BEFORE THE HEARINGS PANEL

IN THE MATTER	of the Resource Management Act 1991 ('the Act')
AND	
IN THE MATTER	of Proposed Plan Change 9 to the Hawke's Bay Regional Resource Management Plan

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STATEMENT OF REPLY EVIDENCE OF ROBERT JON WALDRON FOR HAWKE'S BAY REGIONAL COUNCIL

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1. INTRODUCTION

1.1 My name is Robert Jon Waldron.

1.2 I hold a Bachelor of Science Degree with Honours in Earth Sciences attained in 2002 from the University of Plymouth in the UK.

1.3 I am a hydrologist with over 16 years of experience in surface water investigations and environmental monitoring projects. I have been employed by the Hawke's Bay Regional Council (**HBRC**) since 2006. I currently hold the position of flood Modeller in the regional assets team. I have worked in this role since 2019. Prior to my current role, I worked in the science team as a surface water quantity scientist for 8 years and as a resource analyst for 5 years. My experience includes designing, managing and undertaking surface water projects, programmes, surveys and investigations, analysing and interpreting environmental data, modelling water resources and catchment flooding, providing technical advice and input to policy and planning, regulatory processes and any other matters which require hydrological advice or information.

1.4 I was involved in developing the SOURCE hydrological model for the Ngaruroro, Tūtaekurī and Karamū catchments. I further developed the SOURCE model to be used for predictive scenario modelling as documented in the following publication:

> Waldron, R. 2018. *Surface water quantity scenario modelling in the Tūtaekurī, Ngaruroro and Karamū catchments. Greater Heretaunga and Ahuriri Plan Change (PC9)*. Resource Management Group Technical Report, HBRC Report No. 5013 – RM 18-28, Hawke's Bay Regional Council, Napier, New Zealand.

1.5 I was involved in the TANK collaborative stakeholder working group and delivered technical information to the group, including presentations relating to:

(a) SOURCE hydrological model development; and

(b) surface water quantity scenario modelling

1.6 I am a member of the New Zealand Hydrological Society.

1.7 I have previously been an expert witness for the HBRC in the following processes:

(a) Twyford Consent Hearing 2010; and

(b) Board of Inquiry into the Tukituki Catchment Proposal 2013-2014 (Involving a proposed plan change (PC6) and resource consent applications relating to the Ruataniwha Water Storage Scheme (RWSS).

1.8 I have prepared this evidence in my capacity as an expert, and although this is not a court hearing I confirm that I have read and understand the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note dated 1 December 2014. I have complied with it when preparing my evidence, and I agree to comply with it when I give any oral evidence. Other than where I state that I am relying on the evidence of another person, my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Purpose and scope of evidence

1.9 The purpose of this evidence in reply is to address matters raised in statements of evidence filed by submitters.

1.10 I do not repeat matters that are addressed in the TANK Section 32 Evaluation Report (**Evaluation Report**) nor the Appendix 11 Technical Memo Water Quantity appended to the Section 42A Hearing Report on Proposed Plan Change 9 (**Hearing Report**). However, to assist the Panel, where another witness has raised a significant matter that has already been addressed (and which I do not wish to discuss further), I provide a cross-reference to this report.

1.11 I provide narrative on matters raised by other witnesses only where I consider that what they are saying may not be correct or that it should be qualified.

1.12 For the avoidance of doubt, any failure to cross reference or specifically discuss any matter raised by other witnesses does not mean I agree with that evidence of the other witnesses.

1.13 My evidence will address matters raised in the evidence of Dr Andrew Laughton Dark (for the Winegrowers), Dr Anthony Davoren (for Apatu Farms Ltd, Heinz Watties and Ngaruroro Irrigation Society Incorporated), Mr Marei Boston Apatu (on behalf of Te Taiwhenua O Heretaunga) and Mr Maurice Wayne Black (on behalf of Te Taiwhenua O Heretaunga).

1.14 My evidence addresses the following subject matters:

(a) water use estimates relating to interim allocation limit; and

(b) proposed Ngaruroro River cease take trigger flow.

