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 IAN GRAHAM GARSIDE
– WASTEWATER NETWORK MODELLING
25 June 2021

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INTRODUCTION

Qualifications and experience

1. My full name is Ian Graham Garside. I am a Director of ProjectMax Ltd, a specialised engineering consultancy, a position I have held since May 2020.

2. Prior to this I was a Business Leader and Director of Operations for New Zealand – Water at Jacobs; and Manager and Technical Director of Environmental Engineering at Beca. I have more than 35 years' experience in Water, Stormwater and Wastewater Network Planning.

3. I have a Bachelor of Science in Environmental Science from the University of Sunderland and a Master of Science (MSc) in Engineering Hydrology from the University of Newcastle-upon-Tyne.

4. I am a founder member and former Chair of the Water New Zealand Modelling Special Interest Group.

5. I currently serve as the Chair of the Water New Zealand Conference Technical Committee, a role which I have performed since 2012. I have been a member of the Technical Committee since 2007.

6. My relevant expertise and experience includes:

    (a) Completion of wastewater overflow investigations and remedial work in rural and urban New Zealand, Australia, United Kingdom, United States, Spain and Taiwan;

    (b) Author of Waikato District's Wastewater Overflow Continual Improvement Programme;

    (c) Peer reviewer of Three Waters Modelling Studies in Hamilton and Dunedin;

    (d) Development of Sewer Overflow Abatement Strategy and Inflow / Infiltration Best Practice review for Unity Water in Queensland;

    (e) Technical Direction for Project Storm and Network Consents project for Watercare, which was a precursor to the Central Interceptor storage/conveyance tunnel which is currently being constructed in Auckland;

(f) Project management and technical direction of the preliminary design of a screening facility in downtown Auckland. The screen uses 'state of the art' international design and implementation technology and the construction of the screening chamber achieved an ACENZ Award of Merit in August 2000; and

(g) Author of over 20 technical papers presented at domestic and international conferences.

Code of Conduct

7. 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

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

(a) My involvement in the Gisborne Wastewater Overflows Resource Consent Application (**Application**);

(b) Wastewater Network Model undertaken for the Application;

(c) Response to issues raised in submissions and Section 42A Report;

(d) Summary and Conclusions.

MY INVOLVEMENT IN THE WASTEWATER OVERFLOW CONSENT PROJECT

9. I became involved in the wastewater overflow consent project in its current form in November 2020, but was involved in wastewater network planning work for Gisborne District Council (**GDC or Council**) from 2004 until my departure from CH2M Beca (**Beca**) in 2016.

10. I was first involved with GDC's 3 Waters Team in the mid 2000's when I managed the consultancy resource for the wastewater treatment plant (**WWTP**) upgrade which was delivered in 2010. During this time a wastewater network model was used to examine wastewater overflows within the network and at the WWTP bypass.

11. The background to the wastewater network model is set out in Section 1.1 of the Beca Modelling Report, which was included as Appendix C to the Application (**Report**)[1]. Essentially, in the early 2000s Beca constructed a new wastewater network model using GIS data provided by GDC. The model was used to review the effects of Inflow and Infiltration (**I&I**) and development, and to develop a master plan for the future development of wastewater services for the City. The model was calibrated against flow survey data provided by others (AWT) in 2007 – 2008 and formed the basis of a wastewater master plan, which was issued in 2008.

12. My role in this work was to provide an overview to staff working on the detailed execution of the work, and as such I had a good understanding of the work that was undertaken and the reasons why it was being undertaken.

13. In 2011 Beca wrote a report identifying upgrades required to achieve no sewer overflow events in a 2-year Annual Recurrence Interval (**ARI**) storm event – a performance target that was provided by GDC. These upgrades were to increase storage and conveyance capacity in the network.

14. The model was used, as part of a process to update the 2008 master plan. The updated master plan was issued in 2014 and documented the work to assess the storage volumes required, for various return period rainfall events, to contain the wastewater that would otherwise be discharged to the environment via GDC's emergency discharge overflow valves into Gisborne's rivers. The trunk sewer reticulation needed to transfer this wastewater directly to the WWTP was also determined. The model also quantified the potential benefits of targeted wastewater renewals in areas of high I&I. However, the storage and conveyance components of the master plan were prohibitively expensive and did not address the sources of excessive stormwater entering the wastewater system. I address storage matters further in paragraphs 52-53 below, in response to some matters raised in submissions.

