<u>IN THE MATTER</u>	of the Resource Management Act 1991
<u>AND</u>	
<u>IN THE MATTER</u>	Discharge of Wairoa's treated municipal wastewater and untreated sewer pump station overflows to the Lower Wairoa River Estuary by the Wairoa District Council.

STATEMENT OF EVIDENCE OF SHADE SMITH

QUALIFICATIONS AND EXPERIENCE

1. My name is Shade Smith.

2. I hold the degree of MSc in Marine Science from the University of Auckland. I am Kaitātari matua (Senior analyst) in the Taiao me Ōna rawa (Environment and Natural Resources) Unit at Ngāti Kahungunu Iwi Incorporated (NKII). I am also a consultant marine scientist at Triplefin Environmental Consulting (Triplefin), and have been involved in environmental research and assessments since 2003. I am also the sole owner and Director of Triplefin.

3. I am a member of the New Zealand Marine Science Society and Royal Society of New Zealand (Hawke's Bay branch).

4. My expertise includes coastal marine ecology, benthic ecology, shellfish physiology, and statistical design and analysis. I have authored or co-authored more than 50 reports focussing on ecological impacts associated with coastal activities including land reclamation, dredging and primarily discharges from coastal and estuarine outfalls.

5. My speciality is in assessing the state of estuarine and coastal marine environments and monitoring these environments for signs of an effect from a particular activity, e.g. wastewater, effluent or stormwater discharges. I have been involved in the assessment of effects for a number of industrial and wastewater discharge resource consents including:

   (a) Co-ordinating and preparing environmental assessments of sites in the Lower Wairoa River Estuary to monitor the effects of wastewater discharge on the benthic communities around the Wairoa District Council (WDC) wastewater outfall.

   (b) Co-ordinating and preparing the 2011 environmental assessment of sites offshore Whirinaki Beach to monitor the effects of the Pan Pacific Forest Products Ltd. (Pan Pac) effluent discharge on the benthic communities around the outfall.

   (c) Co-ordinating and preparing the environmental assessment of sites offshore Awatoto to monitor the effects of wastewater discharge on the benthic communities around the Napier City Council (NCC) municipal wastewater outfall.

6. I have also been involved in a number of monitoring studies, including monitoring of discharges to determine compliance with consent conditions, and investigations of effects of activities in coastal environments in addition to the specific wastewater studies outlined above, including:

(a) Co-ordinating and preparing the environmental assessment of the blind arm of the Waitangi Estuary to monitor the effects of stormwater/process water discharge on the benthic communities downstream of the Ravensdown Fertiliser Co-op discharge.

(b) Reef, soft-sediment and estuarine environmental assessments of selected Hawke's Bay reefs, beaches and estuaries for the Hawke's Bay Regional Council (HBRC) as part of their coastal ecology programme.

(c) Assessment of effects on benthic communities from the dredging and disposal of dredged materials from the Port of Napier to spoil disposal sites off Westshore Beach, Hawke Bay.

(d) Survey of subtidal reef habitats and assessment of environmental effects for a proposal by the NCC to construct an attached breakwater and created beach at South Westshore, Hawke Bay.

(e) Assessment of potential effects on the environment from stormwater discharge into the Iron Pot by the NCC.

(f) Consent compliance monitoring of benthic effects in the Ahuriri Estuary from discharge of stormwater via the Purimu Stream, and combined Georges Drive/Plantation and County Drains on behalf of the NCC and HBRC.

7. I am familiar with the WDC outfall and discharge having co-ordinated and conducted the 2007, 2011 benthic surveys of sites surrounding the WDC outfall and prepared the 2018 report titled "Benthic effects monitoring of the Wairoa District Council municipal wastewater outfall at sites in the Lower Wairoa Estuary: 2017 survey".

8. This evidence is presented on behalf of NKII, a body who represent tangata whenua of the Ngati Kahungunu tribal area which includes the Wairoa catchment, and is a joint submitter on this application with Wairoa Taiwhenua.

9. My evidence on behalf of NKII applies in particular to the effects that may arise from changes in the discharge regime into the Lower Wairoa River Estuary, and construction and operation of a replacement outfall and diffuser as a consequence of the proposed consent application.

