4SIGHT CONSULTING

28 January 2021

Wolfgang Kanz
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By e-mail: Wolfgang.Kanz@gdc.govt.nz

Dear Wolfgang,

RE: GISBORNE DISTRICT COUNCIL WASTEWATER OVERFLOW CONSENT – RESPONSE TO S92 REQUEST FOR FURTHER INFORMATION

Please find below our responses to the s92 request for further information regarding the 'Wastewater Overflow Assessment River Monitoring Report' prepared by 4Sight in June 2020.

The commentary in the application and the technical assessments is largely focused on wet weather overflows despite 25% of known dry weather overflows in the past five years having reached a waterway. While dry weather overflows are likely to be short-lived and localised, they have the potential to cause significant in-stream effects, particularly if they occur at a time of low flow/ and low tide in summer and/or coincide with contact recreation-based activity. Please provide an assessment of the potential effects of dry weather overflows on ecological and human health. This could include basic calculations of expected in-river dilution based on different estimated quantities of discharge and different dry-weather flow conditions, with the resultant instream contaminant concentrations compared against relevant guidelines and standards for ecological and human health.

As noted in the request above, dry weather overflows are generally short-lived (typically less than two hours), and localised. Their location is unpredictable and the potential effects on the environment are highly dependent on the river or stream that they may be discharged into due to the difference in potential dilution of the waterways. The Assessment of Environmental Effects (AEE) (page 27) notes that over the past five years, only 25% of dry weather overflows reached a waterway (less than 2 per year).

In response to the question, dilution scenarios have been estimated for a large river – the Taruheru River (Peel St) – and a small river – the Kopuawhakapata Stream (Hirini Rd) using two discharge volumes of 100 L (minimum) and 2,000 L (maximum) over 2 hours (as per page 27 of the AEE) and are shown in Table 1.

It is assumed that the total volume reaches a waterway, which is rarely the case. Flows (median and mean annual low flow [MALF]) for both rivers were obtained from NZ River Maps[1].

Looking at a 'worst-case scenario' in the Taruheru River, using MALF conditions, the dilution estimations range from 500 times to 10,000 times dilution for a dry weather overflow of 100 L and 2,000 L, respectively. The potential dilution is notably much less for a small waterway such as the Kopuawhakapata Stream during MALF conditions exposed to the same discharge volumes, where approximately 30 to 600 times dilution is estimated.

[1] Whitehead, A.L., Booker, D.J. (2020). NZ River Maps: An interactive online tool for mapping predicted freshwater variables across New Zealand. NIWA, Christchurch. https://shiny.niwa.co.nz/nzrivermaps/

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Table 1: Estimates of potential dry weather overflow dilution into the Taruheru River and Kopuawhakapata Stream based on flows (excluding tides) under different discharge scenarios.

Scenario	**River/Stream Flow (cumecs)**	**Dry Weather Overflow Discharge Flow (cumecs)**	**Dilution (x times)**
TARUHERU RIVER			
River: Median flow Discharge: 100L over 2 hours	0.433	0.00001	31,184
River: Mean annual low flow Discharge: 100L over 2 hours	0.136	0.00001	9,822
River: Median flow Discharge: 2,000L over 2 hours	0.433	0.00028	1,560
River: Mean annual low flow Discharge: 2,000L over 2 hours	0.136	0.00028	492
KOPUAWHAKAPATA STREAM			
River: Median flow Discharge: 100L over 2 hours	0.016	0.00001	1,156
River: Mean annual low flow Discharge: 100L over 2 hours	0.009	0.00001	637
River: Median flow Discharge: 2,000L over 2 hours	0.016	0.00028	59
River: Mean annual low flow Discharge: 2,000L over 2 hours	0.009	0.00028	33

To assess the potential effects of dry weather overflows on human health and ecology, the median and maximum concentrations of enterococci and ammonia in the waterway after dilution of the dry weather overflow are estimated and presented in Table 2. These estimates use the dilutions from Table 1 and contaminant concentrations in the (untreated) wastewater.

Enterococci concentrations in wastewater are routinely measured by Council, whereas ammonia concentrations are not (the Wastewater Treatment Plant [WWTP] is not required to measure ammonia in the wastewater before treatment). Accordingly, ammonia concentrations in ‘dry weather’ wastewater were estimated based on the ratio of enterococci and ammonia concentrations measured in the Ormond Road wastewater interceptor during wet weather overflows during 2017 (12 occasions). There was no statistically significant relationship between the enterococci and ammonia concentrations; however, on average, enterococci concentrations were 160,000 times higher than ammonia concentrations and so this was the scaling factor used in Table 2. This is an approximation of ammonia concentrations in the absence of actual measurements, however, the order of magnitude of the approximation is expected to be representative of ammonia concentrations in dry weather wastewater.

