has a consented 90%ile concentration limit of 2.3 mg/L for total ammoniacal nitrogen. To achieve the proposed short and long term target at Tuakau (the closest water quality target site) contained within Table 3.11-1 of 0.003 mg/L in the Waikato River, a dilution of at least 766 fold would be required.

5.11 At low summer low flows, a dilution of only 736 fold, assuming reasonable mixing with the entire Waikato River flow, will be available at the end of the granted 35 year consent for the Pukekohe discharge (in 2052). As a result, under these worst case conditions, the water quality target of 0.003 mg/L will not be able to be met[5]. In my view, given this limit cannot be achieved under worst case summer conditions, it is not appropriate that it be used to assess the environmental effects of point source discharges of treated wastewater.

5.12 The above scenario can be compared to the actual effects of the PWWTP discharge, where the predicted downstream concentration in the Parker

[4] Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000). Table 3.3.10.

[5] Noting that at Waikato River median flows a dilution of 1270 fold is predicted.

Lane Stream (prior to the Waikato River) was predicted as being 2.14 mg/L (following the upgrade) compared to the relevant ANZECC Guideline Value of 2.3 mg/L and United States Environmental Protection Authority (USEPA) Criteria of 6.75 mg/L.

**New short and long term ammonia targets**

5.13 Given the above, it is my professional opinion that Table 3.11-1 should be amended to reflect the ammonia concentrations reported in the WRC Data Report 2016 for five year median values. I agree that these revised 'current states' should have 'no increase' for the 10 year and 80 year targets, which is consistent with the approach taken in the PC1 Section 32 Report. These revised ammonia limits are included in Table 1 below. The lowest limits in that table are set at half the laboratory detection limit.

**Table 1: Recommended Revised Ammonia Short and Long Term Targets**

| **Site** | **5-Year Median (WRC Data Report 2016) – non-detects reported as half the detection limit** | **Current PC1 Annual Median Ammonia Targets (mg $NH_4$-N/L)** | | **Revised Annual Median Ammonia Targets (mg $NH_4$-N/L) per the 5-Year Median (WRC Data Report 2016)** | |
|---|---|---|---|---|---|
| | | **Short Term** | **80 Year** | **Short Term** | **80 Year** |
| Waikato River @ Ohaaki | 0.005 | 0.002 | 0.002 | 0.005 | 0.005 |
| Waikato River @ Ohakuri | 0.005 | 0.003 | 0.003 | 0.005 | 0.005 |
| Waikato River @ Whakamaru | 0.005 | 0.003 | 0.003 | 0.005 | 0.005 |

| Site | 5-Year Median (WRC Data Report 2016) – non-detects reported as half the detection limit | Current PC1 Annual Median Ammonia Targets (mg $NH_4$-N/L) | | Revised Annual Median Ammonia Targets (mg $NH_4$-N/L) per the 5-Year Median (WRC Data Report 2016) | |
|---|---|---|---|---|---|
| | | Short Term | 80 Year | Short Term | 80 Year |
| Waikato River @ Waipapa | 0.015 | 0.007 | 0.007 | 0.015 | 0.015 |
| Waikato River @ Narrows | 0.015 | 0.009 | 0.009 | 0.015 | 0.015 |
| Waikato River @ Horotiu | 0.008 | 0.007 | 0.007 | 0.008 | 0.008 |
| Waikato River @ Huntly | 0.011 | 0.005 | 0.005 | 0.011 | 0.011 |
| Waikato River @ Mercer | 0.005 | 0.003 | 0.003 | 0.005 | 0.005 |
| Waikato River @ Tuakau | 0.005 | 0.003 | 0.003 | 0.005 | 0.005 |

## 6. LONG TERM WATER QUALITY TARGETS – ARTIFICIAL BOUNDARIES

6.1 Watercare's original submission to PC1 stated that:

> *"The long-term water quality targets for Total Nitrogen (TN), Total Phosphorus (TP) and chlorophyll-a are the same downstream of Hamilton as those in the Lower Waikato*

