BEFORE THE INDEPENDENT HEARING COMMISSIONERS
FOR GISBORNE DISTRICT COUNCIL

IN THE MATTER:	of the Resource Management Act 1991
AND	
IN THE MATTER:	of an application by Gisborne District Council for resource consent associated with wastewater overflows

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STATEMENT OF EVIDENCE OF DR PETER STANLEY WILSON
– WATER QUALITY
22 June 2021

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INTRODUCTION

Qualifications and experience

1. My full name is Dr Peter Stanely Wilson. I am a Principal Water Quality Scientist at 4Sight Consulting. I have held this position for two years. Prior to this, I was employed by Waikato Regional Council as a Coastal Water Quality Scientist.

2. I have a Bachelor of Science and Master of Science degree (with honours) in Chemistry from the University of Waikato and a Doctor of Philosophy degree in Marine Biogeochemistry from Auckland University of Technology.

3. My relevant expertise and experience include:

   (a) Developing, implementing, and reporting on (Waikato) regional coastal water quality monitoring programmes, including a coastal recreational water quality programme;

   (b) Tracking the source of faecal contaminants in marine and freshwater environments;

   (c) Developing, implementing, reporting on, or technically reviewing consent monitoring plans and reports for a broad range of activities, including marine farms, marinas, ports, and wastewater treatment plants; and

   (d) Preparing and presenting water quality and ecological evidence previously for council hearings and the Environment Court.

Code of Conduct

4. My qualifications as an expert are set out above. I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence. Except where I state that I am relying on the evidence of another person, this 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 expressed in this evidence.

SCOPE OF MY EVIDENCE

5. My evidence addresses the following aspects of the application:

   (a) My involvement in the Gisborne wastewater overflows resource consent application (**Application**);

   (b) Water quality assessment;

   (c) Response to issues raised in submissions;

   (d) Proposed consent conditions including monitoring plans;

   (e) Summary and conclusion.

MY INVOLVEMENT IN THE WASTEWATER OVERFLOW CONSENT PROJECT

6. I became involved in this project in January 2020 when I was asked to review and subsequently revise an 'Initial River Monitoring Report', prepared by 4Sight in 2017. Additional monitoring had been conducted since the 2017 report was published. My role was to reanalyse the data and prepare a revised report with the findings.

7. I produced a report for Gisborne District Council (**GDC or Council**) titled 'Wastewater Overflow Assessment: River Monitoring Report' dated June 2020, which was included as Appendix I to the Application (**River Monitoring Report or the Report**).

8. I also provided further input into the s92 response titled 'Technical Note – Gisborne District Council – Wastewater Overflow Consent' dated January 2021, which was included as Attachment D to the s92 Response dated 29 January 2021.

WATER QUALITY ASSESSMENT

Background

9. The River Monitoring Report (and the Application) provides a description of the GDC wastewater network. Essentially, it involves controlled overflow points that are dedicated network relief valves, which are opened if necessary to discharge a mixture of wastewater and stormwater in preference to discharges from uncontrolled points (manholes, gully traps etc) on private property.

10. Opening of the overflow points is governed by a standard operating procedure outlined in the Application and in the evidence of Mr West for the Applicant, which determines if

and when an overflow relief valve is opened and in turn, closed. That is, discharges associated with each wet weather overflow event are controlled, and as such, they are supported by records of the location and duration of the overflow.

11. Overflow valves are only opened where necessary such that each overflow event may be a different combination of overflow points, affecting different water bodies on each occasion. GDC has made substantial advances in reducing the quantity of wastewater discharged and the number of locations at which overflow discharges occur.

12. I understand that management processes continue to be refined and overflows are now controlled through two primary (Seymour Rd/Turenne St [Waimata River] and Wainui Road [Turanganui River]) and two secondary (Oak St and Palmerston Rd/Peel St [both Taruheru River]) overflow points. Up to six ‘tertiary’ overflow points may also be used if necessary. I also understand from the evidence of Mr West and Mr Kanz that GDC intends to relocate and replace the Seymour Rd/Turenne St primary overflow location so that it becomes a tertiary overflow point. This is in response to received submissions.

Monitoring locations and methodology

13. Monitoring was conducted at 15 sites within the Gisborne city region. The locations are shown in Figure 1 below and described in Table 2, which is duplicated from the River Monitoring Report:

Table 2: Site names, site numbers, site locations and site coordinates for each sampling site monitored

Stream Name	Monitoring Site Location	Monitoring Site Name	Monitoring Site Number	Site Coordinates
Stream Sampling Sites				
Taruheru River	Tuckers Road Bridge	Tuckers	7	E 2032530 N 5712096
	Lytton Road Bridge	Lytton	5	E 2035244 N 5710509
	Wi Pere Pipe	Wi Pere	8	E 2036997 N 5709556
	Peel Street Bridge	Peel	6	E 2037523 N 5708357
Waimata River	Goodwins Road Bridge	Goodwins	13	E 2041156 N 5711034
	Grant Road	Grant	14	E 2038530 N 5708362
	William Petty Bridge	William Petty	15	E 2037786 N 5708128
Waikanae Stream	Airport Culvert	Airport Culvert	11	E 2033800 N 5709013
	Grey Street Bridge	Grey	12	E 2036828 N 5708060
Turanganui River	Gladstone Road Bridge	Gladstone	9	E 2037580 N 5707995
	The Cut	The Cut	10	E 2036914 N 5707555
Kopuawhakapata Stream	Hirini Street	Hirini	4	E 2037830 N 5707761
Network Sites				
Wastewater interceptor manhole	Harris Street	Harris Street	1	E 2037995 N 5707878
	Munro Street	Munro Street	2	E 2034914 N 5708893
	Ormond Street	Ormond Street	3	E 2037750 N 5708486

