BEFORE A HEARINGS PANEL OF THE GREATER WELLINGTON REGIONAL COUNCIL

UNDER	the Resource Management Act 1991 ("the Act")
IN THE MATTER OF	Resource Consent Applications to Greater Wellington Regional Council pursuant to section 88 of the Act to discharge contaminants to land, air and water
BY	South Wairarapa District Council
FOR	the proposed staged upgrade and operation of the Featherston Wastewater Treatment Plant

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BRIEF OF EVIDENCE OF EMMA LOUISE HAMMOND ON BEHALF OF SOUTH WAIRARAPA DISTRICT COUNCIL

SURFACE WATER QUALITY

DATED 31 MARCH 2018

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Barrister
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EVIDENCE OF EMMA LOUISE HAMMOND ON BEHALF OF SOUTH WAIRARAPA DISTRICT COUNCIL

1. My full name is Emma Louise Hammond.

2. I hold a Bachelor of Science degree with honours in Environmental Science from the University of Leeds (2004) and a Master of Science degree with honours in Water Resource Technology and Management from the University of Birmingham (2008), both in the United Kingdom.

RELEVANT EXPERIENCE

3. I have 10 years of post-graduate experience in the field of water quality, hydrology and environmental assessment for a wide range of infrastructure projects including wastewater planning and water resource assessment.

4. Since 2008, I have been a member of the Chartered Institution of Water and Environmental Management (CIWEM) and a Chartered Member since 2014.

5. I have been based in Auckland since November 2016 working for the management, engineering and development consultancy Mott MacDonald New Zealand Ltd. Prior to this I worked for the Mott MacDonald Group in Hong Kong and the United Kingdom.

6. Most recently, I have been involved in Environment Court mediation for the Pahiatua wastewater treatment plant, Manawatu Region. Prior to this I have been involved in several assessments of environmental effects ("AEE") for wastewater treatment plant resource consent applications across New Zealand. In 2016/2017 I was responsible for the peer review (on behalf of Auckland Council) of Watercare's planned wastewater treatment plants at Snells Beach and Clarks Beach.

7. I am familiar with Featherston wastewater treatment plant ("FWWTP") and the receiving environment of the treated effluent discharge and have visited the site.

CODE OF CONDUCT

8. I have read the Code of Conduct for Expert Witnesses in section 7 of the Environment Court's Practice Note (2014). I agree to comply with that Code of Conduct. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement 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 which I express.

MY ROLE IN THE PROJECT

9. This evidence is presented in respect of the applicant South Wairarapa District Council's ("SWDC") application for resource consents to enable the ongoing operation, maintenance and upgrade of FWWTP ("the Project").

10. I have been involved in the project since August 2016 when I was appointed as the nominated checker for the first draft of the resource consent application and AEE by the project team. The origination and checking of the water quality assessment and resource consent application was undertaken by Mr Craig Campbell and Ms Sarah Sunich, previously of Mott MacDonald NZ Ltd.

11. Following lodgement of the application, in September 2017 I undertook an assessment of additional water clarity data in response to a Section 92 request from Greater Wellington Regional Council ("GWRC"). Following the departure of the Mott MacDonald Project Manager in September 2017, I fulfilled the role of interim Project Manager, a role which is now being undertaken by the Lead Planning Expert Mr Sven Exeter.

12. Prior to and following public notification, I have been involved in conferencing with GWRC's Freshwater Specialist, Dr Olivier Ausseil, around outstanding water quality matters, particularly in relation to possible effects on water clarity in the freshwater receiving environment, Donald Creek. This caucusing culminated in a summary memo by Dr Ausseil dated 8 April 2018. I contributed to the technical supporting memos issued to GWRC in relation to the activity status of the discharge of contaminants to water (SWDC, 2018a) and Policy 71 (PNRP) and S107 (RMA) for the discharge of contaminants to water (SWDC, 2018b). Further caucusing involving Dr Ausseil (Aquanet Consulting Ltd), SWDC's ecological specialist, Mr Keith Hamill (River Lake Ltd), and myself resulted in a Joint Witness Statement between Dr Ausseil and Mr Hamill dated 1 November 2018.

SCOPE OF EVIDENCE

13. My evidence will address the following:

(a) Water quality of the surface water catchment
(b) Summary of surface water quality effects
(c) Mitigation and management of surface water quality effects (conditions)
(d) Response to submissions
(e) Response to officers/technical reports
(f) Conclusion

14. I have assumed that the land application scheme will be operated in accordance with the scheme design and accordingly, based upon the evidence of Ms Katie Beecroft, will not contribute any significant nutrients to the streams through either surface runoff or leaching. My evidence therefore relates to the direct discharge of treated wastewater from FWWTP to Donald Creek.