10. In preparing this statement of evidence I have read the following application documents that are relevant to the areas of my expertise including:

(a) Wairoa Wastewater Treatment Plant Discharge Resource Consent Application and AEE. WDC. November 2018

(b) Peer review of Estuary/Ocean Receiving Environment Report A3I1b. eCoast April 2018

(c) Assessment of effects of Wairoa District Council's existing intertidal sewage discharge on benthic sediment characteristics and ecology – Wairoa Estuary. eCoast, November 2018.

(d) Additional Ecological Investigations (pipi assessment). eCoast, September 2020.

(e) Wairoa WWTP Outfall: 3D Hydrodynamic Numerical Modelling. eCoast, November 2018

(f) Preliminary Feasibility Assessments of Land Passage Options. Report prepared for Wairoa District Council. LEI, October 2017.

(g) Conceptual Design for Wairoa Wastewater. Report Prepared for Wairoa District Council. LEI, November 2018.

11. I have reviewed the following statements of evidence for the applicant:

Dr Shaw Mead

Mr Stephen Heath

Mr Cameron Drury

Mr Hamish Lowe

Mr Phil Lake

Mr Gary Teear

Mr Andrew Heron

12. Other literature or material which I have used or relied upon in support of my opinions is referenced in footnotes.

EXPERT CODE OF CONDUCT

13. I confirm that I have read the 'Code of Conduct for Expert Witnesses'. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

SCOPE OF WORK UNDERTAKEN

14. In my evidence I will describe and address the effects of the outfall discharge on the receiving environment, in terms of sediments, and macrobenthic ecology.

15. In my evidence I will also describe and address the potential benthic effects on the receiving environment from the proposed new outfall extension and discharge, as applied for in the consent under consideration.

BACKGROUND

16. WDC has discharged treated wastewater from the current outfall since at least 1980 via a 150m long pipe with the discharge port simply the terminus of the outfall pipe. Although the previous consent did not specifically require monitoring of the receiving environment three benthic surveys were carried out at approximately 4 yearly intervals from 2007 to assess the effect of treated wastewater discharge on macrobenthos and sediments around the outfall. Two dye dilution studies have also been conducted, in 2007, that estimated dilution of the discharge under worst case scenario conditions, i.e. closed/restricted river mouth, and during normal, i.e. unrestricted mouth conditions.

17. The findings of these studies, in addition to ecological assessments and dilution modelling by eCoast form the basis for the WDC assessment of effects that accompanies the application.

18. Additionally, eCoast peer reviewed all benthic survey reports (eCoast April 2018) who largely maintained the view that approaches used were valid, though stated that there were deficiencies in the sampling design with previous studies focussed on the mixing zone next to the outfall, and that temporal replication was insufficient and that there was no scaling of infauna when comparing results from 2007 onwards to 1996 data.

19. In response to the peer review I say that the comments regarding spatial replication are valid, though the downstream impact site A represents a worst case scenario for effects assessment. So although the area potentially affected may not have been clearly delineated the effects assessments of previous surveys remain valid. In terms of temporal replication, I disagree with the peer review and submit that 4 yearly in depth benthic surveys in this type of environment are quite normal and of course increased temporal replication would be better. In terms of comparison without scaling I reassert original statement that taxa richness varies more with respect to replication rather than the size of infaunal sample.

EFFECTS ON THE BENTHIC ENVIRONMENT – EXISTING OUTFALL

SEDIMENTS

20. Outfalls and the discharge of treated effluent can directly influence the quality, composition and distribution of bed sediments. The grain size distribution or sediment texture is an important factor determining the types of species that inhabit the sediment. In areas around wastewater discharges there is some potential for the accumulation of organic matter, and as a result, a change in the grain size characteristics of the bed sediments.

21. During the 2017 benthic survey around the existing outfall sediments were sampled at 4 sites deemed representative of the benthic environment surrounding the outfall (Figure 1). At each site, a sediment core was retrieved by and the profile visually examined while surficial sediment samples were collected and sent for laboratory analysis of sediment texture (composition/grain size), trace metals, nutrients and volatile solids (organic matter).

SEDIMENT RESULTS

2017SURVEY

22. Sediment oxygenation, indicated by depth of the aRDP layer, at the upstream reference site C was moderate, at the site immediately upstream and inshore of the outfall, sites B and D respectively, oxygenation was moderate – good, whereas at the site located immediately downstream of the outfall, site A, sediments were hypoxic at a shallow depth and, in places, anoxia was developing and therefore oxygenation was poor.