[1] Gisborne Wastewater Network Model Updates and Upgrades, 16 November 2017. CH2M Beca.

15. In 2014 Beca completed recalibration of the existing model using data gathered in winter 2014. Part of the calibration process included updating the population in the model to include 2012 census information.

16. Between 2014-2016 a number of improvements were made to the model to improve its accuracy, and these are set out in the Report. Again, I was not responsible for the actual modelling undertaken, as this was undertaken by a Beca staff member, Tracy Myers, with technical expertise in creating and calibrating wastewater models. However, I was involved in providing technical support to Ms Myers.

17. Between 2014 and 2016 GDC determined that stormwater and wastewater issues should be considered together and created the DrainWise programme, which is described in more detail in the evidence of Mr Kanz. Accordingly, the focus for wastewater network planning changed emphasis from increasing network capacity towards reducing flows into it. GDC engaged my services during this period at a workshop to consider the improvement options and strategies to reduce I&I with an emphasis on the overflow reduction that would occur from direct inflow if reduced by 85%, 75% and 65% which fed into the DrainWise Plan. I assisted GDC and other consultants who were charged with understanding and mapping the stormwater component of DrainWise, including the methodology for developing a consistent approach to the rainfall inputs to be used for wastewater and stormwater modelling.

18. I will describe further in my evidence below, the scenarios modelled and the outputs from the wastewater model, as well as the assessment of the impact to the network under various gross inflow removal scenarios, and the consequential network upgrades that may be required.

19. Finally, I note that I also provided input into the responses to the s92 requests, which were included as Attachment B to the s92 response dated 29 January 2021; and the responses to Topic/Questions [(i)-(iv)] of the s92 response dated 21 April 2021.

WASTEWATER NETWORK MODEL

20. As noted above, the wastewater network model was first created for GDC back in the early 2000s, and has been improved and updated over a number of years. The updates to the model are outlined in Section 2.1 of the Report. Section 2.2 also outlines the assumptions that apply to the model in general.

Scenarios modelled as reported in the Beca 2017 report

21. Section 3 of the Report outlines the scenarios modelled. Beca carried out a first principles analysis to check the capacity of the wastewater network. I understand that the network was originally designed to take 6 x average dry weather flow (**ADWF**)[2], in the domestic area and 4 x ADWF in the Interceptors. Accordingly, (and as set out in the Report) two new network models were created to model these scenarios, one for the 4 x ADWF and one for the 6 x ADWF. While there are regional differences, the design standard for sizing of wastewater reticulation in New Zealand is normally between 4 and 6 x ADWF, so the GDC system is in accordance with standard design practice.

22. A design rainfall event was created in order to run the model with a two year ARI storm (incorporating adjustments for climate change out to 2051). This was assembled using the latest Ministry for the Environment guidance regarding adjustments for climate at the time, and was taken from guidance issued in 2010. I understand that this design rainfall event, was similar to that used for the DrainWise programme.

Inflows to the Wastewater System

23. In 2015 Water New Zealand published the second edition of the Inflow and Infiltration Manual (**I&I Manual** or **the Manual**). The Manual defines the various components of flow which typically enter wastewater networks. These components are referred to as Dry Weather Flow – DWF, Groundwater Infiltration – GWI, and Rainfall Dependent Inflow and Infiltration – RDII and are illustrated below in Figure 2 (Figure 5-1 Wet Weather Components)

[2] ADWF is the average daily flow during a period of dry weather. An ADWF rate of 200 litres/person/day is adopted for design purposes [A graphic showing the difference between ADWF, peak dry weather flow and wet weather flows is included as Figure 1 to the Application (page viii)]

