REPORT

Tonkin+Taylor

Comparison of Modelled Point Source Discharges and Consents on the Waikato and Waipa Rivers

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1 Introduction

As part of the Healthy Rivers Project, a cost optimisation model (the model) has been prepared by others to identify solutions for achieving different water quality scenarios in the Waikato and Waipa Rivers. The model indicates that achieving some water quality scenarios will require significant changes in the contaminant loads entering the rivers, and further information is being sought to understand these changes.

The baseline scenario for the model was calibrated to environmental monitoring data and land use information from recent years. The model has then been used to determine the most effective contaminant reduction combinations from point and diffuse sources to achieve target water quality improvements.

For most point source sites, their modelled contaminant discharges are less than their consented discharges. The reasons for this difference are many, and may include an allowance for future growth, treatment performance uncertainty at the time of consenting, or treatment upgrades since consenting.

An overall picture of how the modelled point source discharges compare with consent conditions has not been available until now.

1.1 Purpose

The purpose of this report is to compare the point source contaminant loads used in the baseline scenario with the load allowed under each sites' consent conditions.

We understand that the Collaborative Stakeholder Group for the Healthy Rivers Project has asked Waikato Regional Council (WRC) to provide this assessment.

1.2 Scope

The scope of this report is the modelled baseline loads and the current consent conditions. Superseded consent conditions and proposed contaminant reduction scenarios are not included.

This report is specifically not a compliance report. Contaminant loads that appear above or below consent limits cannot be read as indicating compliance or otherwise for a site. This can be for a number of reasons, including:

- new consent conditions with lower limits than were applicable during the modelling period;
- the averaging of performance data from multiple years attenuating spikes; or
- converting consent conditions with sub-year detail to match the model's annual timeframe. For example, changing a monthly median limit to an annual median limit.

The work was carried out in accordance with our engagement dated 19 January 2016.

2 The Model

The model uses four contaminants for predicting river water quality – sediment, total nitrogen (TN), total phosphorus (TP), and E.coli. The first three are measured as Tonnes per year. The E.coli load is measured as peta cells per year (ie 10^{15} cells per year).

For the point source discharges, the model only considers the TN, TP, and E.coli loads. The amount of sediment discharged by the point sources is not significant compared to the loads already in the river, so this is not modelled. The model also does not consider flow rates from the point sources, only total contaminant loads.

The model is a steady state model using annual values. This means the model "sees" the year as a single whole. The contribution of seasonal variations, for example when peak production rates occur, are rolled up into the total numbers used for the whole year.

The point source model data is based on available consent monitoring data for the period from 2003-12, although not all sites had data available for the full period. Waikato Regional Council (WRC) staff analysed the monitoring data to give annual loads, these being the mean average actual performance for each site over the model data period. The analysis of the nutrient data is reported in *Sources of Nitrogen and Phosphorus in the Waikato and Waipa Rivers, 2003-12* (Vant, 2014). The microbial analysis is undocumented, with the model values used in this report taken from Appendix C in the draft NIWA report *Modelling E. coli in the Waikato and Waipa River Catchments*.

The calibrated model was then used by WRC to consider scenarios for improving the river water quality by variously reducing loads from point and diffuse sources. This report compares the point source loads in the baseline scenario only.

3 2015 Data and Consent Changes since the Baseline period

Since the modelling data period began, seven sites have had consents renewed. For a number of other sites the comparison in this report will soon become dated, with three consents expired and undergoing renewal, and a further four consents expiring by the end of 2017.

A summary of the consent dates for each site is given in Table 3.1, over. Sites with consent conditions that have changed since the model period began are shaded. For these sites, it must be remembered that where current consent limits are significantly lower than the long term actuals, this cannot be read as confirmation of poor compliance.

To bridge the gap between historic data used in the model and current performance, monitoring data for the 2015 calendar year were considered from 13 of the sites. Data for the dairy factory sites were not included as Fonterra advised that the model data were still representative of their performance.