2. KEY FACTS AND ASSUMPTIONS RELIED ON

2.1 In preparing my evidence I have reviewed the following documents and evidence:

(a) TANK Section 32 Evaluation Report;

(b) TANK Section 42a Hearing Report – Appendix 11 Technical Memo Water Quantity'

(c) Metered Water Use Memo – Jeff Cooke 13 May 2021 (attached as the Appendix to this evidence);

(d) Statement of Evidence of Andrew Laughton Dark for the Winegrowers;

(e) Statement of Evidence of Anthony Davoren for Apatu Farms Ltd;

(f) Statement of Evidence of Anthony Davoren for Heinz Watties;

(g) Statement of Evidence of Anthony Davoren for Ngaruroro Irrigation Society Incorporated;

(h) Statement of Evidence of Marei Boston Apatu on behalf of Te Taiwhenua O Heretaunga;

(i) Statement of Evidence of Maurice Wayne Black on behalf of Te Taiwhenua O Heretaunga;

(j) Statement of Reply Evidence of Kathleen Mary Kozyniak for Hawke's Bay Regional Council; and

(k) Statement of Reply Evidence of Daniel Ryan Fake for Hawke's Bay Regional Council.

3. WATER USE ESTIMATES

3.1 Dr Dark provides comments in his evidence regarding the water use estimated for the 2019-2020 irrigation season (Figure 12 in the Appendix 11 Technical Memo Water Quantity) and regarding the lack of details describing how the presented volumes were derived. Dr Dark's evidence also presents examples of measured water use compared to modelled water use.

3.2 In Dr Davoren's evidence, analyses are provided for examples of measured water use compared to modelled water use.

3.3 The analyses undertaken by Dr Dark and Dr Davoren highlight both the differences that can occur between modelled and measured water use and also the patterns of water use during the last 10 years, including two particularly dry years (2012-2013 and 2019-2020) where water use was high.

3.4 The evidence provided by Dr Dark and Dr Davoren has prompted a revision of the water use data presented in Figure 12 of the Appendix 11 Technical Memo Water Quantity. The water use data in Figure 12 of the Appendix 11 Technical Memo Water Quantity is presented in terms of total groundwater pumping from the Heretaunga Plains Aquifer. The dataset combines modelled water use data (based on modelled irrigation demand data that was derived using climate data, land use data, crop water requirements and available metered water use data) for the period 2010-2011 to 2014-2015, with metered water use data from 2015-2016 to 2019-2010. The metered water use data was adjusted in an attempt to account for a pattern of differences observed when comparing modelled and metered water use over a common period (2010-2015). The water use data presented in Figure 12 of the Appendix 11 Technical Memo Water Quantity, is now considered to over-estimate consented water use and total groundwater pumping between 2015-2016 and 2019-2020.

3.5 Modelled water use data is likely to be the best estimate of historical water use when measured/metered water use data is unavailable. The most recent approach to modelling total historical water use over the Heretaunga Plains, is that which was used to derive the modelled data used in the groundwater and surface water modelling undertaken for the Heretaunga Plains Aquifer and Tūtaekurī, Ngaruroro and Karamū catchments. Combining the modelled data with available metered data would provide the best available estimate of water use over time. The currently available modelled water use from the Heretaunga Plains Aquifer covers the years from 1979-1980 to 2014-2015.

3.6 The metered water use data held by HBRC is the best available record of metered water use data. Not all consented water use is metered, however water metering in Hawke's Bay has increased over the last 10 years, mostly driven by the requirements of the Resource Management Regulations 2010 (Metered Water Use Memo – Jeff Cooke 13 May 2021). As a result, the proportion of the total consented volume that is metered has been increasing. In the Heretaunga Plains (which is represented by the Heretaunga Catchment Zone[1]), the percentage of consented volume that is metered has increased from 60% to 95% over nine years (summarised in Table 1).

1 One of the zones used for s36 RMA science monitoring charges and catchment-based RMA plan changes.

Table 1. Percentage of consented volume metered in the Heretaunga Catchment Zone (Metered Water Use Memo – Jeff Cooke 13 May 2021).