WATER QUALITY OF THE SURFACE WATER CATCHMENT

The Donald Creek Receiving Environment

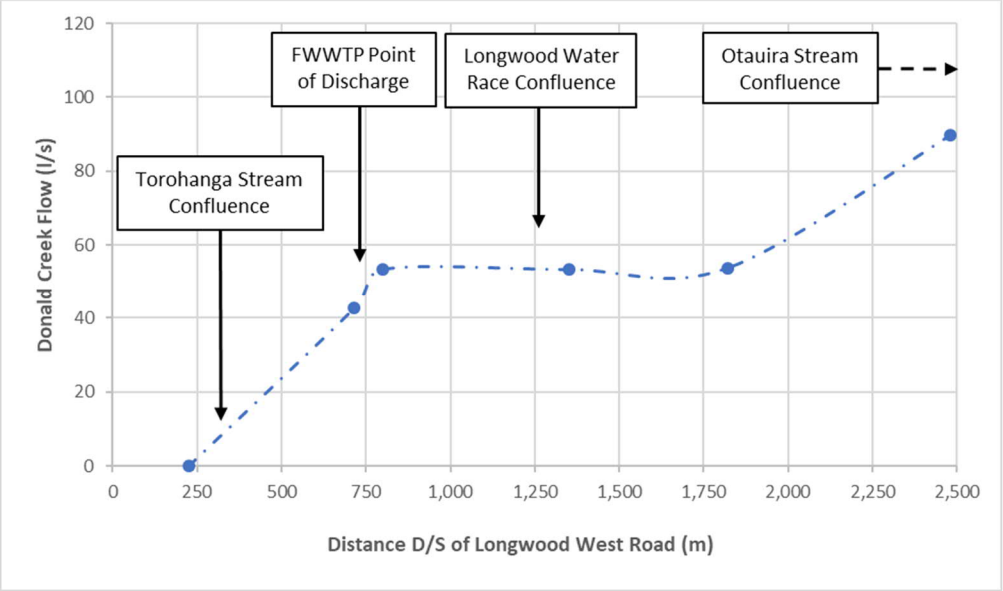
Upstream of FWWTP

15. Donald Creek drains a rural surface water catchment with its source nestled in the Tararua Ranges. Donald Creek is reported to gain and lose flow to groundwater along its length (Butcher, 2016).

16. Flow in Donald Creek naturally accretes along its length, which in the lower reaches downstream of Longwood West Road includes a confluence with a spring fed tributary, the Torohanga Stream[1]. Longwood Water Race contributes flow to Donald Creek approximately 430m downstream of the FWWTP point of discharge (sourced from the Tauherenikau River). Approximately 1.7km downstream of the Longwood Water Race is the confluence of the Otauira Stream (sometimes known as Otauira Stream). This confluence is approximately 2.2km downstream of the FWWTP point of discharge. Lake Wairarapa is a further 2.6km downstream of this confluence. Figure 1 shows Donald Creek's accretion profile based on spot flow gaugings taken along its course on 6 April 2016.

[1] Torohanga stream currently supports a 16 l/s consented water take which supplies a nearby dairy farm (WAR130310), although it is understood that this water take is likely to be surrendered.

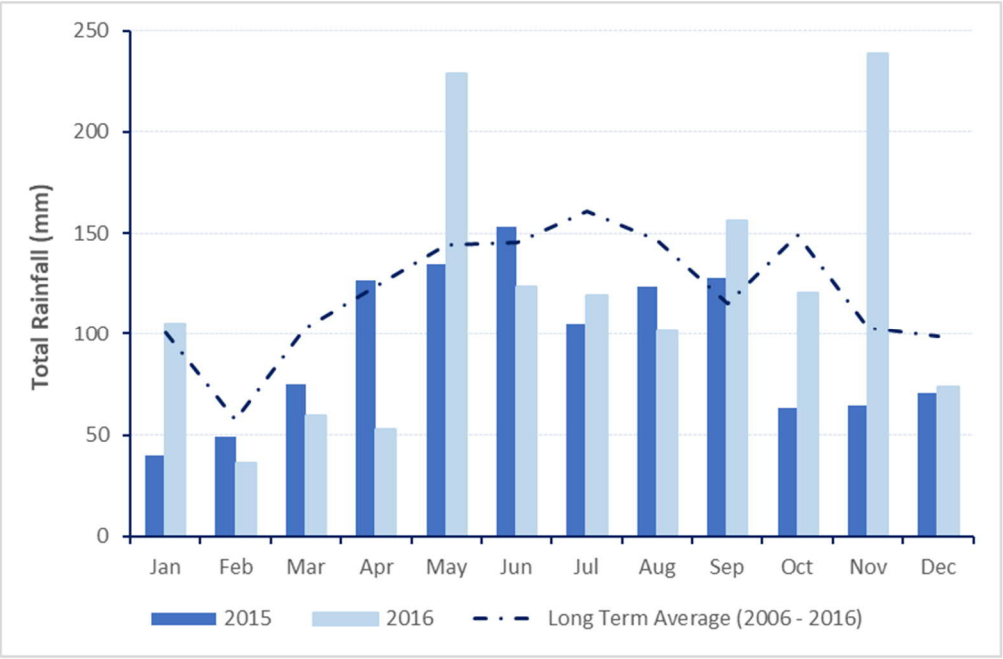
Figure 1: Donald Creek Flow Accretion Profile (6 April 2016)



Source: Adapted from Butcher (2016).

17. In the lower reaches of Donald Creek, some 400m upstream of FWWTP discharge and upstream of the Torohanga Stream confluence, the river bed has been found to be dry (Butcher, 2016). This is also indicated in Figure 1 at the location of Longwood West Road. A review of rainfall records for Woodside shows the 2015/16 summer period to have had significantly less than average rainfall as illustrated in Figure 2.

Figure 2: Rainfall summary - Woodside Weather Station (2006–2016)



Source: Adapted from NIWA (2019).

18. In the absence of a long-term flow series for Donald Creek, a synthetic flow series was derived for the location upstream of the point of discharge from FWWTP. Butcher (2016) used spot flow gaugings from Donald Creek to correlate with the flow record from nearby Otakura Stream and generate a flow series, suggesting an estimated mean flow of 345l/s and median flow of 241l/s (Butcher, 2016). This synthetic flow series was adopted by Mr Campbell in the AEE (SWDC, 2017) for the proposed project for the period 18 March 2005 to 31 May 2016 inclusive, providing mean and median flows of 346l/s and 208l/s, respectively for application in the water quality assessment.