> *River. Watercare is concerned that the discharge of contaminants (including treated wastewater) in the Lower Waikato River will not be able to occur without adversely affecting the water quality target unless the concentrations of TN and TP are lower in the discharge than the river water quality target (i.e. a dilution effect). Whilst wastewater treatment technologies currently exist to reduce TP to these concentrations (i.e. the long-term water quality target) there are no such technologies available to reduce TN to the extent required. This will have significant implications for all wastewater discharges in the long-term".*

6.2 I have attached as Figure 2 to my evidence a graph of the short and long term targets for TN from Table 3.11-1 in the Waikato River (from Ohaaki upstream to Tuakau downstream). Figure 2 also shows the current state, reported from the Section 32 Report for PC1 (2010-14) and the 5-year median value reported in the WRC Waikato River Monitoring Report: Data Report 2016.

**Current state TN**

6.3 The most obvious trend shown in Figure 2 is the gradual increase in concentration of TN down the Waikato River. The current state concentrations reported in the Section 32 Report are broadly similar to those in the Waikato River 2016 Data Report.

**Short term TN targets**

6.4 The short term targets follow a broadly similar pattern, with an increase in TN concentration at all sites downstream of Ohakuri.

**Long term TN targets**

6.5 However, the long-term targets follow a different pattern in that there are two 'bands' where the concentrations remain the same, one between Ohakuri and Waipapa, and the other between Narrows and Tuakau. Between the sites Waipapa and Narrows there is a single and relatively large increase in the concentration.

6.6 In my view, this single large increase has an unintended consequence of potentially allowing point source discharges located between Waipapa and Narrows to discharge contaminants at a large scale with no impact on the long-term target.

6.7 The other consequence of these targets, if they are adopted in terms of determining future compliance, is that they do not allow for the cumulative increase in TN concentrations that occur further down the Waikato River. Any discharge of TN downstream of Narrows (for example), unless it is at

or below a concentration of 0.35 mg/L, would have an adverse effect on the achievement of the TN water quality target. The current limit of operational technology for TN for an advanced WWTP is between 4.5 – 5 mg/L.

**Recommendations regarding TN targets**

6.8 In terms of the long-term TN water quality targets, it is my opinion that:

(a) The long-term targets should reflect the gradual increase in TN concentration that occurs downstream and not introduce artificial boundaries (or sharp jumps in target concentrations); and

(b) A downstream target of 0.35 mg/L at Tuakau should be maintained (i.e. the long-term target at Tuakau should not be changed). However, the upstream targets should reflect a gradual downstream increase to this site.

**Long term TP targets**

6.9 In Figure 3, I have included a graph of TP concentrations downstream on the Waikato River. The same long-term concentration applies downstream of Whakamaru. In my opinion, these long-term targets should be modified in the same way as TN to reflect a gradual decrease in water quality downstream in the Waikato River.

6.10 Given the large amount of water quality modelling undertaken to support PC1, I have not included revised targets for TN and TP here; however, it is obvious that some arbitrary decisions have been made in arriving at the targets that have been applied to the main stem of the Waikato River.

## 7. LONG TERM WATER QUALITY TARGETS – ERRORS IN RELATION TO NITROGEN TARGETS

7.1 As part of reviewing the TN concentrations, I have also investigated the breakdown of the long-term TN target between ammonia, nitrate and TN. The long-term targets for the Waikato River are graphed in Figure 4.

7.2 As nitrate and ammonia are species that make up TN, it is expected that these limits would be less than the TN limit, as there are other components in TN in addition to ammonia and nitrate, including organic nitrogen compounds and nitrite.

7.3 At the upper three sites on the Waikato River, Figure 4 shows low concentrations of ammonia, higher concentrations of nitrate, and then a higher again concentration of TN. This is as expected at these sites, given the relatively high proportion of TN being Dissolved Organic Nitrogen (DON) within the water sourced from Lake Taupo.