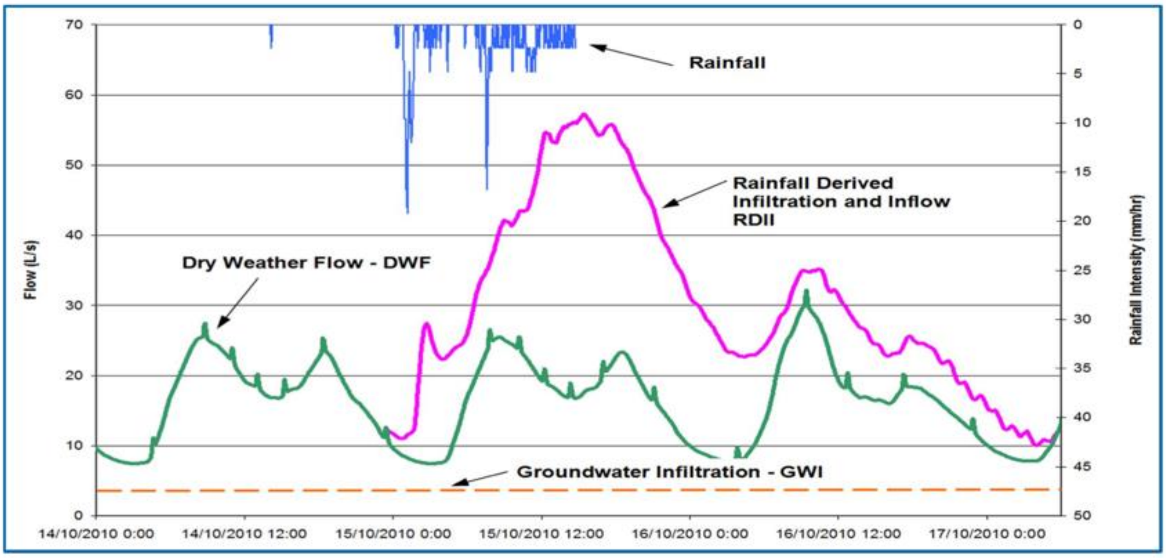

Figure 5-1 Wet-Weather Flow Components

24. It is noted that RDII is defined in the manual as "*Rainfall Dependent Inflow and Infiltration (RDII) - RDII volume is due to inflow from illegally or erroneously connected impermeable areas and infiltration through defects such as pipe or manhole cracks in both sewers and in house laterals during and after a rainfall event. Inflow can be considered as a "fast" response to rainfall. Infiltration generally exhibits a delayed response to rainfall and can occur for many days following a rainfall event. The volume of infiltration can be heavily influenced by antecedent soil moisture, soil type, evaporation and a range of other factors." It is further noted that RDII includes all rainfall dependant flow both direct stormwater inflow (Fast Response) and indirect stormwater inflow (Slow Response).*

25. As outlined in the s92 responses provided by the Applicant, and as I present below, flow records show rapid and substantial increases in wastewater network flows associated with rainfall events.