23. Sediment texture among sites A and C was similar and characterised primarily by mud, or ‘fines’(<63µm) with a sand subsidiary while sites B and D were predominantly very fine/fine sand with site B more sandy and site D more muddy.

24. Trace element levels at all sites were low with all results below ANZECC ISQG – Low sediment quality guidelines, and were in general within the range of average background concentrations of Hawke’s Bay estuarine and lagoonal systems. Evidence of a significant outfall effect in terms of sediment trace elements was absent with normalised levels not significantly different between site C and site A.

25. Concentrations of sediment nutrients, N and P, at all sites were within the moderate range among Hawke’s Bay estuaries suggesting low-moderate enrichment of sediments. Normalised levels of N and P, at site A where not significantly different to the comparable reference site

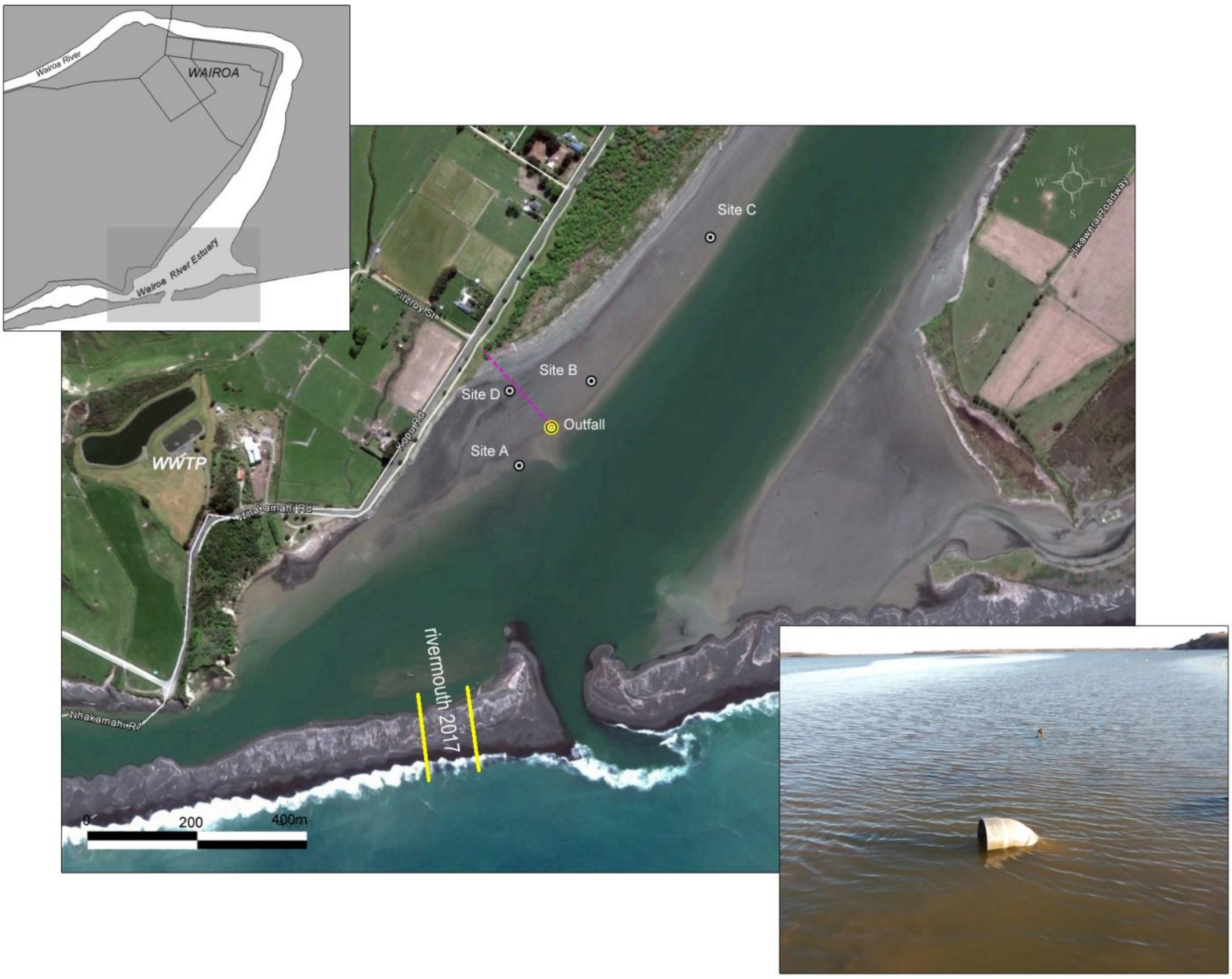

Figure 1: Overview map of the WDC outfall benthic monitoring sites surrounding the outfall.

C, indicating the absence of a significant outfall effect on sediment nutrient levels.

26. Total volatile solids, or organic content, of sediments differed significantly among all sites, with the most polluted site being site A where levels are likely to induce persistent and significant stress on resident infauna and loss of ecological integrity. Levels at the inshore site D were rated as likely to induce moderate stress on infauna. The least polluted sites in terms of TVS were sites B and reference site C which were rated as likely to induce only minor stress on infauna with ecological integrity unlikely to impact ecological integrity.

INTER-SURVEY COMPARISON

27. Sediment texture at site A and C were relatively more consistent over time, compared to site B, which returned to a predominantly sandy composition in the present survey compared to being predominantly mud in the previous 2011 survey. Trend testing did not provide any evidence of significant trends among any sites for any of the sediment fractions.

28. Temporal trend testing of trace elements normalised to the fines fraction revealed 6 statistically significant positive trends, i.e. increasing levels, in Cd, Cr, Cu, Ni, Pb and Zn at site A, and 3 significant negative trends in As, Cd and Zn at reference site C. These results suggest a slight deterioration in sediment quality over time at site A in terms of these elements and a slight improvement at site C.

29. Trend testing of sediment nitrogen levels estimated increasing trends at site A and B, though the result for site B is considered tenuous, and no trends at site C. In terms of phosphorus, levels among all sites were fairly stable, with the only significant trend among sites, a negative trend at site C.