19. A temporary flow gauge has since been installed in Donald Creek upstream of the FWWTP discharge which had a recorded median flow of 258l/s for the period 22 February 2016 to 7 December 2018 inclusive. Butcher (2018) has confirmed this shows "good agreement between the actual recorded flows and the synthetic flows" as justified with analysis of the flow statistics summarised in Table 1.

Table 1: Donald Creek Upstream Flow Statistics

Year	Recorded Flow (l/s)		Synthetic Flow (l/s)	
	Low Flow	Median Flow	Low Flow	Median Flow
2016	21	252	30	257
2017	51	271	44	297
2018	53	251	33	257
2016-18	42	258	36	270

Source: Butcher (2018).

20. The upstream water quality of Donald Creek has been recorded at a location approximately 25m upstream of the point of FWWTP discharge (monitoring location known as Longwood Water Race 2), as part of the ongoing Receiving Environment Monitoring in support of the existing Resource Consent. A summary of the upstream water quality recorded between 8 November 2005 and 7 June 2015, in relation to water quality guidelines for lowland catchments is provided in Table 2. This

summary clearly shows upstream water quality to be impacted by rural land-uses.

Table 2: Donald Creek Upstream Water Quality (2005 to 2015)

Parameter	Unit	Guideline	Threshold	No. of Exceedances	Proportion of Samples Exceeded
Temperature	°C	RMA 1991 FWP 2014	<25	0	0%
Dissolved oxygen (DO)	g/m^3 % saturation	NPS-FM 2014 RMA 1991	>5 ≥80	0 14	0% 16%
pH	pH value	FWP 2014	6.5 – 9.0	1	1%
Visual clarity	Metres	MfE 1994	≥1.6	3	16%
Biochemical oxygen demand (total $scBOD_5$)	g/m^3	Aquanet 2013	<2.0	6	7%
Total nitrogen	g/m^3	ANZECC 2000	≤0.614	87	91%
Dissolved inorganic nitrogen	g/m^3	NIWA 2016	≤0.63	65	73%
Total oxidised nitrogen (TO_x-N)	g/m^3	ANZECC 2000	≤0.444	78	88%
Total ammoniacal nitrogen (NH_4-N)	g/m^3	NPS-FM 2014	≤0.24 (median)	0	0%
Total phosphorus	g/m^3	NIWA 2016	≤0.045	18	20%
Dissolved reactive phosphorus (DRP)	g/m^3	NIWA 2016	≤0.011	44	49%
Escherichia coli (E.coli)	cfu/100ml	MfE/ MfH 2003	<550	24	25%
	cfu/100ml	PNRP 2015	<1,000	0	0%

Source: Adapted from SWDC (2016) – Table 9.

21. Hodder Farm is located immediately adjacent to Donald Creek at the point of FWWTP discharge and is currently an operational dairy farm with consented groundwater takes to support irrigation in summer (WAR130244 and WAR1325133). It is likely that the farm is contributing nutrients and sediment to Donald Creek through surface runoff.

FWWTP Discharge

22. Featherston WWTP currently discharges treated wastewater effluent to Donald Creek, at an approximate location of 1795294E, 5443435N

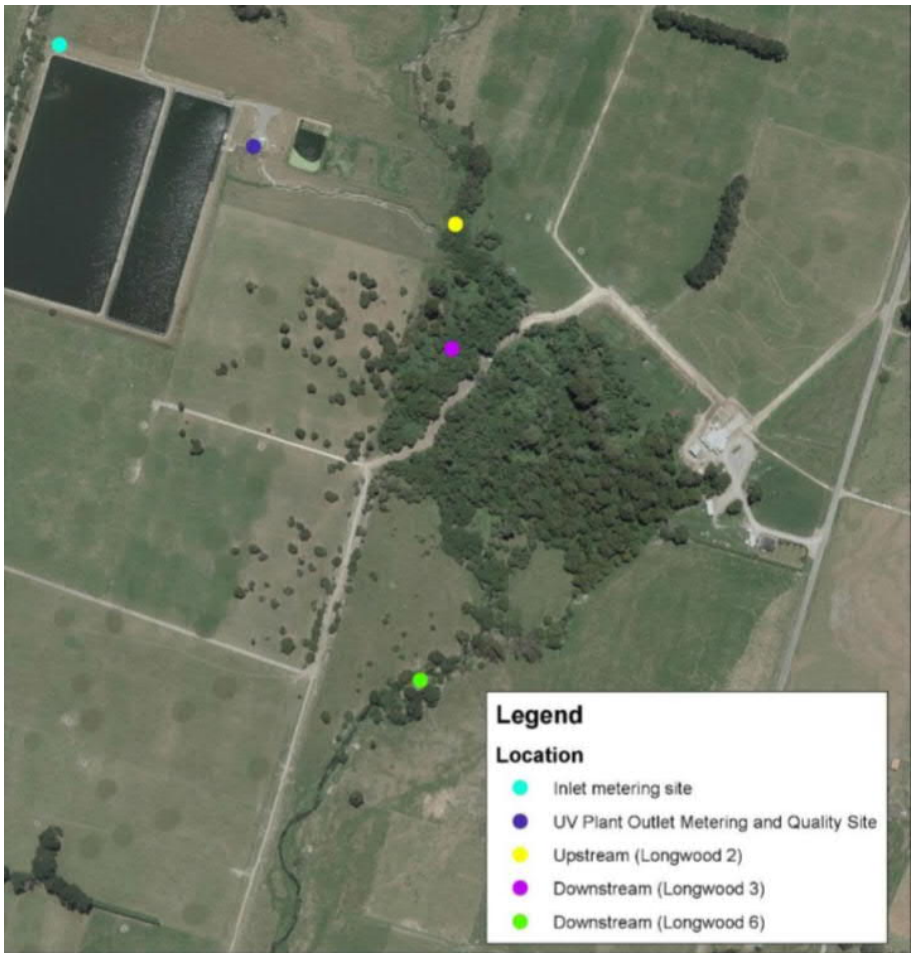
NZTM (NZGD2000). Currently, treated wastewater is discharged almost continuously (99% of the time) to Donald Creek at a median daily flow rate of 1,911m^3/d (recorded between 18 March 2005 and 31 May 2016).