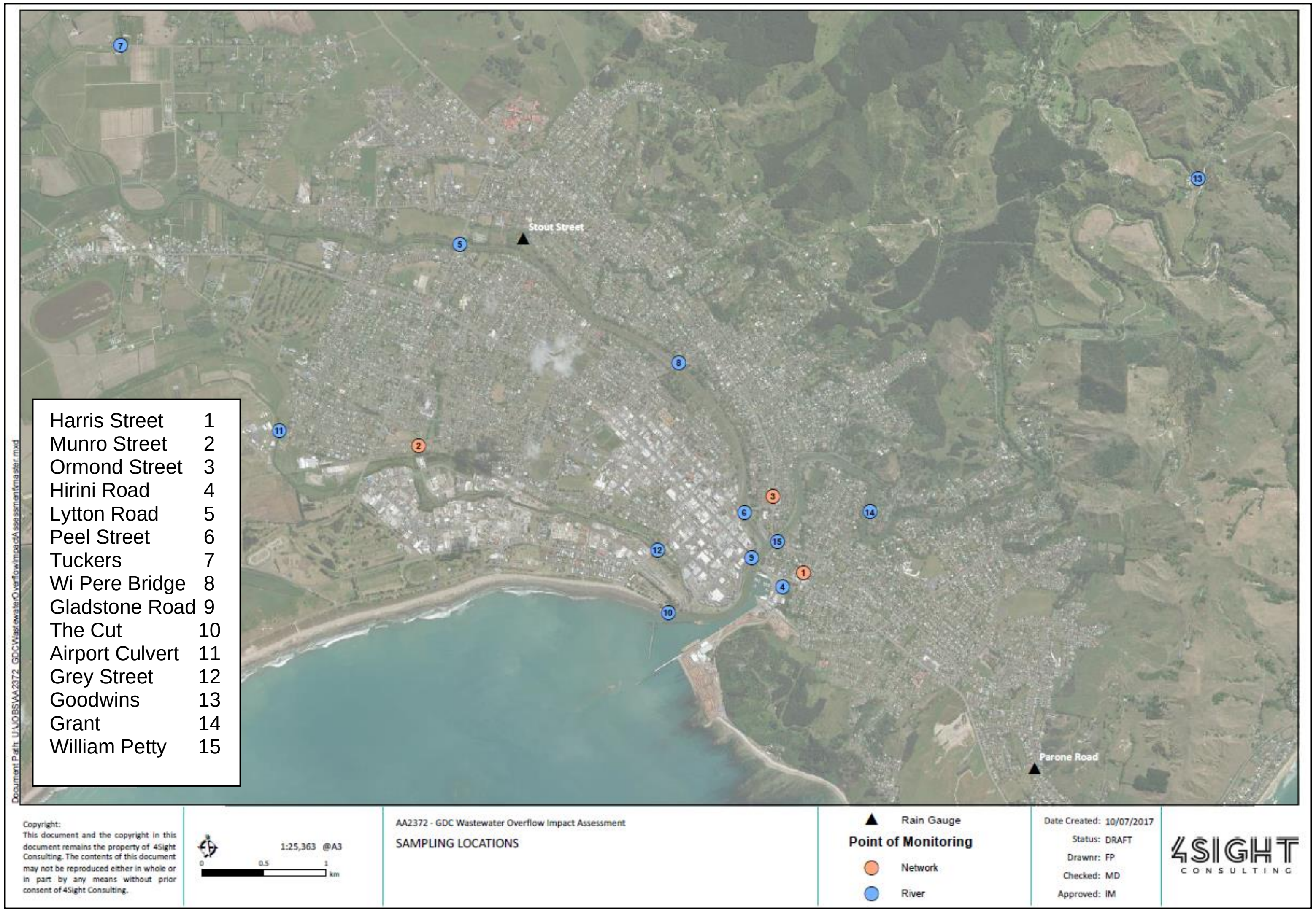

Figure 1: Rain gauge, river and network sampling locations

14. The 15 monitoring sites were separated into:

(a) 12 river sites or 'in-stream' sites, and

(b) three network sites ('in-pipe' sites).

15. Each stream (where possible) was sampled well upstream out of the potential effects of the overflow and tidal influence, as well as at various locations down the length of the stream and down to the coast, to characterise the quality of the river prior to it entering the urban area potentially affected by overflows.

16. In addition to the main streams potentially affected by overflows discussed above, two sites were located on the Waikanae Stream. The Waikanae Stream sites were monitored to assess the effects of overflows to the stream (should any occur), and to provide an indication of the effects of urban stormwater discharge on the stream in the absence of an overflow event.

17. As there were no overflows to the Waikanae Stream during the monitoring period, the results for this stream indicate contaminants such as metals, nutrients and bacteria to these streams from other sources within the catchment.