26. An example of the flow records is set out below (Figure 2):

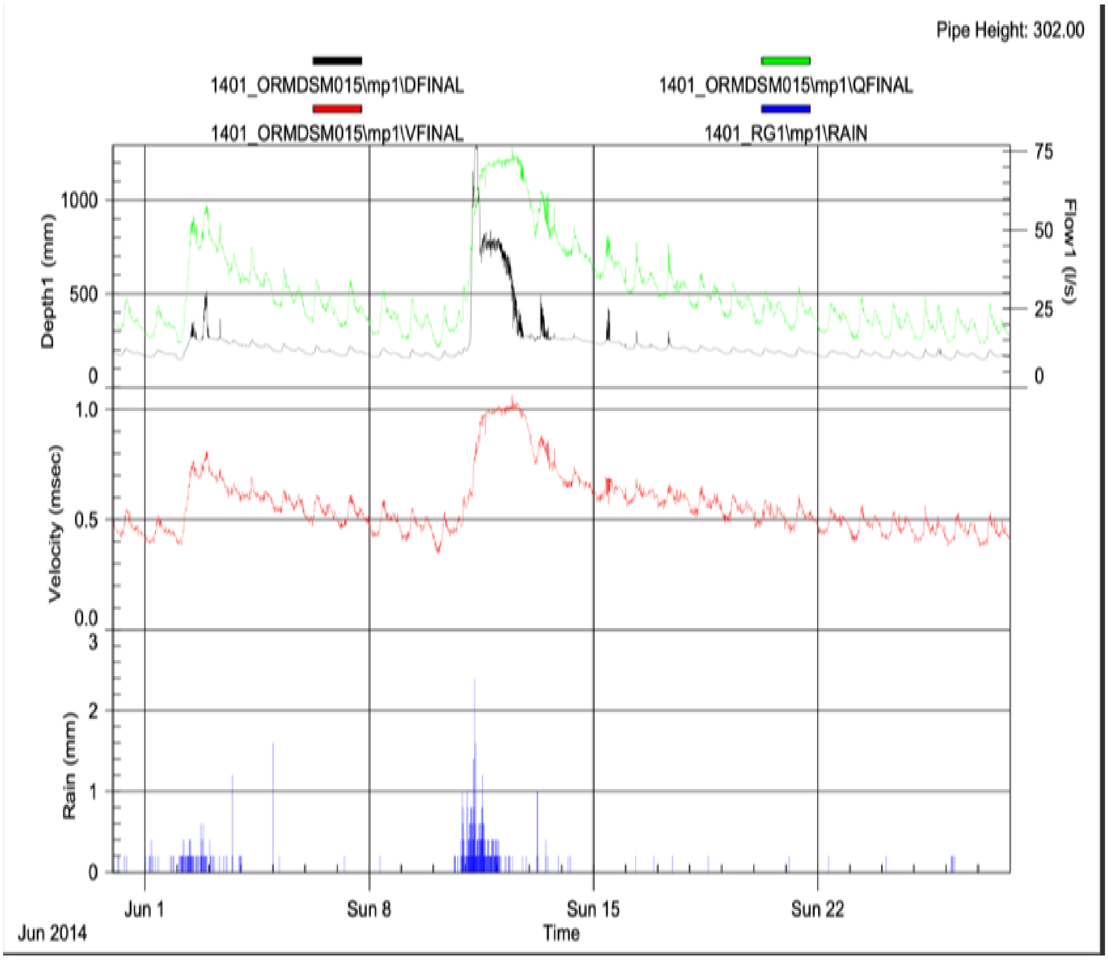

Figure 2 – Flow Record Example

27. I consider that the flow records demonstrate that the substantial increases in wastewater network flows are a result of direct stormwater inflow (**Fast Response**). While there is evidence of a slower response to rainfall in the flow record, the dominant RDII factor is direct stormwater inflow or fast response.

28. Most, if not all, of the flow records demonstrated similar characteristics, indicating that fast response inflow is present in parts of the Gisborne network. This is not surprising as the flow monitors were specifically installed to assist calibrating the model in respect of wastewater network overflows and hence were primarily located in areas where overflows occurred.

29. As noted above, the wastewater model was calibrated to the 2014 flow record at each of the flow gauges. An additional check of the model's prediction was carried out against a 2006 flow record and necessitated some modifications to the sub catchment

hydrology in the model, to allow for surface ponding. This surface ponding is thought to occur when the stormwater and wastewater systems are full and the ponding, in the areas where there is no stormwater network to which it can drain, is gradually released to the wastewater network.

30. Following calibration, the model was used to predict the results (in terms of overflows) of a 85% reduction in direct stormwater inflow for the 2 year ARI event and, in the event that such a level of reduction could not be achieved, the effect of a 75% and 65% reduction. In addition to predicting overflow volumes, the model was used to assist identification of network upgrades that would be required to contain wastewater during a 2-year ARI event under the different levels of reduction.

31. In my opinion, achieving an 85% reduction in RDII is an ambitious target. This is consistent with the figure below from Volume 1 of the I&I Manual. The figure shows percentage reduction in RDII versus percentage of catchment rehabilitated (or put simply leaks in the network fixed). The figure includes actual project data from water agencies in New Zealand, Australia, the US and Canada.