The 2015 data were analysed for three reasons:

- to provide context when placing historic performance data (the model inputs) next to new consent conditions that are much more stringent;
- to provide some flow information for calculating the consent limits that are written as concentrations (mostly microbial conditions); and
- to allow consideration of seasonal performance and seasonal consent limits, where those are relevant.

The 2015 data can be compared directly with the model data. However, when comparing with the consent conditions, the 2015 data has the same mean/median comparison issues as the model data, which are described in the next section.

Table 3.1: Consent issue and expiry dates

#	Site Name	Issue Date*	Expiry Date	Notes
1	Ngaruawahia Sewage	13/04/2011	31/03/2029	New consent and treatment plant upgrade at the end of the model data period
5	Huntly Sewage	13/04/2011	31/03/2029	New consent at the end of the model data period
2	Tokoroa Sewage		31/12/2011	Details of pending consent unknown
3	Cambridge Sewage	17/12/1996	1/12/2016	
4	Hamilton Sewage	18/09/2007	18/09/2027	New consent came into effect mid-way through the data collection period, with stepped reductions that came into effect towards the end, particularly for Total-P.
6	Pukekohe Sewage	20/07/1995	30/06/2015	New WWTP completed in 2010, at end of data collection period.
7	Te Kauwhata Sewage	4/07/2013	4/07/2028	New consent and treatment plant upgrade after the data collection period
8	Meremere Sewage	5/08/2003	5/08/2018	
9	Te Kuiti Sewage	30/01/2015	30/06/2040	New consent and treatment plant upgrade after the end of the data collection period
10	Te Awamutu Sewage	3/11/2000	31/10/2015	Details of pending consent unknown
11	Taupo Sewage			Not modelled
12	Otorohanga Sewage	2/11/2012	2/11/2037	New consent and treatment plant upgrade at the end of the data collection period
13	Kinleith	21/11/2000	1/01/2023	
14	Te Awamutu Dairy	4/04/2003	1/04/2017	
15	Rotorangi Piggery	29/11/2006	1/11/2016	Not modelled
16	Reporoa Dairy	9/12/2014	9/12/2034	Not modelled
17	Lichfield Dairy	22/01/2015	22/01/2050	Not modelled
18	Hautapu Dairy	7/02/2000	31/01/2019	
19	Te Rapa Dairy	29/07/1998	1/09/2017	
20	Affco Horotiu	23/07/2001	1/07/2016	
21	Tuakau Proteins	11/11/2015	11/11/2025	The old consent had stepped reductions through the data collection period.
22	Wairakei		30/06/2026	Consent doesn't limit any modelled contaminants

*shaded rows indicate consents with issue dates after the start of the modelling data period.

4 Calculation and Comparison Methods

The modelling and monitoring data and the consent conditions are in wide range of units, time frames, and statistical types. The approaches used to standardise these against the model are outlined below.

4.1 Means and Medians

The comparison between E.coli consent conditions and model data should be taken as indicative only due to skew in the data making it difficult to compare mean and median values.

Consent conditions are typically specified as medians, for example “the annual median total nitrogen load shall not exceed 40kg/day.” The data used in the model are means of the monitoring data.

Where a dataset is normally distributed then the mean and median will be the same, and the comparison is meaningful. However, if the dataset has a skew, then the comparison becomes less meaningful.

A quick assessment of skew was conducted using monitoring data for the 2015 year from 13 of the point source sites, including the two largest, Hamilton Sewage and Kinleith. Weighting the sites by their contaminant load, the ratio of median to mean averages for TN and TP were very close, at 94% and 97%, respectively. However, for E.coli the ratio was 8%, with the mean ranging from 2.1 to 40 times larger than the median.

The comparison between model (means) and consent conditions (medians) for TN and TP to assess differences in actual and potential (i.e., legally allowed) annual load is considered reasonable.

For E.coli, the mean:median ratio should be considered an upper limit only, with the consented median limit equating to an unknown mean potentially at least an order of magnitude larger.