18. The three network sites were monitored with samples being collected from within the wastewater pipe itself (during heavy rain) to characterise the quality of stormwater-diluted wastewater prior to discharge. This information was then used for the hydrodynamic modelling of the discharge within the bay.

19. The Methodology for Sample Collection and Monitoring Frequency is set out in Sections 2.3.2 and 2.3.3 of the River Monitoring Report, and I do not repeat them here. The parameters monitored are set out in Section 2.3.4 of the River Monitoring Report and in Table 3 which is reproduced below:

Table 3: List of parameters analysed in detail in the River Monitoring Report

Nutrients	Bacteria	Heavy metals	Inorganic compounds	Physiochemical parameters
▪ Total phosphorus ▪ Total nitrogen ▪ Ammonia	▪ Enterococci	▪ Copper (dissolved) ▪ Zinc (dissolved)	▪ Fluoride	▪ Total suspended solids (TSS)

Guideline values

20. In New Zealand, there is a range of water quality parameters that are used as indicators of ecological health or contact recreational risk of a water body. There are multiple sources of guidelines values for these parameters, which can make identifying the most appropriate value complex. Guideline values for parameters analysed in more detail in the River Monitoring Report were sourced from one of the following:

    (a) Tairāwhiti Resource Management Plan (TRMP). Specifically, values from Table DF1.5.2.1 – Water Quality Objectives for the Urban Freshwater Management Unit; and

    (b) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018; www.waterquality.gov.au/anz-guidelines). These were formally known as the ANZECC (2000) Guidelines. Guideline values for freshwater were used as they were either similar to, or more conservative than, the estuarine guidelines and could be applied to all monitoring sites;

    (c) MfE/MoH Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas, 2003 (referred to as the Recreational Water Quality Guidelines). Enterococci was used as the indicator bacteria over *E. coli* because the water in the lower reaches of the urban rivers is tidally influenced and it is used in the TRMP as the indicator for the Urban Freshwater Management Unit;

    (d) Canadian Environmental Quality Guidelines (www.ccme.ca/en). These were used when no New Zealand specific guidelines were available.

21. The National Policy Statement For Freshwater Management 2020 (**NPSFM 2020**) includes numeric attributes states (guidelines/thresholds) for a number of parameters and includes a 'national bottom line' for each. Of the parameters assessed in the River Monitoring Report, the only applicable national bottom line value is for ammonia (toxicity) [0.24 mg/L (annual median) and 0.4 mg/L (annual maximum)]. The other values are only applicable to lakes or are for parameters that were not assessed in the River Monitoring Report. Note that the NPSFM 2020 was released after the River Monitoring Report was completed. Prior to this, the TRMP had ammonia (toxicity) guidelines that were the same as the NPSFM 2014 bottom line.

22. An overview of the relevant water quality guideline values is presented in Table 4.

Table 4: Summary of water quality guideline values. Values in bold were used in the River Monitoring Report. Note that mg/L and g/m^3 are equivalent units.

Parameter	Relevance	Guideline value		
		ANZG (2018)	TRMP	Other
Turbidity*	Amenity, sediment deposition/accumulation	**5.6 NTU** (1)		
Total nitrogen	Can cause nuisance plant growth	**0.281 mg/L** (1)		
Total phosphorus	Can cause nuisance plant growth	**0.023 mg/L** (1)		
Ammonia (toxicity)	Can cause nuisance plant growth/toxic to aquatic life	0.9 mg/L (95% protection) 2.3 mg/L (80% protection)	**1.3 mg/L** (median) **2.2 mg/L** (maximum)	0.24 mg/L (2) (median) 0.4 mg/L (maximum)
Fluoride	Can be toxic to aquatic life			**0.12 mg/L** (3)
Copper	Can be toxic to aquatic life	**0.0014 mg/L** (95% protection) **0.0025 mg/L** (80% protection)		
Zinc	Can be toxic to aquatic life	**0.008 mg/L** (95% protection) **0.031 mg/L** (80% protection)		
Enterococci	Human health		**280 CFU/100 mL** (95th %ile) **500 CFU/100 mL** (median)	140 CFU/100 mL (alert level) 280 CFU/100 mL (action level) (4)

* No guideline for TSS has been established. Refer to the New Zealand specific guideline for turbidity. The correlation between TSS and turbidity is strongly positively correlated.
[1] ANZG (2018) guideline value for New Zealand Warm Dry Low-elevation rivers (80th %ile of data).
[2] National Policy Statement For Freshwater Management 2020.
[3] Canadian environmental quality guidelines for the protection of aquatic life.
[4] Microbiological Water Quality Guidelines for Marine and Freshwater Recreational Areas (2003). Single-sample exceedances.

23. The parameters provided for in the TRMP are currently specific to the Waipaoa Catchment only. This is further set out in Mr Mayhew's evidence. The area is largely defined by the water catchment boundary of the Waipaoa River, but also includes the separate catchment areas of the Waikanae Stream and the Taruheru River. The Waipaoa Catchment has been broken down into four Freshwater Management Units (FMU) – being, Waipaoa Hill Country; Te Arai; Poverty Bay Flats; and Gisborne Urban.

It is important to note that, for the purposes of this Application, only the Gisborne Urban FMU is relevant[1] but it does not cover all of the waterbodies outlined in the analysis below. In particular, it covers the Taruheru River and the Waikanae Stream (but not the Waimata River or Kopuawhakapata Stream). The same guideline values were applied to all waterways in the River Monitoring Report, however, for consistency and to aid comparison among waterways.