Date range	**Percentage consented volume metered**
Year 2011-2012 to 2013-2014	60 – 70%
Year 2014-2015 to 2016-2017	90%
Year 2017-2018 to 2019-2020	95%

3.7 In the absence of full coverage of metered water use data, I have adjusted the available metered water use data to account for the proportion of water use that is un-metered. I have used the data representing the change in percentage of consented volume metered over time (summarised in Table 1) to adjust the available metered data. The metered water use for each year was divided by the percentage of consented volume metered, to calculate the adjusted 100% total estimate. For example, the total volume of 68.3 Mm^3/yr for 2017-2018, was divided by 95% to calculate an adjusted total volume of 71.9 Mm^3/yr. This adjustment provides a revised interim estimate of the total metered water use abstracted from the Heretaunga Plains Aquifer over the period 2010-2011 to 2019-2020.

3.8 The percentage of consented volume metered between 2017-2018 and 2019-2020 is close to full coverage at 95%. Therefore, a relatively minor adjustment was made to the data over this period to estimate the total metered volume. For example, the total volume for 2019-2020 was adjusted (accounting for the 5% of un-metered volume) from 78.4 to 82.5 Mm^3/yr[2] (Table 2).

2 Million metres cubed per year.

Table 2. Metered and adjusted metered annual water use volume.

Year (Jul-Jun)	**Metered volume (Mm^3/yr)**	**Adjusted metered volume (Mm^3/yr)**
2010-2011	39.9	66.5
2011-2012	46.7	77.8
2012-2013	63.2	90.3
2013-2014	53.8	82.8
2014-2015	64.7	71.8
2015-2016	66.5	73.9
2016-2017	67.7	75.2
2017-2018	68.3	71.9
2018-2019	63.8	67.1
2019-2020	78.4	82.5

3.9 When using this method of adjusting the metered data, the degree of uncertainty in the estimated total volume increases as the magnitude of adjustment increases. Therefore, years with less adjustment represent a better (less uncertain) estimate of total metered water use.

3.10 To show how different estimates of water use can vary, I have compared the adjusted metered water use with the modelled water use for the years from 2010-2011 to 2014-2015 in Table 3. The estimates of water use in 2012-2013 and 2013-2014 are close (within 1.9 Mm^3/yr). In the remaining years, the estimates vary between 5.2 and 9.7 Mm^3/yr.

Table 3. Modelled and adjusted metered water use volume.

Year (Jul-Jun)	**Modelled volume (Mm^3/yr)**	**Adjusted metered volume (Mm^3/yr)**
2010-2011	71.7	66.5
2011-2012	68.9	77.8
2012-2013	91.1	90.3
2013-2014	80.9	82.8
2014-2015	81.6	71.8

3.11 As previously mentioned, combining modelled water use data with available metered data would provide the best available estimate of water use over time. Given that modelled water use data is only currently available up to 2014-2015, and that not all consented water use is metered, I have combined the modelled water use data from 2010-2011 to 2014-2015 with the adjusted metered data from 2015-2016 to 2019-2020 into one annual time series dataset. This dataset provides a revised estimate of total consented annual water use from the Heretaunga Plains Aquifer. This dataset is presented in terms of consented groundwater pumping from the Heretaunga Plains Aquifer in Figure 1. The water use is grouped by primary consented use, with the inclusion of consented stock water (although this is a very minor proportion of total use, with it being less than 0.015 Mm^3/yr in any year).