All scenarios assume 2,000 L of wastewater is discharged over 2 hours, the entire discharge reaches a waterway, and there is no removal of contaminants prior to the overflow reaching a waterway. In this regard, the scenario is a highly conservative ‘worst case’ discharge.

Table 2: Estimates of enterococci and ammonia concentrations in two different waterways from a dry weather overflow accounting for dilution by the river. All scenarios assume 2,000 L of wastewater was discharged over a 2-hour period. Estimated concentrations in bold exceed the relevant water quality guideline.

Parameter	Wastewater Concentration	Diluted Concentration (median flow)	Diluted Concentration (MALF)	Guideline Value
TARUHERU RIVER				
Enterococci (median; CFU/100 mL)	1,550,000	**993**	**3,150**	280
Enterococci (maximum; CFU/100 mL)	8,800,000	**5,640**	**17,885**	280
Ammonia (median; g/m^3)	9.69	0.01	0.02	0.4 (NPSFM 2020, annual maximum bottom line)
Ammonia (maximum; g/m^3)	55.00	0.04	0.11	0.4 (NPSFM 2020, annual maximum bottom line)
KOPUAWHAKAPATA				
Enterococci (median; CFU/100 mL)	1,550,000	**26,389**	**47,232**	280
Enterococci (maximum; CFU/100 mL)	8,800,000	**149,821**	**268,155**	280
Ammonia (median; g/m^3)	9.69	0.16	0.30	0.4 (NPSFM 2020, annual maximum bottom line)
Ammonia (maximum; g/m^3)	55.00	**0.94**	**1.68**	0.4 (NPSFM 2020, annual maximum bottom line)

In both rivers and flow scenarios, the estimated enterococci concentration in the river after dilution exceeded the recreational swimming guideline value. In the Taruheru River, estimated concentrations were about 10–60 times higher than the guideline value and in the Kopuawhakapata Stream, about 170–960 times higher than the guideline value. This indicates that the water quality would not be suitable for contact recreation near the location of the discharge point for large dry weather overflow events. Flushing by the river and tides is likely to return these elevated enterococci levels to ambient concentrations within 12–24 hours as the dry weather overflow events are short. Health risk can be mitigated through GDC's standard response protocols.

While not shown in the table above, receiving environment enterococci concentrations in small (100 L) events will be 20 times less than those predicted in Table 2 such that small overflow events are unlikely to result in an exceedance of the guideline value other than in the absolute worst case (concentration and low flow) event.

Estimated ammonia concentrations only exceeded the NPSFM 2020 annual maximum bottom line value in the Kopuawhakapata Stream under the scenario with maximum ammonia concentrations. However, the interim Tairāwhiti Resource Management Plan objective for annual maximum ammonia toxicity is <2.20 g/m^3, of which all scenarios meet. 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. If ammonia levels were elevated following a dry weather overflow event, they would only be expected to be elevated for 12–24 hours following a dry weather overflow event. Such relatively short exposure to elevated ammonia levels will limit the potential for chronic effects, which these guidelines were developed to protect against. Fish (if present) would be able to swim away from the discharge and further reduce the potential effects from a dry weather overflow.

There are a number of factors that mitigate the potential 'worst case' effects described above:

- Dry weather overflows are infrequent (AEE, p 2);
- Over the past five years, only 25% of dry weather overflows have reached a waterway (AEE, p 27);
- The majority of dry weather overflow events are small – a 2,000 L discharge is a maximum, most will be substantially less;
- For overflows that do reach a waterway, only some of the overflow may be discharged into the waterway, with the remainder staying on/being soaked up by the land, or being contained and 'mopped up' by Council's contractor;
- Small streams such as the Kopuawhakapata Stream are unlikely to be used for contact recreation; and
- Council's management of dry weather overflows, as described elsewhere in the s92 response, ensures that clean-up and public health management is implemented.

Overall, water quality in Gisborne's main rivers affected by a large dry weather overflow are likely to be unsuitable for human contact recreation, but this should be short lived and improve in less than 12–24 hours. Microbial water quality in small rivers will be more significantly affected by a dry weather overflow, but these rivers are unlikely to be used for contact recreation and health risks can be managed by Council's response protocols.