24. In addition to event-related monitoring, GDC operates a state of the environment (**SOE**) monitoring programme. Relevant monitoring data from this programme were also provided for analysis. The data were summarised and graphs produced for key indicator water quality parameters. Where possible, water quality results were analysed against relevant guidelines to determine the relative risk of the overflows to human health and the receiving environment. The implications of these levels in terms of human health risk and impacts on ecology are addressed in the evidence of Dr Christopher Dada (human health), Dr Mike Stewart (emerging organic contaminats), and Dr Shane Kelly (ecology).

Existing environment

25. I assessed the existing environment to provide context for the wastewater overflow analysis by analysing SOE monitoring data.

26. Analysis was undertaken of the background water quality in each of the four water bodies: Taruheru River, Waimata River, Waikanae Stream and Kopuawhakapata Stream.

27. My analysis showed that there are, at times, elevated levels of contaminants (faecal bacteria, sediment, nutrients, and heavy metals) in the Taruheru River, Waimata River, Waikanae Stream, and Kopuawhakapata Stream that are unrelated to wastewater overflows. During routine sampling, the highest contaminant concentrations were measured at the most upstream sites. This indicates that the primary source of these contaminants is from the upper catchment. One exception to this is the Waimata River, where there was typically an increase in contaminant concentrations between the most upstream site (Goodwins) and the nearest downstream site (Grant). Without further investigation, it is not possible to identify whether the primary source of contamination is from urban or rural land use as there is a mixture of land use between the two sites.

[1] As shown in Figure DF1.3 of the TRMP

Enterococci

28. With regard to enterococci concentrations, all sites except Tuckers on the Taruheru River and Hirini on the Kopuawhakapata Stream were within (less than) the Urban FMU (annual median) guideline of 280 CFU/100mL. No sites, however, were within (less than) the Urban FMU 95th percentile guideline of 500 CFU/100 mL; that is, none of the sites met the TRMP limits for enterococci. This shows that, in general, the Taruheru, Waimata and Waikanae Rivers have relatively low enterococci concentrations, but on occasion, exceed the guideline value (note this is without any overflows). Both the frequency and magnitude of rainfall events that result in elevated levels of enterococci are the reason for exceeding the annual 95th percentile expressed in the TRMP.

29. Because these data excluded wet weather overflow events, the source of microbial contamination must be from non-wastewater overflow catchment sources, particularly those in the upper catchment.

30. The levels of enterococci in the Kopuawhakapata Stream (inner Kaiti) exceed both the annual median and the annual 95th percentile and suggest chronic microbial contamination (in the absence of wet weather and dry weather overflows). This is shown in Figure 2 of the River Monitoring Report. I understand from GDC's first Section 92 Response (p8) that Council has initiated the development of Watercourse Management Plan for the Kopuawhakapata Stream, and this matter is discussed further in the evidence of Mr Kanz.

Nutrients

31. As set out in Section 3.2 of the River Monitoring Report, excess nutrients (nitrogen and phosphorus) can lead to nuisance algal growth. The Report focused on total nitrogen and total phosphorus concentrations to assess ecosystem health. At high concentrations, components of total nitrogen, nitrate and ammonia, can be toxic to aquatic species. Only ammonia toxicity was assessed in the Report because aquatic animals are more sensitive to ammonia and, therefore, it is the more likely component to approach toxic levels, if at all. A high-level inspection of nitrate data indicated that nitrate toxicity is not likely to be an issue.

32. In general, total nitrogen concentrations are highest in the upper catchment of the relevant river and lowest in the lower catchment,[2] which indicates that the predominant source of total nitrogen is from the upper catchment.

33. There is no total nitrogen guideline in the TRMP (noting again that the Gisborne Urban FMU provisions relate to the Taruheru River and Waikanae Stream only). As a point of reference, the ANZG (2018) 80th percentile guideline value for Warm Dry Low-elevation rivers has been used (0.281 g/m^3). All sites exceeded the 80th percentile guideline value by 2–16 times. This indicates elevated background nitrogen concentrations in the rivers, which generally decrease with distance down the river.

34. Total phosphorus concentrations show a similar pattern to that of total nitrogen, with the highest concentrations being measured in the upper catchment and lowest in the lower catchment[3]; indicating the predominant source of phosphorus to be the upper catchment.

35. There is no total phosphorus guideline in TRMP. As a point of reference, the ANZG (2018) 80th percentile guideline value for Warm Dry Low-elevation rivers has been used (0.023 g/m^3). All sites exceeded the 80th percentile guideline value by 2–22 times, indicating elevated background phosphorus concentrations in the rivers. One exceptionally high concentration (2.4 g/m^3) was measured at Tuckers site on the Taruheru River, which is about 100 times greater than the guideline value.

Ammonia (toxicity)

36. Total ammoniacal nitrogen (herein, ammonia) contributes to the overall total nitrogen load and, at high concentrations, can be toxic to aquatic species. The toxicity of ammonia is primarily a factor of pH, but also water temperature. The reason for this is that total ammoniacal nitrogen (as these data have been measured) comprises NH_3 (ammonia) and NH_4^+ (ammonium). The ratio of NH_3 to NH_4^+ in solution is dependent on pH and temperature and the toxicity is primarily due to NH_3.