23. The quality of the treated wastewater discharged from FWWTP was presented in Section 2 of the AEE (SWDC, 2017), which showed compliance with all Resource Consent effluent quality limits.

Downstream of FWWTP

24. The receiving water quality of Donald Creek has historically been monitored upstream (25m) and downstream (150m) of the point of FWWTP discharge, with a further monitoring location downstream of the confluence with Longwood Water Race (approximately 450m downstream of the discharge point) although this is not required for compliance purposes, as illustrated in Figure 3. The existing consent does not require any monitoring of the Otauira Stream.

Figure 3: Water Quality Monitoring Locations



25. The current water quality effects of the existing FWWTP discharge on the downstream receiving environment of Donald Creek are summarised in Section 6.4.4 of the AEE (SWDC, 2017), and are not re-presented here. Further assessment of existing visual clarity effects was undertaken as part of a Section 92 request from GWRC, as presented in Table 5.

Lake Wairarapa Receiving Environment

26. The current effects of the existing FWWTP discharge on the downstream receiving environment of Lake Wairarapa are summarised in Section 6.4.6 of the AEE (SWDC, 2017).

27. Various reports suggest that Otauira Stream and the FWWTP discharge has a significant contribution to nutrients in the lake. Milne (2009) and Perrie & Milne (2012) estimated a total nitrogen load of 5 tonnes N/year and 1.25 tonnes P/year. More recent modelling of the lake catchment (Allan. M, et al, 2017) estimates that Otauira Stream contributes 7.8% (38.2 tonnes N/year) and 7.9% (3.8 tonnes P/ year) of Lake Wairarapa's nitrogen and phosphorus load, respectively.

28. Section 6.4.6.4 of the AEE (SWDC, 2016) shows nutrient load estimations from FWWTP treated effluent discharge, based on SWDC compliance monitoring data. These estimated nutrient load contributions of 7.1 tonnes N/year (1.6% of estimated annual total nitrogen lake load) and 1.4 tonnes P/year (2% of estimated annual total phosphorus lake load).

29. If current FWWTP treated effluent nutrient loads are applied to the modelling study results by Allan, M. et al, (2017) the existing contributions to Lake Wairarapa from FWWTP could be estimated as 1.6% and 4.5% of total nitrogen and phosphorus contributions per year, respectively. This refinement in lake water quality understanding presents a slight increase (by 2.5%) in the percentage contribution of total phosphorus than was presented in the AEE, total nitrogen remains the same. I consider this to be a minor contribution which will significantly reduce with the proposed project stages. This conclusion

is supported by Dr Ausseil and Mr Hamill (2018) in their Joint Witness Statement.

The Otauira Stream Receiving Environment

30. Donald Creek meets Otauira Stream approximately 2.2km downstream of the FWWTP point of discharge.

31. It has been reported that Otauira Stream runs dry in low rainfall periods, upstream of its confluence with Donald Creek, as supported by the evidence of Mr Hamill. Limited flow data is available for Otauira stream, however, the AEE states that low flow spot gaugings undertaken by GWRC demonstrated a mean low flow of 263m^3/s (based on 12 observations).

32. Water quality upstream and downstream of the confluence, was sampled as part of an ecology survey on 12 October 2016 (Hamill, 2017), as summarised in Table 3. It should be noted that the downstream site represents flows from both tributaries; Otauira Stream and Donald Creek (including the Longwood Water Race).

Table 3: Otauira Stream Water Quality (12 October 2016)

Parameter	Unit	Guideline	Threshold	70m Upstream	100m Downstream
Temperature	°C	RMA 1991 FWP 2014	<25	11.6	12.9
Dissolved oxygen (DO)	g/m^3 % saturation	NPS-FM 2014 RMA 1991	>5 ≥80	11.5 106	10 97
pH	pH value	FWP 2014	6.5 – 9.0	7.3	7.2
Soluble biochemical oxygen demand ($scBOD_5$)	g/m^3	Aquanet 2013	<2.0	<2.0	<2.0
Total nitrogen	g/m^3	ANZECC 2000	≤0.614	0.16	1.29
Dissolved inorganic nitrogen	g/m^3	NIWA 2016	≤0.63	0.07	1.0
Total oxidised nitrogen (TO_x-N)	g/m^3	ANZECC 2000	≤0.444	0.069	0.97
Total ammoniacal nitrogen (NH_4-N)	g/m^3	NPS-FM 2014	≤0.24 (median)	<0.01	0.048

Total phosphorus	g/m^3	NIWA 2016	≤0.045	0.008	0.041
Dissolved reactive phosphorus (DRP)	g/m^3	NIWA 2016	≤0.011	0.005	0.028
Escherichia coli (E.coli)	cfu/100ml	MfE/ MfH 2003	<550	435	649
	cfu/100ml	PNRP 2015	<1,000	as above	as above

Source: Adapted from Hamill (2017).

ASSESSMENT OF POTENTIAL SURFACE WATER QUALITY EFFECTS

33. The proposed project, if approved, will result in progressive and significant improvements to receiving water quality between Stages 1A and 2B, as treated wastewater discharge from FWWTP is progressively removed from Donald Creek. Significant reductions in discharge volumes, frequency and loads to Donald Creek are expected, most notably between Stages 1B and 2A. From Stage 2A onwards, it is assumed that wastewater influent to FWWTP will be reduced substantially, owing to removal of inflow and infiltration (I&I) through network rehabilitation, resulting in significantly reduced discharges to Donald Creek.