4.2 Means and Percentiles

For some sites, the consent conditions could not be compared with the model. This arose where the consent condition was only specified as an upper percentile, without a corresponding median limit. This affected four sites for TN and E.coli, and two for TP.

These limits were usually specified as either one or both of a 90^{th} and 100^{th} percentile limit.

Where an upper percentile limit was specified in addition to a median limit, it was assumed that the upper limit wasn’t more stringent than the median limit.

4.3 Seasonal Conditions

Some consents have seasonal limits. These appear in several combinations – a winter and summer limit together covering the whole year, an annual limit and a more stringent summer limit, and a summer limit only.

Summer and winter limits where added to give the annual limit. Summer and annual limits where treated as summer and winter limits. And summer with no other limit could not be used to give an annual limit.

4.4 Nitrogen and Phosphorus

The method used to compare the 2015 data and the consent conditions with the model input TN and TP numbers is outlined below.

4.4.1 2015 Actual Data

For most sites the 2015 monitoring data included concentrations for TN and TP, ranging from daily to monthly sampling frequency, with weekly being typical. Each observed concentration was multiplied by the actual flow for that day to give a mass flow, and the annual load was the mean of all the mass flows x 365 days.

Some sites had monitoring data for the dissolved nutrient forms only, for example dissolved reactive phosphorous or dissolved inorganic nitrogen. As per the approach used with the long term monitoring data, these were treated as lower limits for the TN and TP, and taken as equivalent.

4.4.2 Consent Conditions

Most consents specified a daily median mass limit for TN and TP, and these was multiplied by 365 days to give an annual limit. Where a condition was specified as a concentration limit rather than a mass limit, this was converted to an annual amount using the mean daily flow. Where a condition was specified as some other form of nitrogen or phosphorus (i.e., not TN or TP), it was treated as a lower limit and taken as equivalent.

4.5 E.coli

Some sites did not have microbial consent limits and the resulting monitoring data were not modelled. This gave fourteen modelled sites for E.coli, compared to 18 for TN and 17 for TP. A further four sites only had upper percentile limits for E.coli, leaving 10 sites with consents that could be compared to the model.

4.5.1 Consent Conditions

Unlike TN and TP, which are commonly specified as daily mass limits (for example, 53 kg/day), E.coli is only specified as a concentration of cells per 100 ml. The concentration is usually a median limit but sometimes only an upper limit of 90^{th} and/or 100^{th} percentiles.

To approximate an annual limit, the mean annual flowrate was used to convert the median concentration limit to an annual load. Two sources of information for the mean annual flowrate were available – the published long term average values from the modelling data report, and the flowrates from the 2015 monitoring data. The greater of these two were used with the median concentration to calculate a lower bound for the consented annual load.

Using the current average annual flow underestimates the consented E.coli load. This is because, except for Te Kauwhata sewage, the consents only specify a maximum flowrate and there will be headroom between the current average flowrate and the maximum average flowrate that could be discharged and still be compliant. However, it was considered that the TN and TP conditions were more likely to be the dominant constraints and that that further work to determine peaking factors was not justified. Also, detailed flow data were not available for all the sites.

4.5.2 2015 Actual Data

For each site the mean daily load was calculated as the product of the daily flowrate and the measured concentration. The annual load was calculated from the mean daily load.

4.6 Calculation Notes for Individual Sites

Where there were specific issues in converting the consent conditions or the 2015 monitoring data to match the model, these are outlined for each site below.

4.6.1 Ngaruawahia and Huntly Sewage

These two sites are described together as their consents are linked.

For both sites, there is a combined daily mass limit (kg/day) for TN and TP for summer. There is also a median concentration limit (g/m^3) that applies all year round.

As the summer limit is more stringent, the two limits were combined to calculate the annual consented load. However, the summer load is a combined total for the two sites, so this was prorated back to each site based on the site's 2015 summer load for that nutrient. The winter component was calculated as the consented median annual concentration multiplied by the actual winter flow for each site.