7.4 However, at Waipapa, Huntly, and Mercer the long-term nitrate targets are greater than the equivalent TN targets. This is simply not possible and would therefore appear to be an error.

7.5 I have further graphed the nitrate limits in Figure 5. The short and long term limits seem to have been derived from maintaining the current state, which is inconsistent with the downstream trend in TN short and long term limits.

7.6 Given the above, there is in my opinion a need to review both the nitrate and TN limits for sites downstream of Whakamaru, for both the accuracy of the concentration value and the relative proportion of nitrogen species.

7.7 NIWA has developed a specific water quality model for PC1, so would make sense that this work is undertaken by NIWA and then made available to submitters.

7.8 The long term targets for ammonia, nitrate and TN at Tuakau appear to be appropriate in terms of the breakdown between species (i.e. the nitrate target is less than then TN target).

## 8. COMMENT ON THE OFFICER'S REPORT

8.1 Sections 584-586 of the Officers Report acknowledge that some of the ammonia limits are lower than the detection limits for the chemical test used by the WRC's current contracting laboratory. However, they suggest more sensitive methods are available that could be used in the future. The officers do not recommend that the ammonia targets be changed to be better aligned to current test procedures.

8.2 As discussed earlier in my evidence, the very low ammonia limits are unnecessarily low and, in my view, should be amended to reflect Table 1 of my evidence.

8.3 The Officers Report (Section 586) states that the achievement of the targets in Table 3.11-1 will be determined through analysis of 5-yearly monitoring data, which will account for any short term variability in water quality, including seasonal variability. As such, it was concluded that

seasonal variation in point source loads are unlikely to compromise meeting the PC1 targets and the Officers therefore do not consider that amendments are necessary to provide for seasonality of point source discharges.

8.4 Earlier in my evidence, I:

(a) Provided an explanation of seasonality effects, both in terms of seasonal variations in the receiving environment of the Waikato River;

(b) Explained how those seasonal effects are currently catered for within existing discharge consents; and

(c) Addressed why the provisions of PC1 are not adequate with respect to seasonality and noted that amendments should be made to the policies of PC1 to address this issue.

8.5 While amendments to policies are a Block 2 matter, I have addressed it in this evidence in response to the comments in the Officers' Report for the Block 1 hearings.

8.6 By reference to Watercare's submission, the Officers report (Section 587) states that it is unclear what the 'artificial boundaries' between upper and lower catchments are, as the water quality targets for each FMU are based on improvement from current state data. I have provided a further explanation on those boundaries earlier in my evidence.

## 9. CONCLUSIONS

9.1 Overall, I am supportive of PC1 insofar as it:

(a) Seeks to reduce the amount of contaminants entering the Waikato River from the Waikato and Waipā catchments;

(b) Has been developed to achieve the Vision and Strategy; and

(c) Seeks to give effect to the NPS-FM.

9.2 PC1 can be improved with specific reference to assimilative capacity of municipal wastewater discharges and I have provided some examples of how this concept can be applied in the Waikato River catchment.

9.3 I have identified some issues with Table 3.11-1, both with its potential application to the wastewater discharge consent process, but also the

specific numbers contained within it in relation to ammonia, nitrate, TN and TP.