37. The TRMP has interim ammonia objectives for the Gisborne Urban FMU which includes an annual median concentration of ≤1.3 g/m^3 and an annual maximum concentration of ≤2.20 g/m^3. These values were consistent with Band C of the NPSFM 2014 (i.e., national bottom line), which was derived for ammonia concentrations normalised to pH

[2] Refer Figure 3 of Report, p15
[3] Refer Figure 4; Table 8 of Report, p18-19

8.0. However, the new NPSFM 2020 provides stricter national bottom lines for ammonia toxicity at 0.24 g/m^3 (annual median) 0.40 g/m^3 (annual maximum).

38. With regard to toxicity, ammonia concentrations at all sites were generally low[4]. Only one ammonia result exceeded the median guideline value set out in the TRMP for the Gisborne Urban FMU, which was measured at Tuckers, with a concentration of 2.4 g/m^3; this also exceeded the TRMP maximum guideline value. In the Taruheru River, ammonia concentrations were highest (and spanned the widest range) in the upper catchment and lowest in the lower catchment, although none of the concentrations (other than one measurement at Tuckers) exceeded the median guideline value.

39. This is consistent with other nutrient measurements and again indicates that the primary source of ammonia is from the upper catchment and its concentration decreases due to dilution and mixing as it flows downstream. A similar pattern was observed at the two locations on the Waikanae Stream. The Waimata River showed a different pattern, whereby, ammonia concentrations slightly increased after the most upstream site (Goodwins) and then were similar to slightly greater downstream at Gladstone. This shows a greater contribution of ammonia downstream from Goodwins than upstream, presumably due to the rural area downstream of Goodwins or the urban catchment although the cause of the increase downstream in this river was not investigated.

40. When assessing ammonia concentrations against the more strict NPSFM 2020 ammonia bottom line values, all sites meet (are within) the median criterion. All sites excluding Goodwins and Grant (Waimata River), however, exceed the maximum concentration of 0.4 g/m^3 on at least one occasion; that is, they did not meet the national bottom line for annual maximum ammonia concentration.

Metal concentrations

41. Metal concentrations (dissolved copper and dissolved zinc) were below the analytical level of detection in most samples; however, they were, at times, up to an order of magnitude higher than their respective guideline values. These high levels are likely to be associated with heavy rain events, and most likely derived from urban stormwater[5].

[4] Refer Figure 5; Table 9, p21 of Report.
[5] Refer Report at pages 23-24

EFFECTS OF WET WEATHER OVERFLOWS

42. The greatest difficulty when assessing the effects of wet weather overflows on water quality is distinguishing the effects of the overflow from those resulting from catchment-derived contaminants that are washed into the waterway, which also contribute to a decrease in water quality. A 'rain only' event was sampled during 12–16 March 2018 where there was heavy rainfall, but no wastewater overflows, that I used as a point of reference. In this context, the effect of wet weather overflows on water quality is the further increase in contaminant levels over and above the levels measured during rainfall events without overflows.

43. GDC records indicate that wet weather overflows occurred on average 2.5 times per year from 2006 to 2019, during heavy rainfall.

44. There are a number of contaminants that are primarily sourced from the upper catchment; that is, there are elevated levels of contaminants that are not derived from wastewater overflows. Notable examples include (as described above) enterococci in the Taruheru River and total nitrogen, ammonia, and total suspended solids in all catchments. During a rainfall event, with or without overflows, these contaminants are generally highest in the upper-catchment sites and become more diluted as they move downstream and are mixed with further stormwater and, when they occur, overflows.

45. Water quality in the mid to lower catchment is affected by urban contaminants (e.g., heavy metals) such as those carried in stormwater and, during an overflow event, from wastewater overflows. During overflow events, water quality is generally poorer downstream of the overflows than it is upstream. The tidal nature of the Gisborne urban rivers adds complexity such that on an incoming tide, contaminants may be 'pushed up', sometimes into a different river than the contaminants came from. Tidal action will aid in the dilution of contaminants in the lower reaches of the waterway.

46. The greatest effect that wastewater overflows have on water quality is the increase of faecal bacteria. This is most notable in the Taruheru River and less so in the other catchments. One reason for this is that the Taruheru River catchment is substantially smaller than that of the Waimata River and accordingly river flows and hence available dilution are less.

Enterococci

47. As noted in the Report, samples were collected directly from the network for analysis (i.e., from the interceptors before dilution with the river). As expected, enterococci concentrations collected directly from these locations were high; in one case measuring as high as 2,000,000 CFU/100 mL.

48. The effect of wet weather overflows on the water quality of Gisborne urban rivers is complex because it is a factor of multiple variables including total contaminant load, the time over which the overflow valves are open, the state of the tide and wind, the amount of rainfall, and the number of overflow valves open on any one river at any one time. The true maximum enterococci concentration during an overflow event is likely to occur over a short period of time and there is a high chance that periodic sampling did not capture this maximum. This made the data more difficult to interpret quantitatively. Instead, a more qualitative approach was used to capture high-level patterns and observations. This sampling regime, however, still provides good insight into changes in water quality in the Gisborne urban rivers during overflow events.