The flow from the Ngaruawahia plant is intermittently stopped to buffer sufficient treatment volume for a coagulation process prior to discharge. This meant some sample days had non-representative discharge volumes, from the discharge only being run for sufficient time to facilitate the sampling, or more than one day's worth of buffered flow discharged. To reduce the under or over-weighting of samples, the mass loads were calculated by:

- Using the average monthly flow for the monthly TN and TP grab samples; and
- using the three day average flow (the sample day and the day either side) for the weekly E.coli grab samples.

4.6.2 Tokoroa Sewage

The comparison for Tokoroa was made against the last valid consent, which expired in 2011.

The modelled loads are a population-based estimate as monitoring data were not available at the time.

Monitoring data were not yet available for December 2015, so data from December 2014 were used to give 12 months of data for the 2015 comparison.

The consent, and hence monitoring data, was in terms of faecal coliform concentrations. This was taken as equivalent to E.coli when comparing with the modelled load.

The TN consent limit is a concentration, this was converted to an annual consented load using the 2015 average flow.

4.6.3 Cambridge Sewage

The nutrient consent conditions and monitoring data for Cambridge are for dissolved inorganic nitrogen and dissolved reactive phosphorus. These were also the data available for the model. As per the model, the dissolved forms have been taken as equivalent to the totals for nitrogen and phosphorus.

The model does not include the microbial load from the Cambridge WWTP, so no comparison was made.

4.6.4 Hamilton Sewage

The consent has different summer and winter median limits for nutrients, and one median limit for E.coli. The summer and winter periods are six months each.

In the consent, the summer limits for N and P, and the all-year limit for E.coli are written in a way that is close but not quite the same as a median limit, evaluating to the slightly more stringent 53rd percentile. For the sake of simplicity, this has been treated as equivalent to a median limit.

The consent limits and actual data are available as TN, TPs, and E.coli, and no conversions were required.

4.6.5 Pukekohe Sewage

This last operative consent expired in 2015.

No comparison could be made with the consent conditions for N, P, or E.coli. These were all specified as 90 and 100th percentiles, and could not be converted to medians to compare with the model or the monitoring data.

The 2015 monitoring data were available as NH_4^+, TP, and faecal coliform values. The NH_4^+ and faecal coliform data were treated as equivalent to TN and E.coli, because this approach was used for the model preparation.

4.6.6 Te Kauwhata Sewage

The Te Kauwhata consent was unique in that it included a median flow limit as well as a maximum flow limit. For this site only, the consented median flow was used, rather than the annual average, to calculate the annual load as this exactly describes the consented median E.coli load.

The 2015 monitoring data and consents were in terms of TN, TP, and E.coli and no further conversion was required.

4.6.7 Meremere Sewage

The nitrogen consent limit and 2015 monitoring data were for a total Kjeldahl nitrogen (TKN) concentration. As with the modelled loads, this was assumed to be equivalent to the TN concentration and multiplied by the 2015 actual flow to give an annual limit.

Similarly, the TP consent condition was a concentration only and was multiplied by the 2015 average flow to give an annual consented load.

4.6.8 Te Kuiti Sewage

The consent has median daily mass limits for both TN and TP for the summer period, and a comparison could be made with the 2015 monitoring data. However, the year-round 90th percentile concentration limit for NH_4^+ could not be used as a median, so it was not possible to calculate an annual consented load for comparison with the model. There are no limits for phosphorus, in any form, outside the summer period, so it was also not possible to compare phosphorus consent limits with the model.

The 2015 monitoring data had 28 days where no flow was discharged. However, the 2015 TN and TP monitoring data was only taken on days when flow occurred. The calculated annual amounts have been prorated down to reflect the days where no contaminants were discharged.