34. The proposal will not alter the location of the treated wastewater discharge at Donald Creek. It will reduce the flow rate, annual and seasonal contaminant loads and the frequency and duration of discharge significantly over the proposed consent period, and so is not considered to be a new discharge (Mott MacDonald, 2018a).

35. Treated wastewater discharges for the proposed project stages were derived by Lowe Environmental Impact (LEI) during the design of the land application scheme in the AEE (SWDC, 2017), and modelled by Mr Campbell in section 6.4.4.3 of the AEE. These flows and associated load reductions are summarised in Table 4 and reflected as days of discharge to Donald Creek.

Table 4: Proposed FWWTP Discharges to Donald Creek with Project

FWWTP discharge to Donald Creek	Current	Stage 1A	Stage 1B	Stage 2A	Stage 2B
FWWTP treated wastewater discharges (flows):					
% time discharge operating (average year)	99%	90%	51%	40%	4%
No. of days discharge operating (average year)	361	329	186	146	14
% time discharge operating (average year) at Donald Creek flows < median	49%	40%	8%	4%	0%
Loads (tonnes/ year and % reduction from current):					
Total nitrogen incl. leaching	7.1	6.9 (3%)	4.1 (42%)	3.8 (47%)	1.5 (79%)
Ammoniacal nitrogen	3.9	3.8 (2%)	2.3 (42%)	2.0 (50%)	0.4 (90%)
Total phosphorus	1.4	1.3 (5%)	0.64 (54%)	0.56 (60%)	0.11 (92%)
Dissolved reactive phosphorus	1.02	0.97 (5%)	0.5 (54%)	0.4 (60%)	0.08 (92%)
Biochemical oxygen demand	12.6	12.1 (4%)	6.7 (47%)	3.8 (70%)	0.76 (94%)
Total suspended solids	1.4	1.3 (7%)	0.64 (54%)	0.56 (60%)	0.11 (92%)

Source: Adapted from SWDC (2016) - Tables 1, 21 and 30.

36. The staged reduction of FWWTP treated wastewater flows to Donald Creek have prioritised the removal of discharges in summer months when river flows are typically less than median. This is the case for Stage 1A. Summer, autumn and spring month discharges are targeted at Stage 1B and 2A, and all discharges except winter month discharges in Stage 2B. This should provide significant water quality improvements through the removal of discharges during low flow events where watercourses are most sensitive.

37. I also refer to Table 2 of Mr Hamill's evidence where he shows the significant reductions from Stage 1B onwards, as a proportion of time each month when discharge will occur at times of low river flow (reflecting a dilution ratio of 1:15).

WATER CLARITY

38. In response to a request for further clarification following a Section 92 request from GWRC, I undertook an assessment of water clarity effects (Mott MacDonald, 2017) downstream of the FWWTP discharge for the existing scenario and proposed project stages. This assessment used additional clarity monitoring data gathered in July and August 2017 at monitoring locations Longwood 2 (25m upstream) and Longwood 3 (150m downstream) using black disc measurements, to supplement existing monitoring data. This data was used to determine a statistical relationship and identify exceedances against a 33% change threshold (deterioration between upstream and downstream locations for a point source). 33% change is considered to be a conspicuous change in Policy 71 of the PNRP.

39. A conservative approach adopting the log-normal distributions of the data set was used to discern exceedances of the threshold with the proposed project, as summarised in Table 5. Noting that the majority of clarity exceedances occurred at river flows less than median and where FWWTP treated wastewater was greater than 9% of river flow.

40. Following this initial assessment, Dr Ausseil and I discussed the calculations and assumptions used, and agreed its overestimation of exceedance occurrences. No allowance was made for the proposed FWWTP discharge profile, as it did not incorporate the progressive reductions in discharge rates and volumes of treated wastewater to Donald Creek. It was therefore agreed that the assessment should be further refined, as reflected in (Aquanet, 2018) and Table 5.

41. Further refinements were made to assess the compliance with P71(a)(iii) of the PNRP which states that "a decrease in water clarity of no more than 33% at flows less than median". This was documented

in a technical supporting memo to only reflect exceedances attributable to less than median river flows (Mott MacDonald, 2018b) as summarised in Table 5.

42. Expert caucusing was undertaken in relation to instream ecology, between Mr Hamill and Dr Ausseil, for which I was involved in respect to water clarity. This caucusing further refined the exceedance potential of the 33% threshold in direct relation to flow dilutions; dilutions less than 1:10 are likely to exceed the threshold all the time, dilutions between 1:10 and 1:15 are likely to exceed 60%, and dilutions greater than 1:15 are likely to exceed 17% of the time.

43. Table 5 consolidates the various refinements to water clarity exceedance estimates in relation to % exceedance of the P71 PNRP threshold (of 33% change) and the number of days of potential exceedance.

Table 5: Clarity Threshold Exceedance Estimates (% occurrence and (No. of days))

Clarity Exceedances	Existing	Stage 1A	Stage 1B	Stage 2A	Stage 2B
Mott MacDonald (2017)	67% (244)	63% (230)	36% (132)	21% (76)	6% (22)
Aquanet (2018)	66% (242)	60% (220)	34% (125)	27% (98)	2% (9)
SWDC (2018)[1]	49% (179)	40% (146)	8% (29)	4% (15)	0% (0)
Joint Witness Statement (2018)	66% (242)	60% (220)	21% (75)	11% (42)	0.6% (2)

Note: [1]SWDC (2018) shows clarity exceedances in relation to PNRP P71(a)(iii) criteria i.e. Donald Creek flows less than median.