**Garrett Hall**
**15 February 2019**

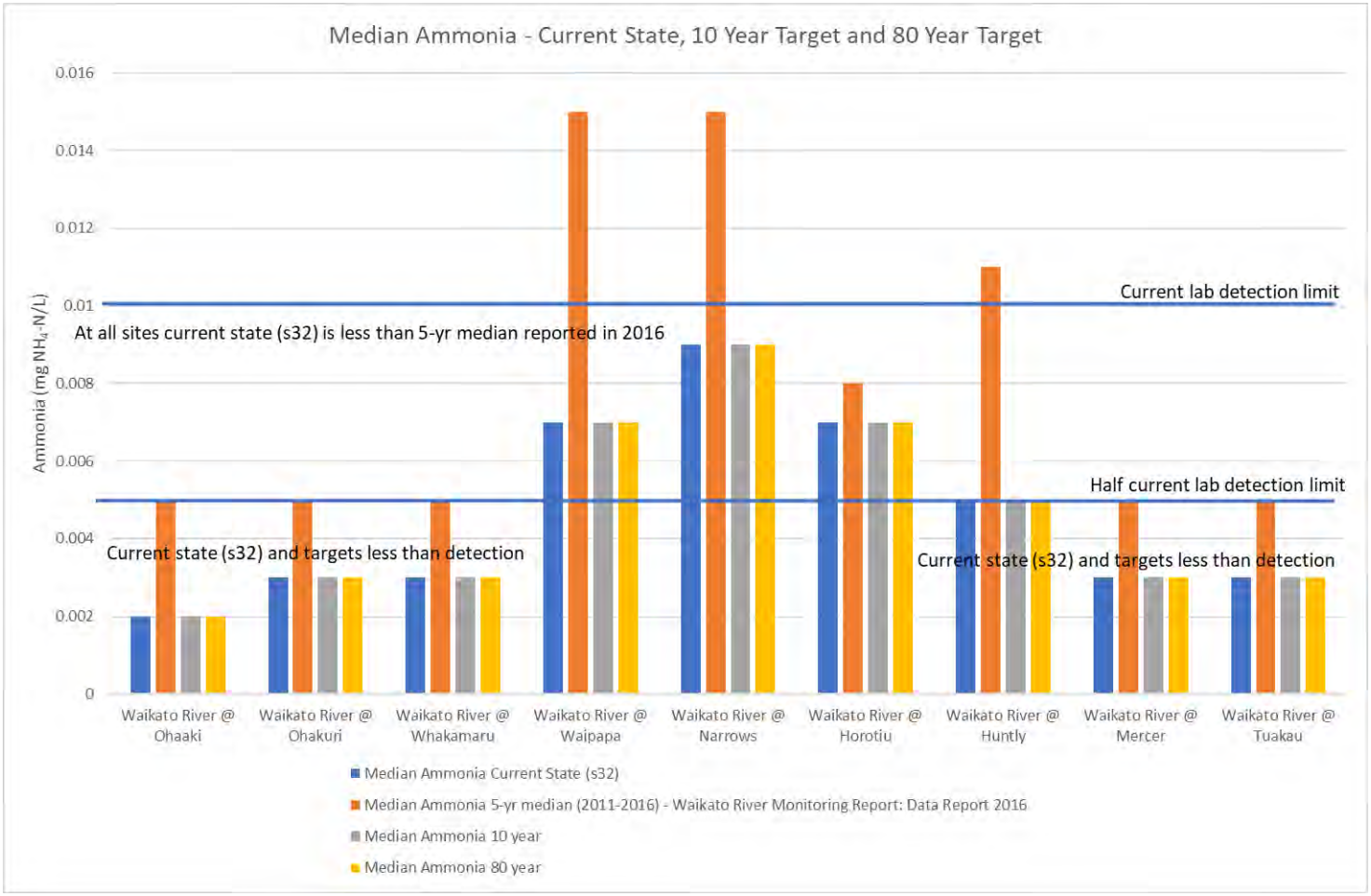


Figure 1: Median Ammonia Water Quality Target – Current State (s32 – 2010-2014), Current State (2016, 5 year median), 10 year and 80 year PC1 target