In the 2015 monitoring data, the annual TN load is significantly higher than the summer load, at 12.8 T/yr compared to 2.8 T/yr, respectively. This is because the 2015 winter load was 17.4 T/yr and the summer consent period is four months.

4.6.9 Te Awamutu Sewage

The nutrient consent limits are in terms of TN and TP kg/d, and no further conversion was required.

The microbial consent condition and data are in faecal coliforms, and these have been taken as equivalent to E.coli, as with the model.

4.6.10 Otorohanga Sewage

The consent has summer and winter limits for all three contaminants, with each season being six months. For comparison with the model, the conditions were combined into an annual amount.

The E.coli monitoring data were sampled fortnightly in summer and monthly in winter. To prevent seasonal bias, and because annual average flow was used to calculate the annual load, the winter monitoring results were given double weighting.

4.6.11 Kinleith

No microbial comparison was made as the consent has no microbial limits and there was no E.coli load modelled for this point source.

Nutrient limits and data are in terms of TN and TP mass loads, and no further conversion was required.

4.6.12 Te Awamutu Dairy

The consented annual nitrogen and E.coli limits are 90th percentiles and could not be compared with the modelled loads. The TP limit was in terms of a daily mass load and no further conversion was required.

Monitoring data for 2015 were not available.

4.6.13 Hautapu Dairy

The consent nutrient limits are in terms of TN and TP mass loads, and no further conversion was required. The consented annual E.coli load was calculated using the average flowrate from the modelling period.

Monitoring data for 2015 were not available.

4.6.14 Te Rapa Dairy

The consent nutrient limits are in terms of TN and TP mass loads, and no further conversion was required.

No microbial comparison was made as the consent has no microbial limits and there was no E.coli load modelled for this point source.

Monitoring data for 2015 were not available.

4.6.15 Affco Meatworks

The nutrient consent conditions are daily mass limits and no further conversion was required.

The microbial consent condition and the weekly monitoring data were for faecal coliforms. It is assumed that the same data were available for the modelling, treating faecal coliforms and E.coli as equivalent. The 2015 monitoring data had 10 samples that were also analysed for E.coli, with a close correlation between the E.coli and faecal coliform results for 9 of the 10.

4.6.16 Tuakau Proteins

The consent nutrient limits are in terms of TN and TP mass loads, and no further conversion was required. The consented annual E.coli load was calculated using the modelled flowrate as this was slightly higher than the average flowrate from the 2015 monitoring data.

Monitoring data for the full 2015 calendar year were not available. The available data were from November 2014 to October 2015, inclusive, with data for May 2015 missing from this period. The sampling frequency for the available data was weekly for TN, monthly for E.coli, and a mix of monthly and weekly for TP. To prevent bias, the weekly TP data were first converted to monthly means.

4.6.17 Wairakei

The TN load included in the model for Wairakei does not have consent conditions or monitoring data to compare it against.

5 Comparison Results

Tables 5.1 to 5.3 compare the consented and actual loads for TN, TP, and E.coli. Where there was no relevant consent condition for that load, the cells are shaded grey. Where there is a condition but it could not be compared, for example an upper percentile, then that is noted as text.

Table 5.1: Comparison of modelled, consented, and 2015 monitoring data for total nitrogen