Estimated ammonia concentrations suggest that aquatic fauna are unlikely to be adversely affected during a dry weather overflow unless there is a large discharge with a high ammonia concentration into a small stream.

Commentary should also be provided on the influence of tidal state/mixing and the main trade waste sources and associated contaminants that have the potential to enter the rivers via overflow discharges.

Overflow valves are generally open for 12–48 hours, that is, one to four full tidal cycles. The most notable effect of the tides on wastewater overflows is that they may, on occasion, 'push' discharges back upstream into rivers that didn't have wastewater overflows – although the extent to which this occurs depends on the river hydraulics as wet weather overflows occur in heavy rainfall when river flows are typically high. The water quality effects from this will be relatively short-lived and mostly reversed on the outgoing tide. Again, health risks can be managed by Council's response protocols.

Major trade waste sources and their potential contribution is addressed by Council in the s92 response.

In relation to the river water quality report (4Sight Ltd), what was the hydrological significance (e.g. ARI) of each of the overflow events monitored, including the "heavy 'rainfall only' event" that was sampled over 12-18 March 2018 (s2.2, p7)?

The magnitude and frequency of the high intensity rainfall events that led to overflows, and that of the 'rainfall only' event, are presented in Appendix D of the application and summarised in Table 3 below. The third column of the table shows the highest ARI that occurred during the event, of which the ARI period ranges from 10 minutes to 1 day in these data. Where the highest ARI during an event occurs for a short period (e.g., 10 minutes), this indicates that the most intense rainfall during this event occurred within a short amount of time. This is in contrast to a highest ARI period of 1-day, where this indicates more persistent rainfall over a longer period. The final column shows the 1-day ARI for each overflow event which can be used to compare across events.

Table 3: Estimated ARI for the seven wastewater overflow events and the one rainfall only event.

Event	Start of Event	Highest ARI (yr) during event (duration)	1-day ARI (yr)
1	4/04/2017	2.4 (1 day)	2.4
2	13/04/2017	5.9 (2 hours)	1.4
3	12/05/2017	1.7 (1 day)	1.7
4	28/05/2017	1.8 (10 minutes)	1.3
5	3/09/2017	1.7 (20 minutes)	1.4
6	4/06/2018	3.8 (20 minutes)	2.0
7	11/06/2018	1.5 (1 day)	1.5
Rainfall Only	12/03/2018	3.5 (10 minutes)	1.0

In addition, please tabulate for each sampling event and comment on tidal height (low, mid or high) and state (ebb or flow) and wind direction and intensity, together with the number of overflow valves open at any one time, given that these factors all combine to influence the effect of the discharges on river water quality.

Data for each sampling event (based on sampling times at Taruheru River at Peel St Bridge) for tide height and state, wind speed and direction, and the number of wastewater values open at the time are tabulated in Appendix A to this letter. Additionally, a summary of the wind state during each overflow event is summarised and presented as wind roses in Figure 1.

Overall, the strongest winds occurred when coming from the north or south-south-east (Figure 1). Northerly winds would support the flushing of overflows into the Coastal Marine Area (CMA), whereas southerly winds may impede flushing into the CMA.

The state of the tide varied among sampling events and the initial opening of overflow valves for each overflow event (Table A1). Overflow valves were typically open for around 10–24 hours (with a maximum of 48 hours for Overflow 7), which is approximately one to two full tidal cycles. Outgoing tides will support dilution and flushing of wastewater overflows, whereas an incoming tide may reduce the amount of flushing into the CMA and potentially force wastewater overflows upstream (depending on the intensity / volume of freshwater flows from the upstream catchment), including upstream in rivers that didn't have any overflows during that event. That is, on an incoming tide, especially with a southerly wind, wastewater overflows could affect the water quality in Gisborne urban rivers that did not have any overflow valves open.