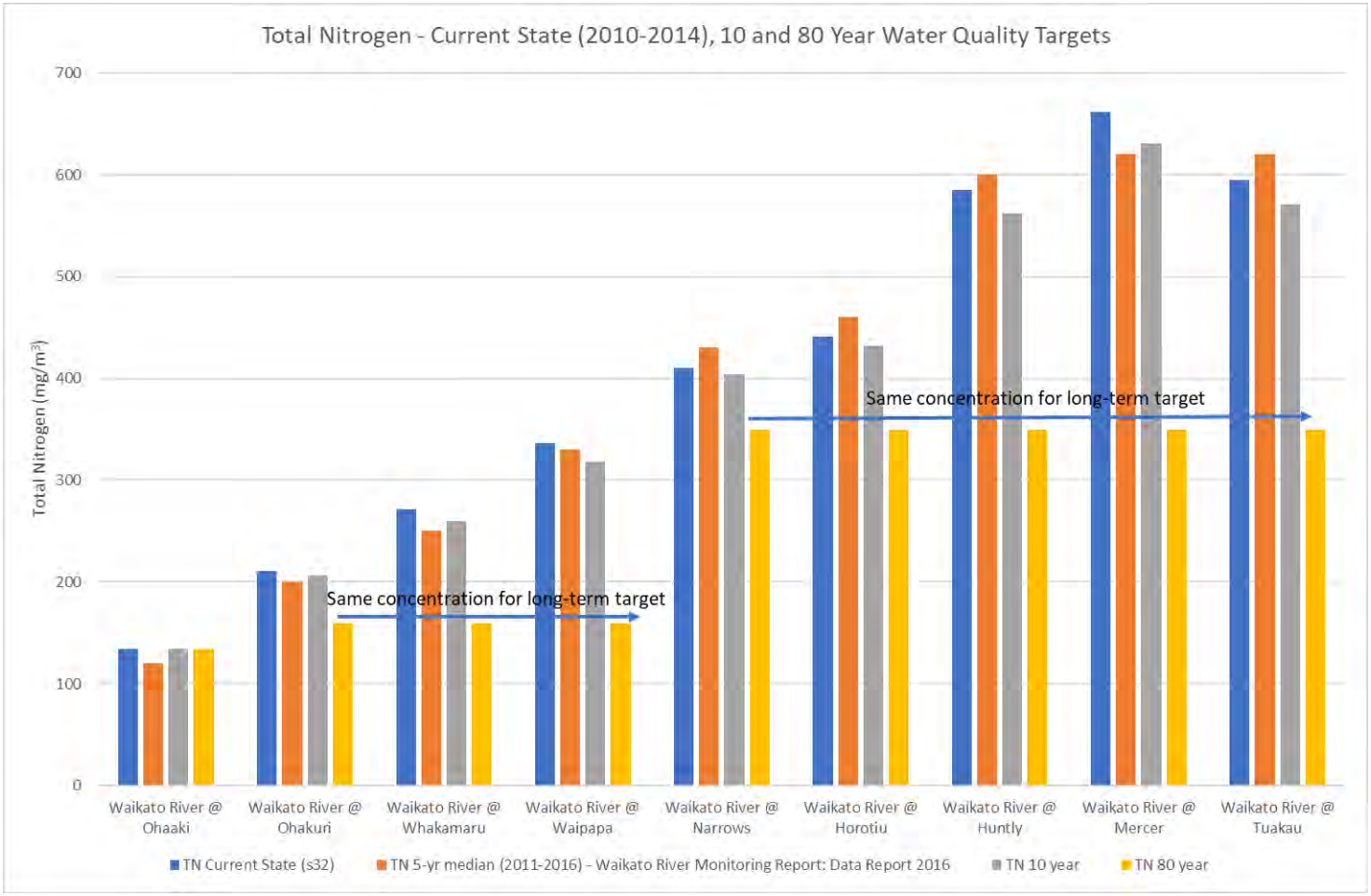


Figure 2: Total Nitrogen Water Quality Target – Current State (s32 – 2010-2014), Current State (2016, 5 year median), 10 year and 80 year PC1 target