44. The key conclusions which can be reached from this are:

a) During Stage 1B the P71 guideline will only be breached for around 8% of the time, as compared to around 49% of time currently. That frequency will reduce to 4% at Stage 2A.

b) In my opinion, the approach of treating all exceedance of the 33% change threshold as being "conspicuous" is unhelpful. My

understanding of the Section 107 RMA standard is that it is directed at recreational and aesthetic values. Presumably P71 only applies to flows below median flow for good reason. It can be assumed that at flows above median clarity changes of greater than 33% do not have the same level of adverse effect on amenity values.

45. Even if a more conservative approach is adopted, and the wording of P71 is ignored, assuming that any change in clarity above 33% is "conspicuous" for the purposes of Section 107, the proposal results in significant improvements from Stage 1B onwards. A reduction from 66% of the time to 21% of the time at Stage 1B and a further reduction to 11% at Stage 2A is predicted. This illustrates the hugely significant benefits of the proposal which will be achieved within 5 years.

46. Water clarity observations taken further downstream (at Longwood 6) during the July and August 2017 monitoring, show marginal improvements in clarity owing to flow contributions from the confluence of the Longwood Water Race just upstream. Sampling showed the same number of exceedances of the clarity change threshold as the site immediately downstream of the FWWTP discharge, but to a slightly reduced scale or magnitude (averaging 3% lower than those observed further upstream, based on 7 samples). Average flows in Donald Creek during this period were augmented by 200l/s downstream of the confluence representing approximately an additional third of the upstream flow, although water quality characteristics of the Longwood Race itself, are relatively unknown.

47. In the absence of significant clarity improvements at the Longwood 6 site, however, it could suggest that the water quality of the Longwood Race is similar to that of Donald Creek downstream of the point of discharge.

48. The project proposes to significantly improve water clarity downstream of the FWWTP discharge, which is likely to occur from Stage 1B onwards as illustrated in Table 5, as a 41% reduction in

exceedances from existing of the P71 threshold at river flows less than median.

49. I conclude that currently and during Stage 1A, the WWTP discharge is causing, and will continue to cause, significant changes to water clarity from the discharge point to at least as far downstream as the confluence with the Longwood Water Race. I consider that this change results in a moderate to possibly significant impact on the aesthetic and recreational values of Donald Creek which in any event are low. I agree that clarity changes provide an indirect indicator of potential effects on aquatic life, but it is my understanding of the evidence of Mr Hamill and from the Joint Witness Statement, that the aquatic effects are caused by suspended solids (as measured by TSS) rather than specifically being caused by changes in visual clarity.

50. I conclude that from the commencement of Stage 1B the discharge will have less than minor or at most no more than minor adverse effects on water clarity. Those effects are further reduced (halved again) by Stage 2A.

51. In my opinion non-compliance with P71 for 8% then 4% of the time from Stages 1B and 2A, does not amount to a more than minor adverse effect on the environment. I have taken guidance from P71 which clarifies that effects below median flow should be disregarded. I also note that this effect (whether above or below median flow) is likely to be further reduced downstream of the confluence with the Longwood Water Race.

52. I also note that the most affected reach of Donald Creek (from the FWWTP discharge) is the immediate 430m downstream of the point of discharge, to the confluence with Longwood Water Race, which accounts for 9% of the total length of the receiving waters to where Otauira stream enters Lake Wairarapa (4.8km downstream).

53. For the purposes of Section 107 of the RMA, I agree that the discharge will infrequently cause conspicuous clarity changes during Stage 2A. From Stage 2B onwards, such effects will be occasional and of short

duration for only 2 days per year (less than 0.6% of the time). In my view those infrequent exceedances will have less than minor adverse effects on the receiving environment in Donald Creek, let alone the receiving environment as a whole.

AMMONIACAL NITROGEN

54. Ammonia toxicity concentrations were calculated and assessed in the AEE by Mr Campbell. A standard mass balance approach for annual median and 95th percentile calculations was considered too conservative, exaggerating the median and 95th percentile calculations considerably. As a result, Mr Campbell applied a Monte Carlo analysis to attribute a random log-normal distribution for total ammoniacal nitrogen, providing more representative estimates of the potential downstream water quality under the proposal.

55. The Monte Carlo estimates for Donald Creek, downstream of the FWWTP discharge point, are discussed in Section 6 of Appendix 8 in the AEE (SWDC, 2017).

56. Thresholds applied to the data set in the AEE include the NPS-FM National Bottom Line (MfE, 2013), USEPA acute limit (2013) and NIWA's guidelines for the National Objectives Framework (2014).

57. The specific threshold for toxicity to freshwater ecology (Fingernail clams) was raised as a possible issue by Dr Ausseil in caucusing with Mr Hamill. Further advice was sought from NIWA on the most appropriate protection level to apply for this species in Donald Creek, to better represent the impact of the proposed project. The appropriate protection level was clarified by Hickey (2018) to be the 95% species protection level, however, the median threshold was suggested to be applied to the 95%ile data set to improve species protection.

58. In their Joint Witness Statement, Mr Hamill and Dr Ausseil (2018) agreed on the following thresholds corresponding to NPS-FM Attribute State B for application to the proposed project (NIWA, 2014):

a) Annual median ≤0.24g/m^3 grading guideline

b) Annual 95%ile ≤0.40g/m^3 surveillance guideline

59. These thresholds have been discussed and agreed to be conservatively set at pH8, rather than adjusting them to the already conservative pH 7.9 (at temperatures of 20°C, as discussed in Section 6.3 of the AEE (SWDC, 2017). Modelled results of the proposed project against these thresholds are provided in Table 6.