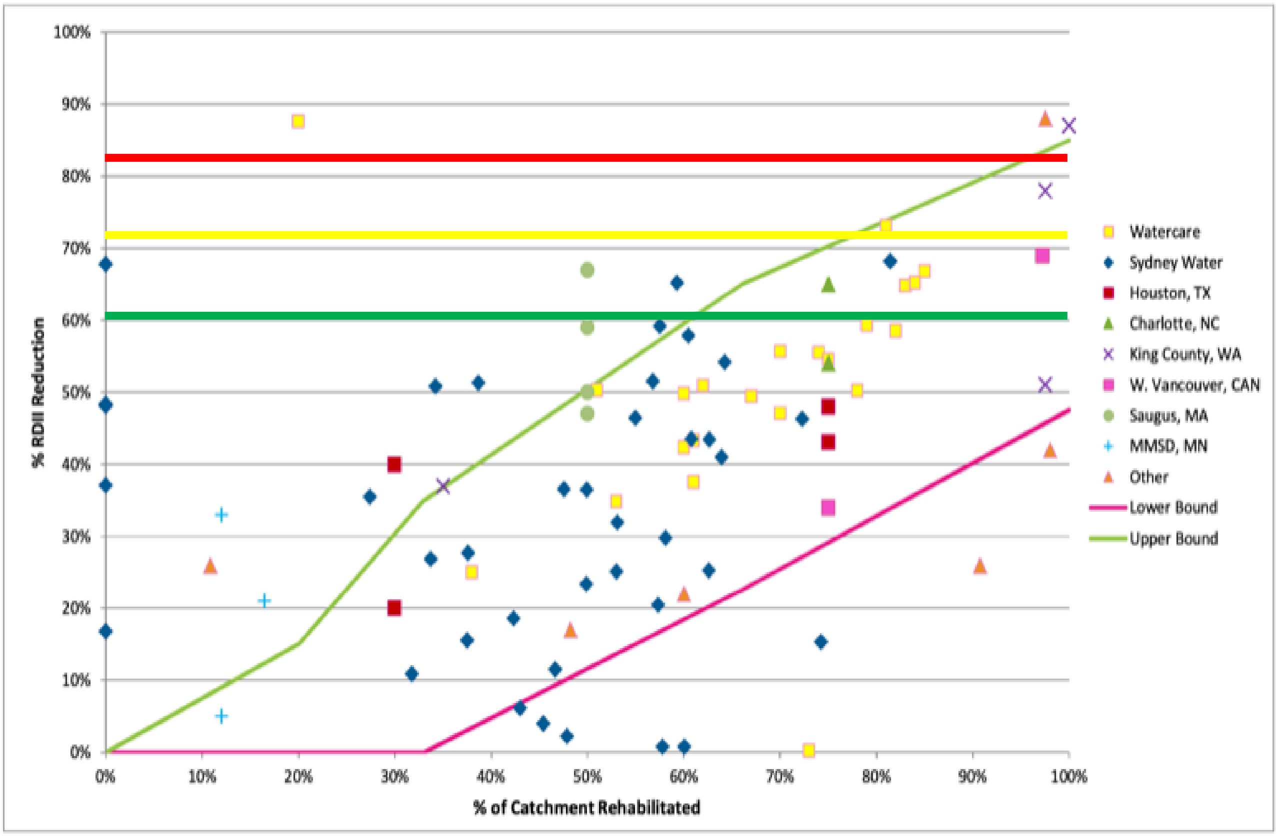

Figure 7-1 Various Project Results - RDII Reduction vs. Percent of Catchment Rehabilitated

32. As I have indicated above, an 85% reduction in Fast Response component of RDII is an ambitious target. To achieve it would require the identification and rectification of a very high proportion of the direct inflows and leaks into the wastewater network, a large number of which are likely to be in private property. In this regard, as advised by Mr Kanz, the DrainWise programme includes inspection of all sites within the reticulated area – although it is too early to predict the level of rehabilitation that can be achieved. However, the modelling indicates that there are alternative network upgrade options, available should lesser inflow reduction be achieved in practice – albeit at increased investment.

33. Notwithstanding this, I support the approach to reduce direct inflow as far as possible, as this directs effort at resolving the problem at its source and makes storage and containment of flows more feasible and manageable. As I discuss below, in my opinion,

it is an appropriate approach with the ability to modify the type of intervention if necessary to achieve the desired level of overflow containment.

Model Results and Upgrades to the Network

34. The model outputs from the 4 x ADWF analysis indicated that all wastewater flows could be accommodated within the network.