49. The highest enterococci concentrations recorded over the monitoring programme were measured in the lower Taruheru River, most notably during Events 1 and 2[6] when there were overflow discharges to the river[7]. The maximum concentrations were about twice as high during these overflow events than the maximum recorded during routine (background) sampling. However, there is no clear relationship between the estimated volume of wastewater discharged into the Taruheru River and the highest measured enterococci concentrations. Enterococci concentrations were higher in the Taruheru River during Event 2 than they were during Event 1, despite Event 2 having around one-third of the volume of wastewater discharged relative to Event 1 and from one less overflow source[8]. This may be due to the timing of sampling following the overflow discharge. Additionally, there was a greater volume of rain during Event 1 (~28 mm/day) than during Event 2 (~15 mm/day), which may have resulted in greater dilution within the river.

50. The Waimata River generally only had small elevations in enterococci concentrations during overflow events. Concentrations typically increased from upstream to

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[6] Refer Figure 11 on p30 of report, p30
[7] see Table 1
[8] see Table 1

downstream, indicating the contribution from wastewater overflows through the urban section of the river.

51. The Waikanae Stream was not subject to overflows and, while maximum levels were elevated (typically 5,000 to 20,000 CFU/100mL), they were similar to (and in some cases less) than those observed in routine monitoring. While the Cut is located at the mouth of the Waikanae Stream, it is also influenced by overflows from all upstream sites and hence isn't reflective of water quality within the Waikanae Stream.

52. The Hirini site on the Kopuawhakapata Stream had consistently high enterococci concentrations even though it only received wastewater overflows during Events 1 and 2. This may indicate the presence of illegal cross-connections of private wastewater pipes to the stormwater network or other microbial sources, which would provide a constant source of contamination into the receiving environment.

Duration of overflow events

53. Results from the event-based monitoring show that the parameter most affected by wastewater overflows was enterococci. Enterococci concentrations in the river increased substantially after the overflow valve was opened but returned to pre-event levels within 48 hours after the closure of the overflow. The concentrations peaked during the overflow event when the valve was open, with concentrations then dropping off progressively once the overflow valves had been closed, decreasing to approximately half the peak concentration within the first 24 hours, and returning to pre-overflow concentrations approximately 48 (or slightly longer) of the overflow valve being closed. This general pattern is observed for all contaminants measured in this study. The dilution/dispersion of contaminants in the stream combined with the effects of tidal flushing at the stream mouth and in the lower half of the Taruheru River allows for the dissipation of contaminants in a comparable time frame to that which would occur after a normal heavy rainfall event that does not include wastewater overflows.

Nutrients

54. In general, nutrient concentrations were highest in the upper catchment of the Taruheru, indicating that the upper catchment was the dominant source. Wastewater overflows appear to maintain the elevated concentrations of nutrients in the lower reaches of the rivers, rather than providing additional dilution as was measured during the rainfall event with no overflows. The short period over which nitrogen and phosphorus are

elevated due to wastewater overflows is unlikely to add substantially to the existing catchment-derived effects.

Total suspended solids

55. Maximum total suspended solid concentrations were frequently lower during overflow events than during rainfall events with no overflows. This is most likely due to the nature of the storm event and wider catchment characteristics (sediment sources in upper catchment areas) and erosion during heavy rainfall events is likely to be the most dominant source. During a heavy rain event, total suspended solid levels in discharged wastewater overflows can be less than background levels in the river.

Ammonia

56. Ammonia concentrations measured during rainfall and overflow events were below the toxicity guidelines values. This indicates that the potential toxicity risk to aquatic organisms is low.

Heavy metals

57. Metal concentrations (dissolved copper and dissolved zinc) were generally low in the rivers. During wastewater overflows, the stormwater component, rather than the wastewater component, is likely to be the dominant source of metals.

Network improvements

58. I understand that since I prepared the Wastewater Overflow Assessment report, GDC have committed to implementing network and management improvements such that the Seymour Road overflow location will be removed as a primary overflow and become a tertiary overflow (i.e., used rarely, if at all). The improvement will also redirect the discharge from the small tributary directly into the Waimata River. This is likely to reduce adverse water quality effects during heavy rainfall between Seymour Road and the confluence of the Waimata and Taruheru Rivers. Further information on the proposed improvements is presented in Mr West's evidence.

Assessment against the TRMP

59. The TRMP includes a number of narrative and numeric water quality objectives that are relevant to this assessment; specifically, dissolved oxygen, nitrate toxicity, ammonia toxicity and enterococci. I include these in Table 5 and provide commentary on whether

I consider whether wet and dry weather overflows are likely to cause the Gisborne urban rivers to exceed such objectives. I note that dissolved oxygen was not assessed in the River Monitoring Report or my Section 92 Response and, therefore, my conclusions regarding dissolved oxygen are based on my expert opinion.

60. I understand that a dry weather overflow protocol has been proposed by the Applicant, which includes sampling for ammonia, enterococci, and dissolved oxygen, which are relevant to the following objectives. This is explained in more detail in Mr Mayhew's evidence. I support the monitoring of theses parameters after a dry weather overflow (and the other listed in the proposed protocol). I note that nitrate is not included in the protocol and, based on the likely low level of risk of nitrate toxicity due to overflows, I consider its omission to be appropriate.

Table 5: Water quality objectives for the Gisborne Urban Freshwater Management Unit. Relevant attributes from TRMP Table DF1.5.2.1.