Table 6: Total Ammoniacal Nitrogen Concentration Estimates

	Threshold at pH8 (pH7.9)	Existing	Stage 1A	Stage 1B	Stage 2A	Stage 2B
Median full data set	0.24 (0.27)	**0.44**	**0.44**	**0.29**	0.24	0.04
95%ile full data set	0.40 (0.46)	**1.70**	**1.70**	**0.88**	**0.73**	0.14

Source: SWDC (2017) – Appendix 8 – Table 36. Note: Existing data, not modelled. Bold red data shows exceedance of the threshold.

60. Existing data and Stage 1A show an exceedance of the 95% species protection level for both median and 95th percentiles, classifying the downstream water quality as NPS-FM Band C (80th protection level). Stage 1B shows a slight exceedance for median and 95th percentile exceedance of the 95% species protection level, categorising Donald Creek as NPS-FM Band C. Stage 2A shows median compliance and 95th percentile exceedance of the 95% species protection level, classifying the downstream water quality as NPS-FM Band B (median) and NPS-FM Band C (95%ile). By Stage 2B the proposed project would fully comply with the 95% protection level categorising Donald Creek as NPS-FM Band B, thus meeting the requirements to support Freshwater clams.

61. I note that these figures only relate to the times at which the discharge is occurring. By Stage 2A this frequency is reduced from 99% of the time to 40% of the time, and by Stage 2B this will further reduce to 4% of the time. Furthermore, by Stage 2A the discharge will be

largely removed at times of low flow as shown in Table 4. Mr Hamill discusses the implications of this for fingernail clams in his evidence, and has also undertaken a time-step analysis to refine the representation of intermittent flows on ammoniacal nitrogen concentration, of particular relevance to Stages 1B, 2A and 2B.

DISSOLVED OXYGEN

62. Dissolved oxygen concentrations downstream of the FWWTP point of discharge will progressively improve as direct discharges of treated wastewater are significantly reduced in Donald Creek, particularly from Stage 2A onwards.

63. These improvements will be instantaneous in terms of magnitude in Donald Creek (owing to higher dilutions of the treated wastewater) as discharges will be targeted at higher river flows. In addition, these improvements derive from a significant decrease in the frequency and duration of discharges at low flows and low dilution rates. as there will be fewer occurrences of treated wastewater discharges to Donald Creek.[2]

Escherichia coli

64. Section 6.4.4.8 of the AEE (SWDC, 2017) suggests that exceedances of the MfE recreational 'Red Mode' threshold for E.coli of 550cfu/100ml could occur at times with the proposed project. I agree that is the case, however, by Stage 2B, these occurrences will be limited in duration and frequency as direct discharges will only occur during winter months when land application is not possible and recreational activities are highly unlikely. I have found no evidence of any contact recreation in Donald Creek or Otauira Stream during any time of the year.

65. Although there is very little recreational value in Donald Creek and Otauira Stream downstream of the FWWTP discharge, there are some recreational uses in Lake Wairarapa.

[2] Refer to Table 2 of Mr Hamill's evidence in relation to reduction in the frequency of low dilution scenarios.

66. It has been estimated that 14.7% of the total E.coli contributions to Lake Wairarapa originates from Otauira Stream (Allan, M, et al, 2017). Only a proportion of the load from the stream to the lake derives from the FWWTP. This is evidenced by the E.coli counts observed upstream of the discharge point, as illustrated in Tables 2 and 3. Further E.coli loads enter Otauira Stream via farm runoff to Donald Creek, Longwood Water Race and Otauira Stream upstream of the confluence with Donald Creek.

67. I conclude that E.coli from the current discharge is unlikely to be the only source of bacteria in the surface water catchment. Any current risks to surface water users will be significantly reduced with the proposal by Stage 2A, as the discharge will be limited in duration and frequency and will largely be occurring in Winter. Dr McBride addresses health risk and Mr Exeter will cover recreational values and usage in his evidence.

SUMMARY OF WATER QUALITY EFFECTS

68. In summary, surface water quality effects of the proposal can be presented as per Table 7.

Table 7: Summary of Surface Water Quality Effects

Water Quality Effect	Existing	Stage 1A	Stage 1B	Stage 2A	Stage 2B
Clarity	Moderate to Significant	Moderate to Significant	Minor	Less than Minor to Minor	Less than Minor
Ammoniacal Nitrogen	Moderate to Significant	Moderate to Significant	Moderate	Minor	Less than Minor
Dissolved oxygen	Minor[3]	Minor	Minor	Less than Minor	Less than Minor
E.coli	Minor	Minor	Minor	Less than Minor	Less than Minor

[3] Subject to monitoring confirmation.

69. I note that in reaching these conclusions I have adopted an approach which considers these residual water quality effects in terms of their magnitude, extent, frequency and duration as compared to the upstream situation, or a situation in which the discharge was not occurring. In practice (as discussed by Mr Exeter) that is somewhat artificial because the discharge to Donald Creek exists and without the proposal will continue to exist for some years. If one instead focussed on the benefits of the proposal in terms of improvements in water quality, it is clear that there are significant improvements at Stage 1B and these improvements further increase at Stages 2A and 2B. In water quality terms, the most significant improvements occur by the commencement of Stage 1B.

MITIGATION AND MANAGEMENT OF SURFACE WATER QUALITY EFFECTS

70. The thresholds and receiving environment monitoring proposed in Schedule 2 of the Consent Conditions, are considered to be appropriate to identify any adverse effects which might occur under the proposal.

71. Continued monitoring of upstream river flow in Donald Creek to identify median flow thresholds in order to manage the direct discharges to Donald Creek (Schedule 2, Condition No. 11).