35. The model outputs from the 6 x ADWF analysis indicated that all wastewater flows could be accommodated within the network, except at two locations where minor flooding from manholes was predicted. These locations were at 203 Stanley Road and Back Ormond Road pumping station (associated with the Taruheru development). Therefore, in general, the network has sufficient capacity to accommodate a design peak wet weather flow based on a theoretical peak to average flow ratio of 6. As noted above, that is in accordance with standard design practice.

36. The model's predicted response to the 2 Year ARI design event (without any intervention) indicated discharges from 154 manholes with a total of 56,017 m^3 discharged.

37. The model's predicted response to the 2 Year ARI design event with a simulated 85% reduction in Fast Response runoff and the reduction of 85% of the stormwater ponding, indicated there would be discharges from 4 manholes with a total of 95m^3 of wastewater discharged. The model was used to determine additional minor upgrades (increased capacity) required to completely eliminate the overflows in the 2 Year ARI design event. A total cost estimate of $500,000 was provided for these minor upgrades. As Mr West indicates, the remaining upgrades are planned for 2021/22 ($200,000).

38. The model's predicted response to the 2 Year ARI design event with a simulated 75% reduction in Fast Response runoff and the reduction of 75% of the stormwater ponding indicated that there would be discharges from 20 manholes with a total of 1,530m^3 of wastewater discharged. The model was used to determine additional upgrades (increased capacity) required to completely eliminate the overflows in the 2 Year ARI design event. A total cost estimate for these upgrades of $2.3M was made.

39. The model's predicted response to the 2 Year ARI design event with a simulated 65% reduction in Fast Response runoff and the reduction of 65% of the stormwater ponding indicated that there would be discharges from 38 manholes with a total of 5,661m^3 of wastewater discharged. The model was used to determine additional upgrades

(increase in capacity) to completely eliminate the overflows in the 2 Year ARI design event. A total cost estimate for these upgrades of $5.7M was made.

40. The methodology and proposed approach for achieving the gross inflow removal are primarily through the GDC DrainWise strategy and approach, which is set out in more detail in the evidence of Mr West and Mr Kanz on behalf of GDC.

41. As noted above, I consider that GDC's wastewater network has been designed with sufficient capacity to adequately convey 6x ADWF. Results from the model indicate that gross stormwater inflow, both fast response inflow and delayed inflow from private property stormwater ponding, contribute to the majority of the wet weather overflows from the wastewater network.

42. Accordingly, I agree with the aim of GDC's Wastewater Discharge Reduction Plan to reduce gross inflow of stormwater into the network by 85% (through DrainWise), but as a backup (should this not be achieved), revert to a position of accepting the reduction actually achieved and augmenting this with in-catchment storage or increased conveyance at strategic locations within the network. In my opinion, reducing stormwater inflow (particularly from large, direct sources) is an important first step in reducing overflows and making increasing in-catchment storage of increased conveyance more feasible and affordable.

43. It is recognised that flow reduction strategies often have an element of uncertainty in terms of their outcomes (i.e. flow reductions actually achieved) and certainly take long periods of time. Best international practice, also advocated in the I&I Manual, is to monitor the effectiveness of flow reduction activities to optimise the techniques used. As the effectiveness tests require, by definition, rainfall and therefore runoff, they need to be conducted over a long period of time to get the best results. In this regard, I also support the proposal to continue to assess overflow events, and the rainfall events that cause them, to better understand the network's response to large rainfall events and to assess whether reductions in RDII are being achieved. Ideally this should be an ongoing activity and I understand this is provided for in the draft consent conditions put forward by the Applicant, as discussed in Mr Mayhew's evidence.

44. As I indicated above, the Beca assessment provided estimated costs for necessary upgrades required to remove remaining overflows with 85% of the gross inflow removed, and also 65% and 75% inflow removal. The incorporation of these items into Council's planning is discussed in the evidence of Mr West.

45. It should be noted that the report was prepared in 2017 and consequently the capital expenditure associated with the network upgrades, whilst being the same interventions as in the report, is likely to have increased due to inflation and market pricing increases. However, I do not consider those increases to be significant in the normal course of events, we are certainly seeing local and global market pricing increases as a consequence of COVID19.