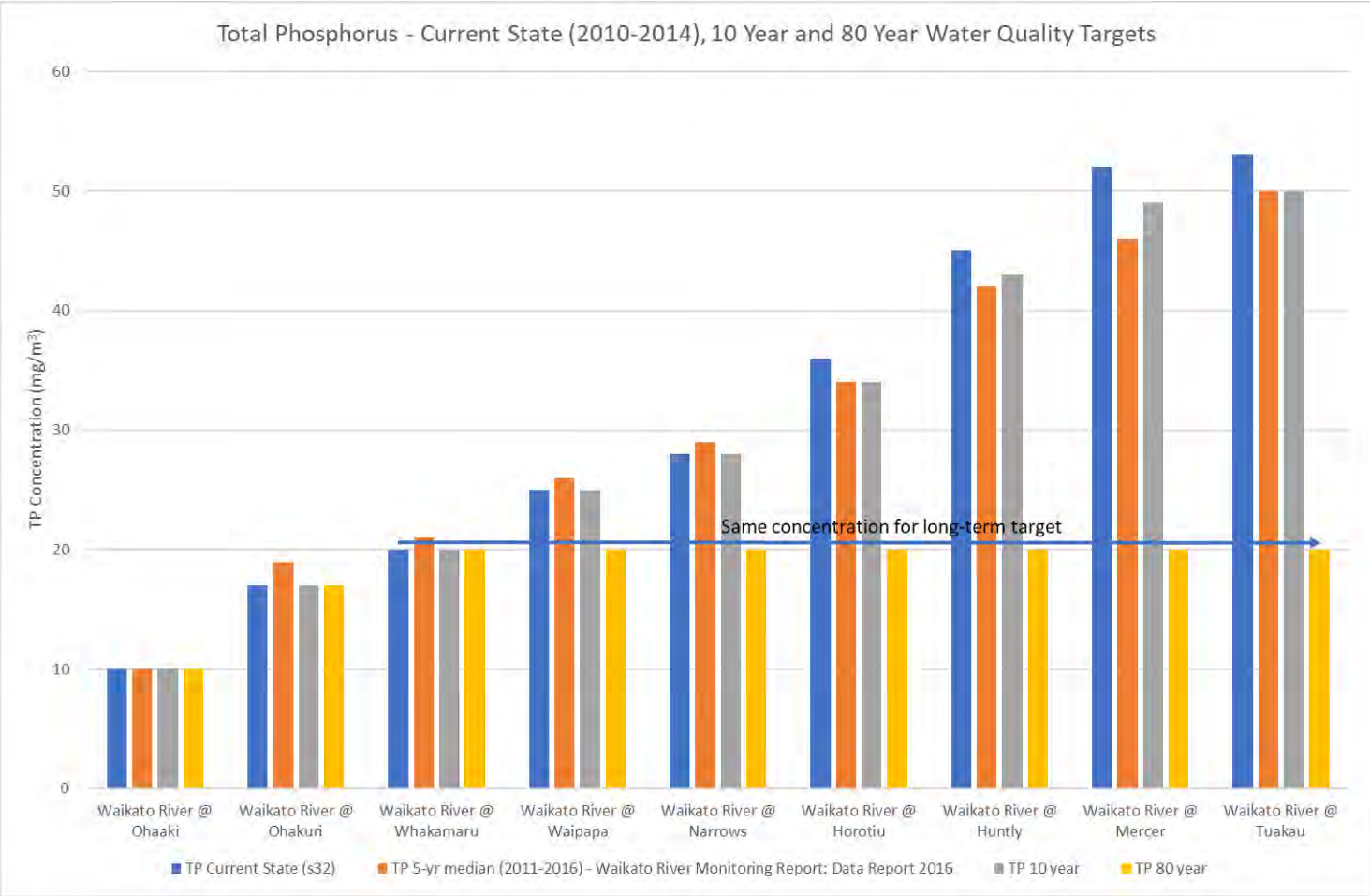


Figure 3: Total Phosphorus Water Quality Target – Current State (s32 – 2010-2014), Current State (2016, 5 year median), 10 year and 80 year PC1 target