Attribute	Narrative Objective	Numeric Objective	Wet Weather Overflows (WWO)	Dry Weather Overflows (DWO)
Dissolved oxygen - INTERIM OBJECTIVE	Occasional minor stress on sensitive organisms caused by short periods (a few hours each day) of lower dissolved oxygen. Risk of reduced abundance of sensitive fish and macroinvertebrate species.	Summer (1 Nov -30 April) DO 1 day minimum ≥ 5mg/L, (B Band) based on sampling at least monthly during daylight hours) Summer (1 Nov -30 April) DO 7-day mean minimum ≥ 5.0mg/L, (C Band) the mean value of 7 consecutive daily minimum values based on continuous sensor monitoring for at least one week.	Due to the large volume of water during heavy rainfall, I consider the likelihood of WWO substantially decreasing the dissolved oxygen concentration and being the cause of not meeting the dissolved oxygen objectives to be low.	DWO have the potential to temporarily decrease oxygen concentrations near the discharge location particularly if a significant DWO enters a small stream. Such decreases in oxygen may cause the waterway to not meet the 1-day minimum dissolved oxygen objective. However, DWO would be unlikely to cause the waterway to not meet the 7-day minimum objective.
Nitrate toxicity – INTERIM OBJECTIVE	High conservation value system. Unlikely to be toxicity effects on even the most sensitive organisms	Nitrate Annual median ≤1.0mg/L (A Band) Nitrate Annual 95th Percentile ≤1.5mg/L (A Band) Both calculated from monthly samples over a 5 year rolling period	Based on my high-level inspection of measured nitrate concentrations during WWO (para 31), I consider the likelihood of WWO causing an exceedance of the nitrate toxicity objectives to be very low.	The risk of nitrate toxicity is much less than that of ammonia toxicity for both DWO and WWO. Based on my high-level inspection of measured nitrate concentrations during WWO, I consider the likelihood of a DWO exceeding the nitrate toxicity objectives to be low.

Ammonia toxicity – INTERIM OBJECTIVE	80% species protection level: Starts impacting regularly on the 20% most sensitive species (reduced survival of most sensitive species).	Ammonia Annual median ≤1.3mg/L NH4 –N/L (C band) Ammonia Annual Maximum ≤2.20 mg/L NH4 –N/L Both calculated from monthly samples over a 5 year rolling period	Maximum measured ammonia concentrations during WWO were all <1.1 mg/L (see River Monitoring Report, Figure 15). Based on this, WWO are unlikely to cause the ammonia annual median or maximum objectives to be not met.	Based on the estimates in my Section 92 Response, DWO are unlikely to exceed the annual median or maximum ammonia toxicity objectives, even when discharging into one of the smaller waterways. I note, however, that a DWO may exceed the NPSFM 2020 annual maximum bottom line of 0.4 mg/L if discharging into a small waterway. DWO into larger rivers, such as the Taruheru are unlikely to exceed the NPSFM 2020 annual maximum bottom line.
Enterococci	People are exposed to a low risk of infection (less than 1% risk) from contact with water during activities with occasional immersion and some ingestion of water (such as wading and boating).	Annual median ≤ 280 cfu/100mL Annual 95th percentile ≤ 500 cfu/100mL Median and 95th percentile values both calculated from monthly samples over a 5 year rolling period	During heavy rainfall, enterococci concentrations are highly elevated without the addition of overflows. WWO further elevate enterococci concentrations but, due to their infrequent nature, are only likely to affect the 95^{th} percentile objective; WWO are unlikely to affect the median enterococci objective.	DWO may result in high but temporary elevations of enterococci. Due to their infrequent nature, they are only likely to affect the 95^{th} percentile enterococci objective; DWO are unlikely to affect the median enterococci objective.

Response to s92

61. The s92 raised a number of questions regarding water quality. I summarise the questions and my responses, below.

62. It was noted that the Application and River Monitoring Report largely focussed on the effects of wet weather overflows, although 25% of known dry weather overflows in the past five years reached a waterway (i.e., less than two per year). A Section 92 Request for Further Information was made by the Processing Planner to assess the potential effects of dry weather overflows on ecology and human health. As noted above, I provided a response which was included as Attachment D to the s92 Response.

63. In response, I took a highly conservative approach and estimated the potential concentrations of enterococci (human health) and ammonia (ecological health) in a large (Taruheru River) and small (Kopuawhakapata Stream) river assuming a dry weather overflow of 2,000 L was discharged over a period of two hours and the entire discharge reached the waterway (which is rarely the case). Concentrations were estimated for median flow and mean annual low flow conditions. As such, the assessment provided a 'worst case' scenario.

64. In both rivers and flow scenarios, the estimated enterococci concentration in the river after dilution exceeded the 280 CFU/100 mL action trigger level in the Recreational Water Quality Guidelines. This indicates that the water quality would not be suitable for swimming near the location of the discharge point for large volume dry weather overflow events. Flushing by the river and tides will likely return water quality to ambient conditions within 12–24 hours following the overflow event. I note that small overflow volumes (e.g., 100 L) would be unlikely to result in enterococci concentrations that exceed the Recreational Water Quality Guidelines.

65. Estimated ammonia concentrations only exceeded the NPSFM 2020 annual maximum bottom line value (0.4 g/m^3) in the Kopuawhakapata Stream. The interim TRMP objective for annual maximum ammonia toxicity is <2.20 g/m^3, of which all scenarios met. This suggests that, based on the data available, dry weather overflows are unlikely to cause adverse effects to aquatic fauna with regard to ammonia toxicity unless a large volume with high ammonia concentrations is discharged into a small stream.