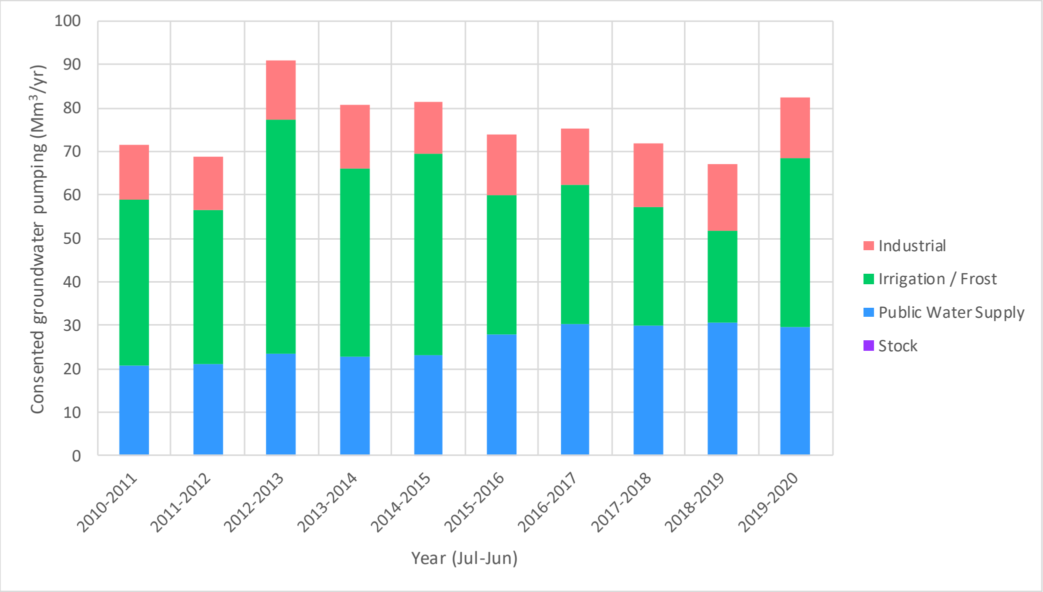

Figure 1. Estimated consented groundwater pumping from the Heretaunga Plains Aquifer, grouped by primary use.

3.12 The revised estimate of total consented annual water use from the Heretaunga Plains Aquifer indicates that 2012-2013 and 2019-2020 were years with the highest water use during the ten-year period (2010-2011 to 2019-2020). Total water use was estimated to be 91.1 Mm^3/yr in 2012-2013 and 82.5 Mm^3/yr in 2019-2020. The 2013-2014 and 2014-2015 years also estimate total water use greater than 80 Mm^3/yr.

3.13 The reply evidence of my colleague Dr Kozyniak, highlights that the droughts in the summers of 2012-2013 and 2019-2020 were severe enough to be declared adverse events by the Ministry for Primary Industries. The rainfall analysis presented in Dr Kozyniak's reply evidence indicates that the rainfall during the irrigation seasons in one or both of these years, represent periods of lowest rainfall in the ten-year period (2010-2011 to 2019-2020) and fall within the 5th percentile of long-term records. The estimated water use during 2012-2013 and 2019-2020 is thus likely to represent requirements for the 95th percentile or 95% reliability.

4. NGARURORO RIVER CEASE TAKE TRIGGER FLOWS

4.1 In the evidence from Mr Apatu and Mr Black, concerns were expressed regarding the cease-take trigger flow[3] proposed for the Ngaruroro River, and its associated predicted habitat protection level of 44% for torrentfish. Both Mr Apatu and Mr Black argued for raising the cease-take trigger flow due to their concerns. While my colleague Mr Fake discusses cease-take trigger flows in relation to fish habitat protection in his reply evidence, it must be noted that the selection of a specific cease-take trigger flow should take into account a variety of other factors.

4.2 The surface water quantity scenario modelling I undertook for the Tūtaekurī, Ngaruroro and Karamū catchments (Waldron 2018), identified the following:

(a) potential adverse effects on the reliability of supply for existing water abstractors resulting from current and alternative flow management options for rivers and streams in the modelled catchments;

(b) effects of current flow management rules on river flow compared to flows in a naturalised system (unaffected by abstractions); and

(c) potential benefits or adverse effects on river flow resulting from alternative flow management options for rivers and streams in the modelled catchments.

4.3 In my surface water quantity scenario modelling report (Waldron 2018), I provide a detailed analysis of the potential effects on restrictions to water users and potential effects on specific low flow statistics (which help to describe and understand simulated changes to the low flow regime under different scenarios), resulting from the current cease-take trigger flow of 2400 l/s set for the Ngaruroro River at Fernhill, plus alternative higher cease-take trigger flows.