Number	Site	Full Year			Summer		Winter	
		Modelled (T/yr)	Consented load** (T/yr)	2015 actual (T/yr)	Consent (T/yr)	2015 (T/yr)	Consent (T/yr)	2015 (T/yr)
1	Ngaruawahia Sewage*	8	10.9	7.7	20.8	5.8		
5	Huntly Sewage*	14	19.1	14.5		8.2		
2	Tokoroa Sewage**	32	47.6	37.3				
3	Cambridge Sewage**	54	90th percentile	54.8				
4	Hamilton Sewage*	189	356	182	164	165	548	199
6	Pukekohe Sewage**	21	90, 100th percentile	7.5				
7	Te Kauwhata Sewage*	2	3.2	2.8				
8	Meremere Sewage**	1	1.2	0.5				
9	Te Kuiti Sewage*	26	90th percentile (NH_4)	12.8	15.7	2.8		
10	Te Awamutu Sewage**	11	21.2	7.3				
11	Taupo Sewage	Not modelled						
12	Otorohanga Sewage*	14	9.1	5.9	7.3	3.0	11.0	9.4
13	Kinleith	145	219	135				
14	Te Awamutu Dairy**	15	90th percentile	No data				
15	Rotorangi Piggery	Not modelled						
16	Reporoa Dairy	Not modelled						
17	Lichfield Dairy	Not modelled						
18	Hautapu Dairy**	17	36.5	No data				
19	Te Rapa Dairy**	11	53.8	No data				
20	Affco Horotiu**	90	245	101				
21	Tuakau Proteins*	30	27.4	22.0				
22	Wairakei	50	No condition	No data				

*Consent limits have changed since start of model data period ** Consent expires in next 5 years

Table 5.2: Comparison of modelled load, consented load, and 2015 actual load for total phosphorus

Site Number	Site	Full Year			Summer		Winter	
		Modelled (T/yr)	Consented load (T/yr)	2015 actual (T/yr)	Consent (T/yr)	2015 (T/yr)	Consent (T/yr)	2015 (T/yr)
1	Ngaruawahia Sewage*	2.5	2.45	0.2	6.3	0.2		
5	Huntly Sewage*	4.2	6.98	1.8		1.3		
2	Tokoroa Sewage**	6.5	No limit	5				
3	Cambridge Sewage**	8.5	90th percentile only	4.9				
4	Hamilton Sewage*	63.1	146	32	36.5	27.2	255.5	35.9
6	Pukekohe Sewage**	13.7	90, 100th percentiles	5.0				
7	Te Kauwhata Sewage*	0.9	1.1	0.7				
8	Meremere Sewage**	0.2	0.4	0.1				
9	Te Kuiti Sewage*	4.0	No limit	2.6	11.0	1.0		
10	Te Awamutu Sewage**	7.0	9.5	2.6				
11	Taupo Sewage	Not modelled						
12	Otorohanga Sewage*	2.1	1.6	1.8	1.5	1.7	1.8	2.0
13	Kinleith	19.1	23.0	15.8				
14	Te Awamutu Dairy**	4.8	4.7	No data				
15	Rotorangi Piggery	Not modelled						
16	Reporoa Dairy	Not modelled						
17	Lichfield Dairy	Not modelled						
18	Hautapu Dairy**	0.5	1.8	No data				
19	Te Rapa Dairy**	10.8	20.8	No data				
20	Affco Horotiu**	13.8	36.5	15.3				
21	Tuakau Proteins*	8.4	11.3	6.9				
22	Wairakei	Not modelled						

*Consent limits have changed since start of model data period. ** Consent expires in next 5 years

Table 5.3: Comparison of modelled, consented and 2015 monitoring data for E.coli

Number	Site	Full Year			Summer		Winter	
		Modelled (P/yr)	Consented load (P/yr)	2015 actual (P/yr)	Consent (P/yr)	2015 (P/yr)	Consent (P/yr)	2015 (P/yr)
1	Ngaruawahia Sewage*	0.0785	0.0008	0.0001				
5	Huntly Sewage*	0.0326	0.0012	0.0006				
2	Tokoroa Sewage**	0.0652	0.0024	0.0003				
3	Cambridge Sewage**	Not modelled						
4	Hamilton Sewage*	0.7430	0.0207	0.0076				
6	Pukekohe Sewage**	0.0840	90, 100th percentiles	0.0042				
7	Te Kauwhata Sewage*	0.0008	0.0060	0.0011				
8	Meremere Sewage**	0.0051	0.0040	0.0027				
9	Te Kuiti Sewage*	0.3023	90th percentile	0.0031				
10	Te Awamutu Sewage**	0.0495	90, 100th percentiles	0.0022				
11	Taupo Sewage	Not modelled						
12	Otorohanga Sewage*	0.2644	0.0078	0.0024	0.0017	0.0036	0.0139	0.0012
13	Kinleith	Not modelled						
14	Te Awamutu Dairy**	0.0002	90th percentile	No data				
15	Rotorangi Piggery	Not modelled						
16	Reporoa Dairy	Not modelled						
17	Lichfield Dairy	Not modelled						
18	Hautapu Dairy**	0.0006	0.0034	No data				
19	Te Rapa Dairy**	Not modelled						
20	Affco Horotiu**	0.0103	0.0093	0.0140				
21	Tuakau Proteins*	0.0081	0.0009	0.0000				
22	Wairakei	Not modelled						