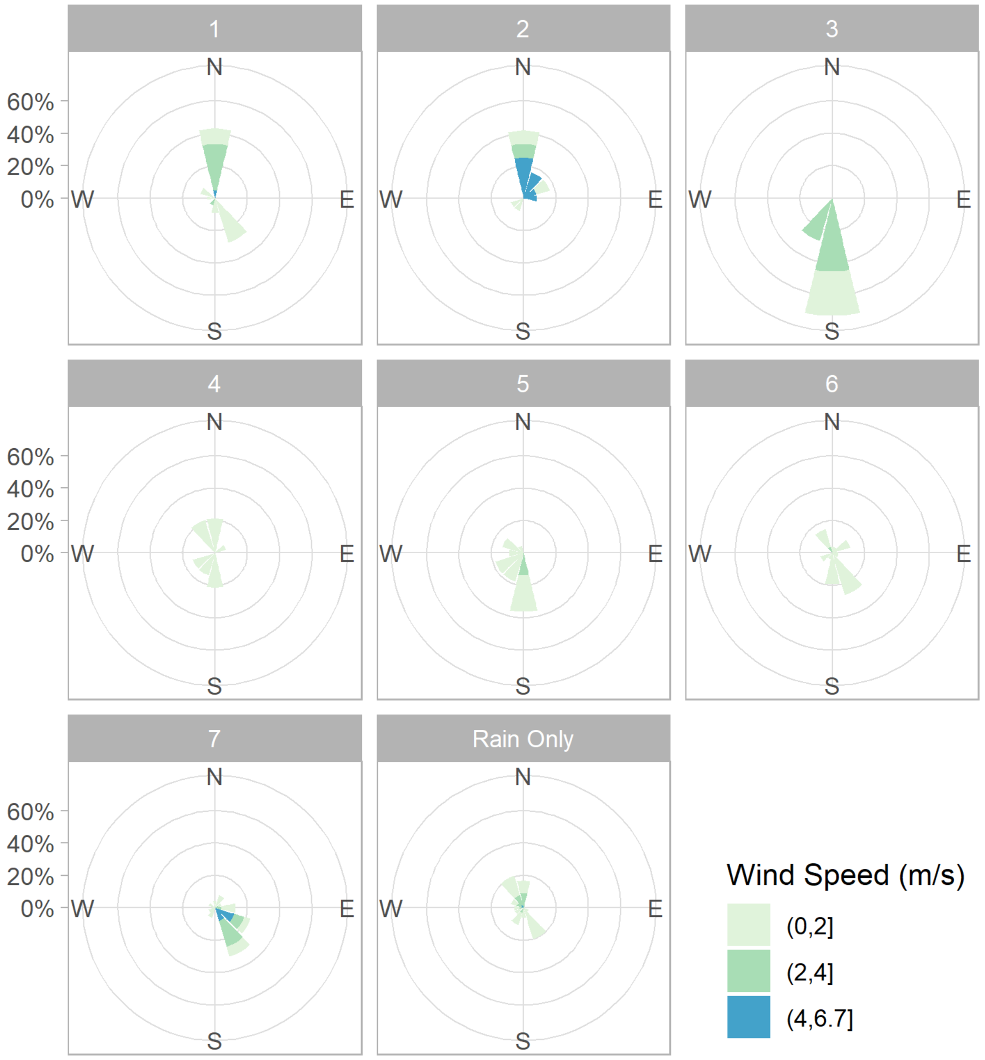

Figure 1: Wind roses summarising wind conditions during each overflow and rain-only event. The distance of the shaded area from the centre of each plot indicates the percentage of time wind was blowing in that direction.

Please also comment on how the monitoring results – which reflect past/current discharge locations – likely translate to proposed future discharge locations.

During wet weather overflows analysed in the 4Sight water quality report, discharges occurred from 10 different locations. As per the Application, Council have made changes to control overflows through two primary (Wainui and Seymour/Turenne – discharging into the Waimata River) and two secondary (Peel/Palmerston and Oak Street – discharging into the Taruheru River) locations. As noted in the report, limiting overflows to these sites, and only having secondary overflows on the Taruheru River, should reduce the extent of adverse effects – in particular on the Taruheru River.

The Wainui location discharged during every one of the seven monitored events and the Seymour/Turenne only during Event 7. Peel/Palmerston and Oak Street discharged on about half of the overflow events. In this regard, the monitoring results are generally representative of water quality during overflow events, especially considering the large variation in water quality among events. Due to the primary overflow locations being located on the Waimata River, which is a larger river and has a larger catchment than the Taruheru River, overflows should receive the greatest amount of dilution/flushing by river/tidal flows and reduce the potential impact on water quality. Further, we understand that Council is proposing to change its management of the network to replace the Seymour/Turenne overflow with a tertiary (rarely used) overflow to the Waimata River. This will further reduce the potential for adverse effects.

In addition, as stated in the Application, Council is seeking consent on the basis of a programme of work as part of its DrainWise Programme. This programme of work will upgrade the wastewater and stormwater systems and require private property infrastructure improvements, and thereby reduce the frequency and volume of overflows. As the DrainWise Programme is implemented, the frequency and volume of overflows and associated adverse effects will progressively reduce.