S92 RESPONSE

46. As advised above, I contributed to the Applicant's response to the s92 requests from the processing team. I would like to briefly address one point in the second response relating to the model.

Accuracy of/reliance on the model

47. The last statement in the s92 request sought:

Whether there is sufficient technical data to substantiate the anticipated 85% reduction of direct inflows and the level of confidence that can be afforded to this assumption.

and

If the model is out by X percent then achieving the required volume reductions may not be achievable (in the worst case)

48. The model that has been developed is a mathematical representation of the Gisborne wastewater network. As I have indicated above, and as discussed in the s92 response, it has been developed by experienced wastewater network modellers and calibrated against a large number of flow gauges for a number of single rainfall events. As such, I consider that it is appropriate in predicting overflow volumes under different inflow-reduction scenarios for single events.

49. However, as with all models, it is a 'best estimate' of performance. As such, it is important to recognise that the approach adopted by GDC to reduce overflows is not predicated on just modelling. While I consider the 85% reduction to be an ambitious target, it is clear from the flow monitoring data that fast response inflow dominates wet weather wastewater flows. In my opinion, this necessitates an approach that seeks to resolve the high inflow sources as far as possible and, depending on the success of the flow reduction achieved, move to in-network storage and conveyance options as

necessary to achieve the desired overflow standard of no overflow in a 50% AEP (2 year ARI) rain event.

50. The important aspect from my perspective is that resolving inflow requires a long term approach and it is essential that this approach adapts over time depending on results observed. The on-going monitoring, reporting and review processes built into the consent, as discussed by Mr Mayhew, enable this to occur. In my opinion, such an adaptive approach is essential and is consistent with best management practice world-wide.

RESPONSE TO ISSUES RAISED IN SUBMISSIONS

51. The following issues have been raised in submissions, which I will comment further on:

(a) Insufficient consideration of alternatives e.g. storage options;

(b) The desire for a shorter consent term; and

(c) Provision for climate change.

Consideration of alternatives e.g. storage options

52. Some submitters have raised issues with GDC's consideration of alternatives, including storage options. I understand that the consideration of alternatives will be discussed further in the evidence of Mr West. However, I wish to comment further on the issue of storage options.

53. Storage options, and indeed options which seek to provide additional conveyance can be expensive and are not without increased maintenance burdens associated with emptying storage and dealing with sediments and odour. Because the I&I issue is so great within Gisborne relative to other locations, adopting a flow reduction strategy initially makes sense even if the 85% reduction target is not achieved. This is because storage and conveyance facilities (as well as maintenance burdens), are likely to be smaller than they would have been had no attempt at flow reduction been made.

Provision of a 20 year term

54. I understand that a number of submitters have raised issues with the 20 year consent term sought by the Applicant and seek a reduced term, some as short as 2-5 years.

55. Wastewater network improvements take significant amounts of time to implement, to determine the extent to which the interventions are effective, and to enable the approach to be adapted to the results. This is particularly true of strategies around inflow reduction – which requires a detailed, site-by-site approach to identify key sources. International best practice is to continually monitor the effectiveness of the intervention and modify the intervention, if appropriate. Accordingly, there are very few occasions over a, say 10-20 year, period when you can really tell whether the intervention has been successful. As Mr Mayhew advises, the Consent Application provides for monitoring and reporting of overflow events and discharge volumes and the analysis of the rain events that led to overflows occurring. I consider this to be appropriate and note that it will take some time for the successful reduction in inflow to become clear.

Climate Change

56. The modelling work described in my evidence allowed for consideration of climate change effects on rainfall, using guidelines appropriate at the time. More recent work has indicated that rainfall intensity is likely to increase and therefore the relative amount of direct stormwater is also likely to increase. Therefore is even more important to consider and attempt to manage the direct response components in the future than in the past to reduce the amount of network storage that is required to meet overflow reduction objectives.

Section S42A Officers Report

57. I note that the Wastewater Network -Technical Review report attached to the Section 42A Report (**Wastewater Technical Review**), in particular paragraphs 32, 35 and 36, supports the suitability of the modelling and its supporting information for the purpose it was used for.