4.4 The modelled effects on restriction resulting from different cease-take trigger flows on the Ngaruroro River are presented in Section 4 and Appendix D of my report (Waldron 2018). Figure 2 is taken from my report and highlights the change in predicted restriction, in terms of the average number of days of restriction per year. The statistics show that increasing the primary cease-take trigger flow throughout the scenarios predicts progressively larger effects on restriction, thus progressively reducing the reliability of supply for existing water abstractors. For example, increasing the trigger flow from 2400 l/s to 3600 l/s (70% habitat trigger low) predicts that there will be on average 7 more days of restriction each year. With the trigger flow increased to 4400 l/s (90% habitat trigger flow), a further 6.6 days of restriction

3 Historically referred to as a minimum flow.

are predicted. A table presenting the full suite of restriction statistics for the Ngaruroro River scenarios is provided for reference in the Appendix to this evidence.

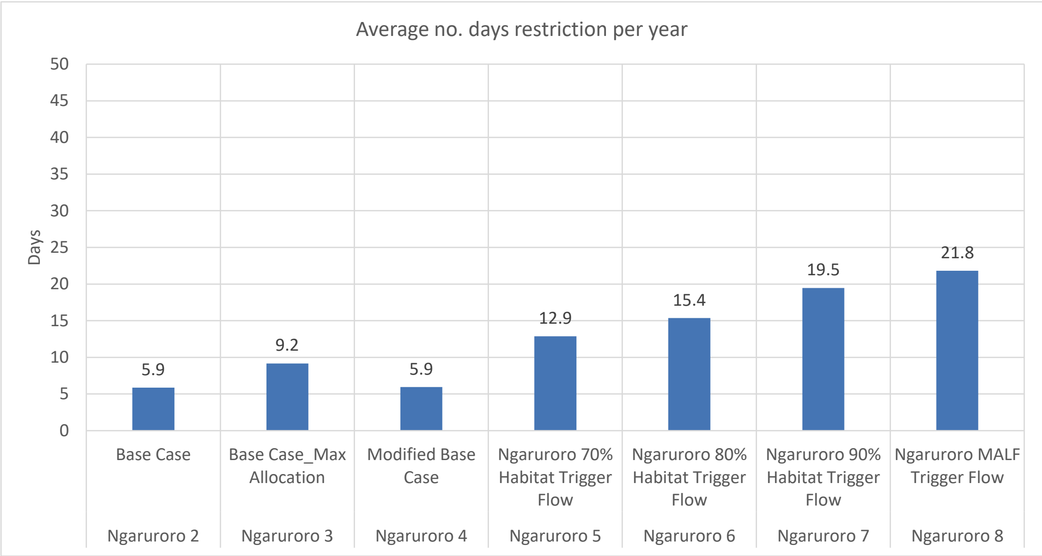

Figure 2. Ngaruroro cease-take trigger flow scenarios – Average number of days on restriction per year. (All restriction statistics are based on the analysis of 9-month irrigation seasons from September to May for the modelled simulations between 2015 and 2032.

4.5 Changes to the mean annual 7-day low flow (**MALF**)[4] and Q95[5] low flow statistics were also presented in my report, to help describe and understand potential changes to the low flow regime. A table showing the predicted changes to these low flow statistics is provided for reference in the Appendix to this evidence, together with a table providing the full suite of analysed flow statistics. Increasing the cease-take trigger flow in the Ngaruroro River from 2400 l/s predicted small improvements to low flows, up to a 3.3% increase in MALF when simulating a 4000 l/s (80% habitat trigger flow) cease-take trigger flow and up to 0.5% increase in Q95.

4.6 Modelled flow for the Ngaruroro River during a period simulated with the climate equivalent to 2012-2013, is presented in Figure 3. The figure plots the modelled flows for scenarios with a cease-take trigger flow of 2400 l/s and 4000 l/s, to show the effect of the different trigger flows on river flow. The higher cease-take trigger flow of 4000 l/s is predicted to maintain a slightly higher flow for a period of approximately 7 days, slowing the river flow recession before it reaches 2400 l/s. At this flow, all surface water and stream depleting groundwater abstractions have ceased in both scenarios. However, river flows in both scenarios continue to recede

4 This is the average of annual low flows (ALF) in a flow record. The ALFs are calculated for each hydrological year (Jul-Jun) from a 7-day moving average of daily mean flows.
5 The daily mean flow that is equalled or exceeded for 95% of the time over the period of record.

at the same rate, while groundwater abstraction from the wider Heretaunga Plains Aquifer continues to impact on river flow.