Kind Regards,

Dr Pete Wilson
Principal Coastal Scientist
4Sight Consulting Ltd

APPENDIX A

Table A1: Tide and wind characteristics during each sampling event. Sampling time are for samples collected from Taruheru River at Peel St Bridge.

Overflow Event	No. Valves Open	Date / Time	Tide Height (m)	Tide Height	Tide State	Wind Direction (°)	Wind Speed (m/s)
1	Before (0)	4/04/2017 13:39	1.7	high	outgoing	161	2.3
1	6	5/04/2017 9:18	1.1	mid	incoming	355	2.9
1	0	6/04/2017 16:36	1.4	mid	outgoing	331	1.9
1	0	7/04/2017 15:31	1.9	high	outgoing	146	1.2
1	0	10/04/2017 14:29	1.3	mid	incoming	136	0.9
2	Before (0)	13/04/2017 8:40	1.8	high	outgoing	226	0.4
2	0	14/04/2017 8:04	1.9	high	incoming	348	2.4
2	0	14/04/2017 11:45	1.1	mid	outgoing	336	3.7
2	0	14/04/2017 14:08	0.6	low	outgoing	336	3.5
2	0	14/04/2017 16:00	0.8	low	incoming	306	3.0
2	0	15/04/2017 14:18	0.7	low	outgoing	286	2.2
2	0	15/04/2017 14:28	0.7	low	outgoing	286	2.2
2	0	16/04/2017 13:52	0.9	low	outgoing	335	2.3
2	0	19/04/2017 8:33	1.2	mid	incoming	349	2.2
3	Before (0)	11/05/2017 11:52	0.7	low	outgoing	354	2.0
3	0	13/05/2017 9:00	1.7	high	outgoing	213	2.6
3	0	13/05/2017 11:59	0.9	low	outgoing	185	2.3
3	0	13/05/2017 12:44	0.8	low	outgoing	201	3.0
3	0	13/05/2017 14:55	0.8	low	incoming	199	2.3
3	0	14/05/2017 13:01	0.8	low	outgoing	224	4.7
3	0	15/05/2017 15:16	0.7	low	incoming	334	0.8
3	0	18/05/2017 14:10	1.3	mid	outgoing	316	6.4
4	2	29/05/2017 13:20	0.5	low	outgoing	188	1.8
4	0	30/05/2017 11:47	1.6	high	outgoing	351	2.3
4	0	31/05/2017 10:11	2.0	high	incoming	350	2.8
4	0	2/06/2017 12:03	1.9	high	incoming	250	0.7

5	Before (0)	2/09/2017 12:45	1.5	high	incoming	154	2.8
5	0	4/09/2017 11:28	0.8	low	incoming	222	2.7
5	0	5/09/2017 13:15	1.1	low	incoming	340	1.9
5	0	9/09/2017 12:10	0.8	low	outgoing	330	8.4
Rainfall	0	12/03/2018 15:10	1.7	high	outgoing	154	0.6
Rainfall	0	13/03/2018 12:10	1.1	mid	incoming	306	3.1
Rainfall	0	14/03/2018 12:40	1.0	low	incoming	148	1.2
Rainfall	0	15/03/2018 12:23	0.9	low	incoming	313	2.9
Rainfall	0	16/03/2018 12:27	0.7	low	incoming	301	3.8
Rainfall	0	18/03/2018 8:00	1.9	high	outgoing	231	1.7
6	2	5/06/2018 9:20	1.7	high	incoming	191	0.9
6	0	6/06/2018 10:56	1.7	high	incoming	346	2.7
6	0	7/06/2018 9:14	1.2	mid	incoming	212	2.7
6	0	8/06/2018 12:28	1.8	high	incoming	160	2.2
7	Before (0)	10/06/2018 8:50	0.6	low	incoming	309	1.1
7	3	11/06/2018 9:42	0.6	low	incoming	9	1.1
7	5	12/06/2018 11:20	0.6	low	incoming	80	2.7
7	0	13/06/2018 11:25	0.5	low	incoming	354	4.7
7	0	14/06/2018 12:15	0.4	low	incoming	342	2.3
7	0	15/06/2018 10:46	0.8	low	outgoing	347	3.8
7	0	15/06/2018 11:00	0.7	low	outgoing	347	3.8
7	0	17/06/2018 11:10	1.4	mid	outgoing	344	4.3