58. In relation to the recommendations around proposed consent conditions, I understand that this was based on the consent conditions filed with the Application and that the

conditions have since been updated by the Applicant. These matters are addressed in the evidence of Mr Mayhew.

59. I note that paragraph 62 of Wastewater Technical Review has been incorporated into Sch 4.4 of the comments and recommendations on conditions, where it states '*It would be prudent to include a condition that requires contingency planning in the first few years of the consent should remedial works not produce the expected reduction in dry and wet weather overflow events and durations'*. I would support contingency planning being developed based on the annual review of priorities, but would make the observation that there must be sufficient information regarding overflow occurrence to trigger the contingency plan. In theory in a four year period the 50% AEP (2 year ARI) rain event should only have happened twice and therefore the conclusion that the 'flow reduction isn't working', is in my opinion premature until after between 4 and 6 years post implementation of the consent.

60. At paragraph 59 of the Wastewater Technical Review three recommendations are made, which again are incorporated into Schedule 4.7(a)-(c) of the recommendations. In principle I agree with these recommendations but I understand that these matters will be addressed further in the evidence of Mr West.

61. A recommendation made in paragraph 63 of the Wastewater Technical Review has been incorporated in Sch 20.3, which is that the Applicant "*undertakes a periodic update of the wastewater model to account for significant changes in the network, a demonstrated reduction in I&I, changes in population predictions etc*. *This could be incorporated into 5 year review and reporting."* I agree that a model review might be required (for overflow management reasons), but only if the flow reduction was not working. As such I consider committing to an automatic review of the model as part of the Year 5 review could be premature. As such, I consider the appropriate approach would be for Council to first determine whether the approach is working (as outlined above); and if not (and as required) then consider updating the model to assist with review of priorities and any contingency planning (if required).

62. Finally, I note the S42A report states *'term of 10 years is considered appropriate for dry weather overflows with an eradication strategy to be adopted into the consent conditions.'* Requiring eradication of dry weather flows has limited if no precedence that I am aware of in New Zealand; as dry weather overflows are often caused by factors outside the control of the consent holder. These factors include blockage and subsequent overflows caused by residents flushing inappropriate items in to the

wastewater system and by power or mechanical failure, for instance. Whilst the risks associated with these factors can be mitigated in part by education and backup systems and spares, they cannot be completely eliminated. As such, I do not consider there is any justification from a wastewater management perspective for either a shortened consent term just for dry weather overflows, or the adoption of an ‘eradication strategy’ for these types of overflows.

SUMMARY AND CONCLUSIONS

63. I have been involved with wastewater network planning with Gisborne District for over 20 years.

64. I was involved in the production of two wastewater network master plans issued in 2008 and in 2014.

65. I understand GDC’s desire to move (under the DrainWise programme) to a flow reduction strategy for the management of wet weather overflows.

66. Inflow and Infiltration in the Gisborne Network is significant and is dominated by the fast response component.

67. The Gisborne network was designed in accordance with industry standards and conforms with these standards.

68. The modelling work which was carried out in 2017 confirms that an 85% reduction in fast response flows and stormwater ponding will virtually eliminate overflows during a 50% AEP (2 year ARI) rain event.

69. I believe that an 85% reduction in Fast Response component of RDII is an ambitious target, and to achieve it would require the identification and rectification of a very high proportion of the direct inflows and leaks into the wastewater network, a large number of which are likely to be in private property. I believe it to be prudent to have contingency network upgrades available in the event that this reduction is not achieved, and that is provided for in the Application.

70. I support the approach to reduce direct inflow as far as possible, as this directs effort at resolving the problem at its source and makes storage and containment of flows more

feasible and manageable. It is an appropriate 'first step', with the ability to modify the type of intervention if necessary to achieve the desired level of overflow containment.

71. The important aspect from my perspective is that resolving inflow requires a long term approach and it is essential that this approach adapts over time depending on results observed. It is therefore important that the results obtained (in terms of percentage reduction and more particularly overflow occurrence), are appropriately measured, recorded and acted upon. I consider the Application and proposed consent conditions provide for this process to be undertaken.

Ian Graham Garside

25 June 2021