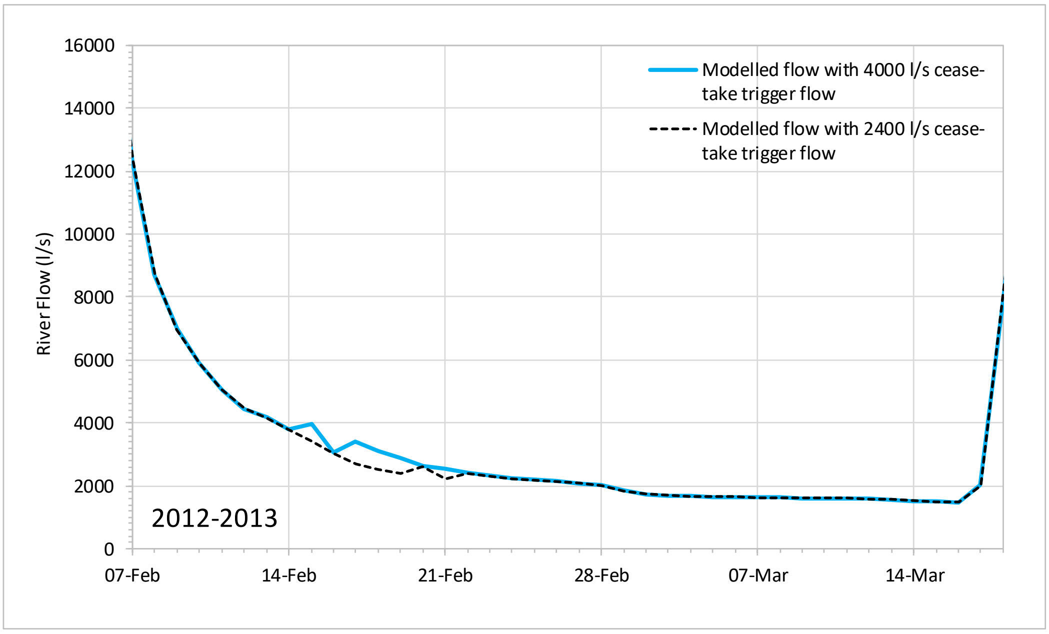

Figure 3. Modelled Ngaruroro River flow with 2400 l/s and 4000 l/s cease-take trigger flows.

5. CONCLUSION

5.1 I present a revised estimate of water use in terms of groundwater pumping from the Heretaunga Plains Aquifer based on the best currently available water use data. The estimated water use during 2012-2013 and 2019-2020 is likely to represent requirements for the 95th percentile or 95% reliability. I consider that PPC9 seeks to improve the management of water allocation and that it will assist in doing so.

5.2 Further, the selection of a cease-take trigger flow for the Ngaruroro River should take account of multiple considerations. I present relevant considerations and hope they assist the Panel in considering this matter.

Robert Waldron
19 May 2021

REFERENCE

Waldron, R. 2018. *Surface water quantity scenario modelling in the Tūtaekurī, Ngaruroro and Karamū catchments. Greater Heretaunga and Ahuriri Plan Change (PC9)*. Resource Management Group Technical Report, HBRC Report No. 5013 – RM 18-28, Hawke's Bay Regional Council, Napier, New Zealand.

APPENDIX

Metered Water Use Memo – Jeff Cooke 13 May 2021

MEMO

To:	Rob Waldron
From:	Jeff Cooke
Date:	13 May 2021
Subject:	**METERED WATER USE**
File Ref:	
CC:	Jo Rodgers

Summary

Metered water use over time data needs to have the changes in the amount consented water that was metered taken into account when interpreting it. Up until about 2017 the amount of metering was increasing, so apparent increases in water use prior to this date will largely be due to increasing metering. Since 2017 metering is estimated to cover about 95% of the consented volume of groundwater water taken in the TANK catchments.

There are a variety of checks performed on the data that gives us confidence that the metered record is a good representation of water use.