72. Dissolved oxygen monitoring at a suitable location upstream and downstream of the point of discharge should be undertaken for a period of 7 days, recording data at least hourly in order to characterise diurnal profiles. A low flow period in Donald Creek should be targeted within the first 2 years of the proposal and repeated at the start of Stage 1B.

RESPONSE TO SUBMISSIONS

73. Some submitters[4] have expressed concerns over the quality of the proposed FWWTP discharge and the effects on the surface water receiving environment including Donald Creek and Otauira Stream. The water quality effects have been addressed from paragraph 38 onwards of my evidence, which shows the proposal has been designed to significantly reduce the effects on receiving water quality in Donald Creek and further downstream.

74. Other submitters[5] have raised concerns about the effects of the proposal on Lake Wairarapa. The progressive load reductions to Donald Creek and Lake Wairarapa have been highlighted in my evidence (para 26 onwards) and shows that by Stage 2A nutrient contributions from FWWTP are likely to have minor adverse effects.

RESPONSE TO OFFICERS S42A REPORT

75. Pages 23 to 27 of the Officer's report (GWRC, 2019) refer to estimated clarity exceedances and discharge frequencies with as if they were certain. It should be noted that whilst the calculations have used observed data to estimate the likelihood of discharge and exceedance, it is not by any means certain that exceedances will occur as frequently as estimated. More appropriate terminology such as is likely to show a conspicuous change would provide clearer differentiation between perceived and known effects.

76. Page 33 of the Officers Report references a submission which cites Perrie & Milne (2012) stating that FWWTP is not an insignificant source of nutrients to the Lake (Wairarapa). As stated in paragraph 29 of my evidence, FWWTP nutrient load contributions are considered to be minor in comparison to total lake nitrogen and phosphorus loads. This

[4] Including but not limited to submitter #43, #76 and #92.
[5] For example, submitter #9, #10 and #13.

was agreed by Dr Ausseil and Mr Hamill in their Joint Witness Statement (p12, 2018). Furthermore, the current loads discharged from FWWTP to Donald Creek (and further downstream), will reduce significantly, as highlighted in Table 4 of my evidence. There will, however, be an ongoing load from Otauira Stream to the lake from other rural sources.

77. Page 43 of the Officers Report suggests that this resource consent application is primarily a discharge to water, with a "gradual" discharge to land component. This application has been designed to treat wastewater through suitable land, resulting in progressive reductions in discharges to water to only 4% of current flows by Stage 2B. By Stage 2A the total volume of discharge to the stream is reduced by 59% (Table 4). In my view it is incorrect to describe that as a "gradual" discharge to land component.

78. Page 43 goes on to suggest that high levels of effects will continue in Donald Creek for at least 13 years (the proposed timeframe to reach Stage 2B), and that the quality and quantity will remain the same as existing. This is incorrect. Receiving water quality improvements have been assessed and discussed throughout the AEE (SWDC, 2017), and my evidence all of which show progressive and significant improvement. This is also illustrated in Table 4, 5 and 6 of my evidence for nitrogen, phosphorus, ammoniacal nitrogen and water clarity.

79. Some increases in FWWTP treated wastewater quality parameters are likely, owing to the separation of I&I from the wastewater network, the main environmental benefit of this is to reduce the overall treated wastewater flows from FWWTP, which results in contaminant load reductions to the environment. The load reductions to Donald Creek at each stage are shown in Table 4.

80. On Page 49 of the Officers Report, Ms Arnesen suggests that Policy 43 of the RPS is not met, in part owing to what she sees as "no improvement" to Donald Creek or downstream receiving environments. I do not understand the basis for the suggestion that there is no

improvement to Donald Creek, and this does not align with the Joint Witness Statement of Dr Ausseil and Mr Hamill. I refer again to Table 4, 5 and 6 in my evidence which show predicted continuous and significant improvement in downstream water quality owing to reduced nutrient and contaminant loads to Donald Creek and reduced frequency and duration of discharges from FWWTP as a result of the proposed project. The majority of that improvement will occur within 5 years, if consent is granted.

81. Page 52 of the Officers Report states that effects from the proposed direct discharge to Donald Creek are not managed i.e. avoided or reduced, as required by Policy 5.2.6 of the RPS. I disagree for the reasons outlined in the previous paragraph. I would also add that in addition to the significant reductions to contaminant load to Donald Creek and downstream, there is further improvement resulting in reducing discharge at times of low river flow and low dilution. By Stage 2A FWWTP discharges below median flow are largely avoided, as illustrated in Table 4.[6]

82. Discharges of treated wastewater have been designed to preferentially discharge to Donald Creek when river flows are greater than or equal to 3 x median flow, in order to provide sufficient dilution and minimise adverse environmental effects. Discharges at river flows greater than or equal to 2 x median flow are then targeted as required. This is true across all project stages.

CONCLUSION

83. I have summarised the refinements made to water clarity estimations made through expert caucusing between Dr Ausseil, Mr Hamill and myself. It is clear, that the proposal will result in significant improvements to water clarity from Stage 1B onwards and that these will increase substantially by Stage 2A. In my opinion, the overall

[6] See also Mr Hamills Table 2 and his discussion of the reduction in discharges at times of low dilution.

effects of the proposal on the water quality of the receiving waters (including Otauira Stream, will be no more than minor by Stage 1B and will further reduce at Stage 2A to a point where they can be regarded as less than minor. In my view as least from Stage 1B, the water quality effects on such contact recreation and aesthetic values as exist, will be less than minor.

84. It is evident that the progressive reductions in nutrient and other contaminant load contributions proposed at FWWTP through the project over the next 13 years, and assessed in detail in the AEE, have not been given due consideration in the Officers Report. My evidence clarifies the expected improvements in receiving water quality downstream of the point of FWWTP discharge, which are significant.

Signed:

Emma Hammond

31 March 2019

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