30. TVS at site A was estimated to be increasing over time, while at site C levels were stable with no trends detected. A positive trend was also estimated at site B, though this result is viewed with some scepticism. It was also noted that the levels of TVS were likely to be driving the sediment N levels given the similarity in variability over time of N and TVS.

SUMMARY

31. The results of previous dye dilution studies have shown that when the river mouth is unrestricted and discharge occurs on an ebb tide, wastewater exits the estuary in a relatively short timeframe (30 – 40 mins) (Barter 2007). In this situation discharge related effects may be expected at the monitoring site immediately downstream of the outfall

only, i.e. site A. During periods of restriction at the mouth potentially all three monitoring sites around the outfall, i.e. sites A, B and D, could be exposed to the plume and be affected by the discharge. During the present survey, at two of the three sites surrounding the outfall (sites A and D), there was some evidence of the discharge affecting sediment characteristics, with the most pronounced effects evident at site A.

32. Potential negative effects on sediment characteristics from wastewater discharge include the accumulation of contaminants such as fine sediments, organic matter, trace elements and nutrients. In the present survey negative effects related to wastewater discharge were principally concerned with the deposition of organic matter, with current and past organic matter accumulation evident at site A and site D respectively. This resulted in reduced levels of sediment oxygenation at site A compared to the similarly comprised upstream reference site C. Moreover normalised levels of TVS at site A were 3.8x higher than the normalised levels at reference site C. At the levels of TVS, or organic matter, found at site A induction of persistent and significant stress on resident infauna and loss of ecological integrity is likely. While at site D it is suggested that the levels of TVS would likely induce moderate stress on infauna. These effects also appear to be compounding over time with a statistically significant and ecologically meaningful increasing trend in organic matter detected at site A.

33. Aside from the accumulation of organic matter at site A there was no evidence to suggest contamination by trace elements of sediments with no difference in normalised levels among site A and C and all sites well within ANZECC guidelines and comparable to Hawke's Bay estuarine and lagoonal background concentrations. Although adverse effects from these contaminants are unlikely at present there appears to have been a slight deterioration of sediment quality over time at site A, with Cd, Cr, Cu, Ni and Pb increasing over time.