Water Metering

Water metering in Hawkes Bay has increased over the last 10 years and a lot of the increase has been driven by the requirements of the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010. These regulations required that all consented water takes with a consented rate of extraction over 5 l/s had to have a meter fitted by November 2016. The regulations also require regular verifications to check the meter accuracy. The regulations specified a staged approach to meter installations:

Consented rate of take	Meters required by
20 l/s and above	November 2012
10 l/s to 20 l/s	November 2014
5 l/s to 10 l/s	November 2016

Resource Consents could require metering to be fitted prior to these dates and some consents in the Ngaruroro catchment have been required to have meters fitted since November 2010.

The actual dates achieved for meter installation often lagged the required date due to limitations in supply of meters, installer workload and consent holder reluctance. An indication of the percentage of metered consented volume of water was obtained from annual billing records. For groundwater takes in the Heretaunga Catchment Zone[1] (which incorporates the Heretaunga Plains) the percentage of the consented volume where the consent has metering is shown in the table below. The billing year is from 1 July, and this is the same as the water year defined in the regulations and used for hydrological summaries in New Zealand.

Date Range	Percentage consented volume metered.
Year 2011-2012 to 2013-2014	60 – 70%
Year 2014-2015 to 2016-2017	90%
Year 2017-2018 to 2019-2020	95%

[1] One of the zones used for s36 RMA science monitoring charges.

Data Quality

The system for checking the water metering data quality is multifaceted and has evolved over time. The main elements are summarised in the table below.

Element	Description	Comments
Meter Verifications	The meter is compared against a reference meter and the difference in reading assessed and reported as accuracy. The regulations require a verification within the first year after installation and every 5 years after that. The regulations require that water meter records are accurate to 5% implying that the verification should be to within 5%. Since 2015 Meter Installations have been required to be by approved installers following the New Zealand Water Measurement Code of Practice. The installation requirements were developed to promote the installation of appropriate meters and accurate water use measurement.	Of the verifications that have been done in Hawke's Bay to date 96% have been accurate to within 5%. The verifications that have been outside of this range have generally either been retested, or had the meter replaced. There is an ongoing program to chase verifications that are required, and check the results of the verifications meet the requirements.
Check readings	Check readings have been obtained from site visits and when installations or verifications have been done. Once a take has multiple check readings then the volume that has passed through the meter can be compared with the volume recorded for the meter.	Historically few check readings were obtained, these are increasing now and any discrepancies identified are investigated and the database record corrected if necessary and appropriate.
Compliance checking	The volume taken is compared against what the consent allows and any breaches of the consent conditions are investigated. Similarly water use that is identified where water meter records don't indicate water use is also investigated.	If investigations identify an issue with the data provided then this is rectified in the database.
Visual checks	When new data is imported into the system visual 'consistency' checks are often done on the data.	Discrepancies between new data and previous data (step changes etc) are investigated and the database records adjusted if appropriate.

The National Environmental Monitoring Standard (NEMS) for Water Meter Data was originally published in 2013 and version 2 was published in 2017. The standard relates to 'near real-time data' i.e. telemetered data and do not cover manually read water meter data that is allowed by the regulations. The standards also require that sites are inspected annually and the difference between the volume that has passed through the meter and the volume recorded from telemetry is less than 1%.

About 50% of the water meter data in Hawke's Bay is estimated to be telemetered, with the rest provided from manual readings. While many of the telemetered meters are now visited regularly this was not the case in the past and historically. The combination of these factors means that much of the water use data for Hawke's Bay can only achieve Raw (QC200) or Poor (QC400) codes according to NEMS, however the systems that are in place and are described in the table above mean that more confidence can be attributed to the water use data than would be apparent if the NEMS criteria were the only ones used.

Note: The regulations were reviewed in 2020 and now require telemetry of the water use data, but there is a staged implementation of the requirements between 2022 and 2026.

Ngaruroro River at Fernhill cease-take trigger flow scenario restriction statistics. A range of restriction statistics including the calculated change from the Base Case scenario to all other alternative scenarios. All restriction statistics are based on the analysis of 9-month irrigation seasons from September to May for the modelled simulations between 2015 and 2032.