*Consent limits have changed since start of model data period. ** Consent expires in next 5 years

5.1 Comparison of Model baseline and estimated consented loads

A summary of how the modelled loads compare to estimated consented loads is given in Table 5.4. Again, it must be stressed that for some sites, this is comparing old performance against new consent conditions.

Generally, the modelled nutrient loads are less than the estimated consented loads, with some sites discharging significantly less than their consented limit. For the sites that have microbial conditions, the modelled E.coli loads are generally well in excess of current consent conditions. It should be noted that where consents changed, very large reductions in permitted E.coli loads were common. This was typically a direct outcome of treatment plant upgrades. Furthermore, the estimated consented load is at best a lower bound for the actual consented load.

This comparison is at an annual level. For the five sites with seasonal conditions, this may hide a pinch-point from a seasonal load limit. This is particularly true for Hamilton Sewage, where the 2015 summer TN load was very close to the consented summer TN load but this is not apparent when the summer values are combined with the winter monitored and consented loads.

Table 5.4: The ratio of the modelled annual loads (Model) to the estimated consented annual loads (Consent)

#	Site Name	TN Model/Consent Ratio	TP Model/Consent Ratio	E.coli Model/Consent Ratio
1	Ngaruawahia Sewage*	0.7	1	102
5	Huntly Sewage*	0.7	0.6	27
2	Tokoroa Sewage**	0.7	Could not compare	27
3	Cambridge Sewage**	Could not compare	Could not compare	Not modelled
4	Hamilton Sewage*	0.5	0.4	36
6	Pukekohe Sewage**	Could not compare	Could not compare	Could not compare
7	Te Kauwhata Sewage*	0.6	0.8	0.1
8	Meremere Sewage**	0.9	0.5	1.1
9	Te Kuiti Sewage*	Could not compare	Could not compare	Could not compare
10	Te Awamutu Sewage**	0.5	0.7	Could not compare
11	Taupo Sewage	Not modelled	Not modelled	Not modelled
12	Otorohanga Sewage*	1.5	1.3	34
13	Kinleith	0.7	0.8	Not modelled
14	Te Awamutu Dairy**	Could not compare	1	Could not compare
15	Rotorangi Piggery	Not modelled	Not modelled	Not modelled
16	Reporoa Dairy	Not modelled	Not modelled	Not modelled
17	Lichfield Dairy	Not modelled	Not modelled	Not modelled
18	Hautapu Dairy**	0.5	0.3	0.2
19	Te Rapa Dairy**	0.2	0.5	Not modelled
20	Affco Horotiu**	0.4	0.4	1.1
21	Tuakau Proteins*	1.1	0.7	9
22	Wairakei	Could not compare	Not modelled	Not modelled

*Consent limits have changed since the start of the model data period.
** Consent expires in next 5 years

5.2 Comparison of Model baseline and 2015 actual loads

A summary comparison of 2015 monitoring data with the model monitoring data is given in Table 5.5, for those sites where 2015 data were available. This gives an indication of how site discharges may have changed since the modelling period. The reasons for changes may include improvements to the treatment process, commercial or residential growth increasing treatment loads, or 2015 environmental conditions affecting treatment performance. Some variation is expected when comparing a single year to a long term average.