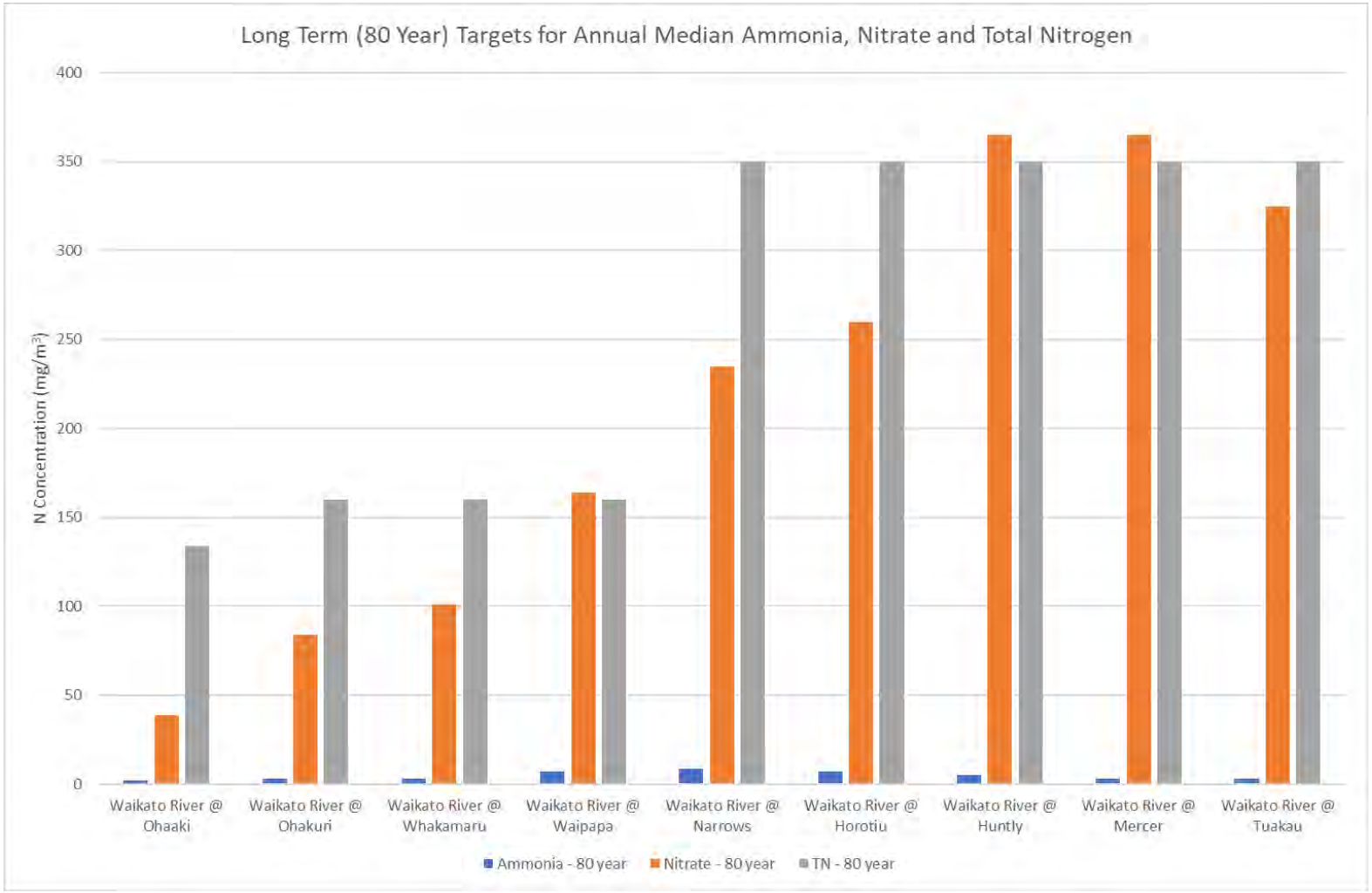


Figure 4: Nitrogen Species Water Quality Targets – 80 year target

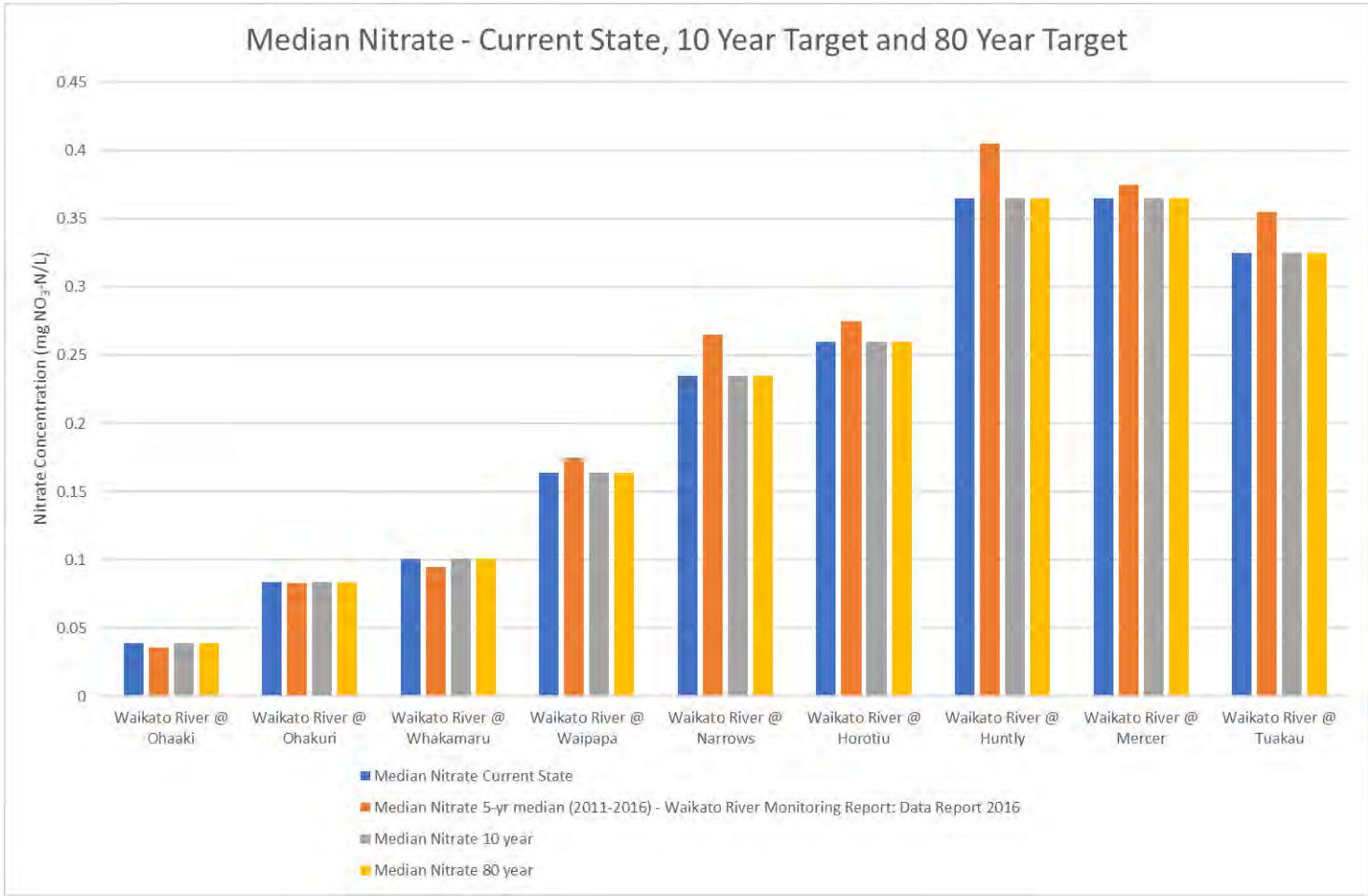


Figure 5: Median Nitrate Water Quality Target – Current State (s32 – 2010-2014), Current State (2016, 5 year median), 10 year and 80 year PC1 target