66. Questions were also raised in the First Section 92 Request about the effects of tidal state, rain intensity, and wind on water quality during overflow events. In general, wet weather overflow values are open for 12–48 hours, which is one to four full tidal cycles.

In addition to assisting with flushing, the most notable effect of the tides is that they may ‘push’ an overflow upstream into a river that didn’t have a wastewater overflow; this may be exacerbated by strong, onshore winds. The combination of heavy rainfall and tidal flushing will promote the dilution of wastewater overflows.

67. Finally, commentary was requested on how monitoring results likely translate to future discharge locations. During the monitoring period that was analysed in the River Monitoring Report, wet weather overflows discharged from 10 different locations across the Taruheru and Waimata Rivers and the Kopuawhakapata Stream (i.e., a combination of primary, secondary and tertiary overflow points). The DrainWise Programme will reduce the number of primary overflow locations (by removing the Seymour/Turenne primary overflow location) so that only the Wainui Road location on the Waimata River remains as the primary overflow point. I have also briefly mentioned this earlier, in paragraph 58. The Waimata River and its catchment is larger than that of the Taruheru, which means that overflows should receive the greatest amount of dilution and flushing by tides and river flow, likely resulting in overall reductions of the potential impacts on water quality from wet weather wastewater overflows in Gisborne urban rivers.

RESPONSE TO ISSUES RAISED IN SUBMISSIONS

68. The following issues relating to water quality have been raised in the submissions lodged with Council:

    (a) Application of the ANZECC guidelines to intertidal areas is confusing – Ngati Oneone;

    (b) Environmental impact of continued long term discharging is unacceptable – Margot Ainsworth.

69. I respond further to these issues below.

70. Ngati Oneone’s submission states at paragraph 6(a):

We note that the Council AEE has compared the water quality to freshwater values in the ANZECC guidelines. Given that Turanganui, Taruheru and Waimata are estuarine systems and are tidal for their entire reaches within Gisborne City, this comparison is confusing.

71. I acknowledge the confusion using freshwater guideline values to assess estuarine water. Enterococci is the exception to this, being the preferred faecal bacteria indicator

in estuarine and marine waters. I made this decision so that all monitoring sites could be assessed to the same guideline value. Monitoring sites in the upper to mid sections of the catchment are freshwater sites and, therefore, comparing these to estuarine guideline may be inappropriate. For consistency, I compared all results to the freshwater guidelines, as these are more conservative, except for the 95% protection of species guideline for copper, which is 0.0014 g/m^3 for freshwater and 0.0013 g/m^3 for estuarine waters.

72. Margaret Ainsworth's submission states:

Environmental impact of continued long term discharging is unacceptable.

73. On average, wastewater overflows have occurred 2.5 times per year. These overflows exacerbate water quality degradation that occurs during heavy rainfall, regardless of whether there are overflows or not, but do not appear to prolong the time that water quality remains degraded. I consider the DrainWise Wastewater Discharge Reduction Programme, which GDC has committed to, to be an appropriate effort to substantially reduce the frequency and volume of overflows, which are likely to result in overall, long-term improvements in water quality.

PROPOSED CONSENT CONDITIONS INCLUDING MONITORING PLANS

74. Based on my assessment as described above, I recommend that consent conditions be developed to address the following:

(a) Signage for at least 24 hours in affected areas after a dry or wet weather overflow event; and

(b) A revised monitoring plan that describes an approach to measure instream microbiological contaminants during overflow events, which will inform public health management.

75. I understand that these matters are already provided for in the draft conditions as outlined in the evidence of Mr Mayhew.

76. I do not consider ongoing monitoring of heavy metals, nutrients, ammonia, total suspended solids, and fluoride in-stream and in-pipe during overflow events to be necessary. In my opinion, these have been sufficiently characterised and assessed through the monitoring conducted to date and the wastewater contribution to effects associated with the contaminants is low.

SUMMARY AND CONCLUSIONS

77. At times, the water quality in Gisborne's urban rivers is degraded due to elevated levels of contaminants (faecal bacteria, sediment, nutrients, and heavy metals) that are unrelated to wastewater overflows.

78. The greatest effect of wet weather overflows on water quality is a large increase in faecal bacteria; faecal bacteria concentrations can be up to twice as high than they are during a rainfall event with no wastewater overflows. However, faecal bacteria concentrations exceeded the recreational water quality guidelines during heavy rainfall with and without wastewater overflows, indicating that the water was highly likely to be unsuitable for swimming at these times even in the absence of overflows.

79. Wastewater overflows contribute to the levels of nutrients (including ammonia), total suspended sediments, and metals; however, the dominant source of these contaminants during heavy rainfall is typically catchment (non-wastewater) derived.

80. Contaminants in the river returned to pre-event concentrations within about 48 hours of the rainfall event. This period is no longer than would be expected following heavy rainfall with no overflows.

81. GDC has committed to upgrading wastewater and stormwater systems and reducing the frequency and volumes of overflows as part of its DrainWise Wastewater Discharge Reduction Programme. Reductions in the frequency and volume of wastewater discharges are likely to result in overall improvements to the water quality in Gisborne urban rivers.

Dr Peter Stanley Wilson

22 June 2021