Where loads have increased from the model period, this does not indicate noncompliance, as most sites were discharging less than their consented limits.

Using 80% as the threshold, there were five sites with significant TN load reductions and nine sites with significant TP reductions. There were also nine sites with E.coli load reductions, but these were much larger reductions, typically two orders of magnitude smaller, reflecting plant upgrades.

The combined loads from the modelled point sources contribute 7% of the overall nitrogen mass flow and about 18% of the overall phosphorus mass flow in the two rivers (Vant, 2014). There has been little change in the nitrogen load between the modelled and 2015 data periods. For those sites that had 2015 data, the total phosphorus load reduced by about 40% from the modelled period to 2015. Assuming the sites without 2015 data have maintained similar performance, this is about a 5-6% reduction in the total phosphorus mass flow in the rivers, compared to the modelled period.

Table 5.5: The ratio of the 2015 annual loads to the modelled annual loads

#	Site Name	TN 2015/Model Ratio	TP 2015/Model Ratio	E.coli 2015/Model Ratio
1	Ngaruawahia Sewage*	1.0	0.1	0.001
5	Huntly Sewage*	1.0	0.4	0.02
2	Tokoroa Sewage**	1.2	0.8	0.005
3	Cambridge Sewage**	1.0	0.6	Not modelled
4	Hamilton Sewage*	1.0	0.5	0.01
6	Pukekohe Sewage**	0.4	0.4	0.05
7	Te Kauwhata Sewage*	1.4	0.7	1.4
8	Meremere Sewage**	0.5	0.6	0.5
9	Te Kuiti Sewage*	0.5	0.7	0.01
10	Te Awamutu Sewage**	0.7	0.4	0.04
11	Taupo Sewage	Not modelled	Not modelled	Not modelled
12	Otorohanga Sewage*	0.4	0.9	0.01
13	Kinleith	0.9	0.8	Not modelled
14	Te Awamutu Dairy**	No 2015 data	No 2015 data	No 2015 data
15	Rotorangi Piggery	Not modelled	Not modelled	Not modelled
16	Reporoa Dairy	Not modelled	Not modelled	Not modelled
17	Lichfield Dairy	Not modelled	Not modelled	Not modelled
18	Hautapu Dairy**	No 2015 data	No 2015 data	No 2015 data
19	Te Rapa Dairy**	No 2015 data	No 2015 data	No 2015 data
20	Affco Horotiu**	1.1	1.1	1.4
21	Tuakau Proteins*	0.7	0.6	0.001
22	Wairakei	Could not compare	Not modelled	Not modelled

*Consent limits have changed since the start of the model data period. ** Consent expires in next 5 years

6 Conclusion

The comparison of estimated consented loads and modelled baseline loads found that a large number of consent conditions have changed since the beginning of the model baseline period. This affected seven of the 18 modelled sites. A further seven consents either have expired or will expire by the end of 2017.

In general, the sites' modelled nutrient removal performance was better than what is required under current consent conditions.

For sites with microbial consent conditions, their modelled performance was generally much worse than that required by their current consent conditions. Many of these sites now have more stringent consent conditions than applied during the modelling period, and the 2015 monitoring data showed much improved performance, generally exceeding the current consent requirements.

Four modelled sites did not have 2015 monitoring data available, with only two non-municipal sites covered, precluding commentary on the overall 2015 performance.

For those sites where 2015 monitoring data were available, the total 2015 nitrogen loads were generally the same as those used in the model. Improvements in the 2015 point source phosphorus loads compared to the modelled loads were equivalent to a 5-6% reduction in the modelled total phosphorus mass flows in the rivers. The overall point source E.coli load is also improved compared to the model.

7 Applicability

This report has been prepared for the exclusive use of our client Waikato Regional Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions in this report are based on discrete monitoring data. The temporal variability of water quality is inferred but it must be appreciated that actual conditions could vary from the assumed model.

Tonkin & Taylor Ltd

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