Ngaruroro River at Fernhill	Scenario												
	Ngaruroro 2	Ngaruroro 3		Ngaruroro 4		Ngaruroro 5		Ngaruroro 6		Ngaruroro 7		Ngaruroro 8	
	Base Case	Base Case_Max Allocation		Modified Base Case		Ngaruroro 70% Habitat Trigger Flow		Ngaruroro 80% Habitat Trigger Flow		Ngaruroro 90% Habitat Trigger Flow		Ngaruroro MALF Trigger Flow	
	Primary cease-take trigger flow (l/s)												
	2400	2400		2400		3600		4000		4400		4700	
	Statistic value	Statistic value	Change from Base Case	Statistic value	Change from Base Case	Statistic value	Change from Base Case	Statistic value	Change from Base Case	Statistic value	Change from Base Case	Statistic value	Change from Base Case
Full record statistics													
Record length (Years)	17	17	-	17	-	17	-	17	-	17	-	17	-
Total % restriction	2.2%	3.4%	1.2%	2.2%	0.02%	4.7%	2.6%	5.6%	3.5%	7.1%	5.0%	8.0%	5.8%
Average no. days restriction per year	5.9	9.2	3.3	5.9	0.06	12.9	7.0	15.4	9.5	19.5	13.6	21.8	15.9
Recurrence interval for year with period of ≥3 consec. days restriction (Years)	3.4	3.4	-	3.4	-	1.9	-1.5	1.7	-1.7	1.5	-1.9	1.4	-2.0
Recurrence interval for year with period of ≥10 consec. days restriction (Years)	17	17	-	17	-	5.7	-11.3	4.3	-12.8	2.4	-14.6	2.1	-14.9
Example dry year statistics - Climate equivalent to 2012-2013													
No. days restriction	52	58	6	52	-	63	11	66	14	73	21	78	26
No. periods of ≥3 consec. days restriction	3	3	-	3	-	4	1	5	2	5	2	5	2
No. periods of ≥10 consec. days restriction	2	2	-	2	-	2	-	2	-	2	-	2	-

Ngaruroro cease-take trigger flow scenarios – MALF and Q95 for Base Case vs alternative scenarios. The MALF and Q95 have been calculated from the scenario modelled flow records at Ngaruroro River at Fernhill.

	Scenario								
	Ngaruroro 2	Ngaruroro 3		Ngaruroro 4		Ngaruroro 5		Ngaruroro 6	
	Base Case	Base Case_Max Allocation		Modified Base Case		Ngaruroro 70% Habitat Trigger Flow		Ngaruroro 80% Habitat Trigger Flow	
Ngaruroro River at Fernhill	River Flow (l/s)	River Flow (l/s)	% change from Base Case	River Flow (l/s)	% change from Base Case	River Flow (l/s)	% change from Base Case	River Flow (l/s)	% change from Base Case
MALF	3842	3419	-11.0%	3837	-0.1%	3935	2.4%	3967	3.3%
Q95	4221	3534	-16.3%	4220	-0.04%	4231	0.2%	4243	0.5%

Ngaruroro cease-take trigger flow scenarios – Full suite of flow statistics for cease-take trigger flow scenarios

	Ngaruroro River at Fernhill					
	Cease-take trigger flow scenario					
	Ngaruroro 1	Ngaruroro 2	Ngaruroro 3	Ngaruroro 4	Ngaruroro 5	Ngaruroro 6
Flow statistic	**Naturalised**	**Base Case**	**Base Case_Max Allocation**	**Modified Base Case**	**Ngaruroro 70% Habitat Trigger Flow**	**Ngaruroro 80% Habitat Trigger Flow**
Minimum	1548	1261	1258	1255	1255	1255
Maximum	8795786	8784913	8784947	8784879	8784879	8784879
Mean	47276	46603	46236	46601	46609	46613
Median	23564	23101	22824	23100	23100	23100
MALF	5035	3842	3419	3837	3935	3967
Q95	5576	4221	3534	4220	4231	4243
Q75	13983	13012	12405	13009	13011	13011
Q25	43738	43410	43233	43409	43409	43409
Q5	105611	105331	105185	105330	105330	105330