34. In terms of nutrients, levels at all sites were within the moderately enriched range, but well within results observed for other Hawke's Bay estuaries (Madarasz-Smith 2016).

35. Based on these results, it is suggested that the discharge is likely to be having a persistent adverse effect on sediment quality from organic loading at site A immediately downstream from the discharge.

36. Effects from the discharge of treated effluent on sediment composition are absent, and effects on the oxic status of sediments beyond 50m of the outfall are considered no more than minor.

MACROBENTHIC ECOLOGY

37. Human activities such as effluent discharge can impact the benthos in a number of ways; including smothering, oxygen depletion, toxic contamination, and organic enrichment. Some macrofaunal species are highly sensitive to such effects and rarely occur in impacted areas, while other, more opportunistic species can thrive under altered conditions. Different species respond differently to environmental stress, so monitoring macrobenthic assemblages can help to identify anthropogenic impact.

38. During the 2017 benthic survey macrobenthic infaunal communities were sampled at the same 4 sites as surficial sediments were sampled (Figure 1). At each site 3 benthic infaunal cores were collected within a 5m radius of each other. Samples were sieved at the site, biology retained in jars and transported to the laboratory where stain was added and samples poured into shallow trays and all biological material carefully picked out and identified to the lowest taxonomic grouping.\

MACROBENTHIC INFAUNAL RESULTS

2017 SURVEY

39. Typically the analysis of macrobenthic infaunal community structure involves assessment of biological metrics including diversity, abundance, taxa richness and evenness and multivariate permutational analysis of variance of abundance data. These analyses provide a quantitative basis to assess change in community structure from the discharge of effluent from an outfall.

40. Average infaunal abundance and diversity indices (collectively called biological summary indices consisting of number of individuals (N), number of taxa (S), Shannon-Weiner diversity index (H'), Pielou's evenness (J') and Margalef's richness (d)) for each of the 4 sites were calculated.

41. Dominant taxa encountered during the present survey included: the spionid polychaete worm, *Boccardia* sp., the nereid worm *Nicon aestuariensis*, the estuarine snail *Potamopyrgus estuarinus*, the amphipod *Paracorophium excavatum*, and pipi, *Paphies australis*.

42. In general polychaete species dominated the abundance among all sites except for site D where molluscs were numerically dominant.

43. Taxa richness (S) was low at all sites, with no significant differences estimated between sites. Similarly there were no differences among sites in Margalef's richness (d) or the Shannon-Weiner diversity index (H'). Abundance (N) was low-moderate among all sites, with site B

estimated to have significantly more individuals than any other site. However the distribution of individuals or evenness (J') at sites A, C and D was significantly higher than site B.

44. Given the few statistically significant differences among sites for the various summary indices, the magnitude of any outfall related effect on infaunal community characteristics at sites immediately around the outfall compared to the reference site is therefore slight.

45. Infaunal community structure analyses however indicated a high level of spatial variability, with each sites assemblage significantly different to every other site.

46. Given the similarity in the % fines between site A and reference site C and shared key species, i.e. *Nicon aestuariensis*, but significantly higher levels of organic matter content in sediments at site A, it is suggested that the assemblage is not majorly affected by the increased organic content.

INTER-SURVEY COMPARISON

47. The highest degree of inter-survey variability across all indices and among sites was site A, suggesting this site is subject to higher levels of stress than sites B and C.

48. Trend testing of abundance, and diversity indices indicated an ecologically significant decrease in taxa richness and abundance at both site A and reference site C. At site B an ecologically significant decrease in abundance was also detected.

49. In general, these results indicate the community at site A is subjected to increased levels of stress compared to upstream site B and reference site C, and that over time benthic community 'health' at all sites has deteriorated but is particularly pronounced at site A

50. In terms of community structure, communities varied greatly both temporally and spatially though the factor 'year' (i.e. temporal variability) is the primary explanatory variable, followed by 'site' (i.e. spatial variability).

51. Despite the variability, generally over time, the communities at sites A and B have been more similar to one another compared to site C and the magnitude of temporal variation is relatively greater at these sites compared to site C.

52. Therefore, it is suggested that as well as natural variability there are other factors at sites A and B that significantly influence community structure, e.g. wastewater discharge.

53. The differences between years may be attributable to a shift in the key drivers of community composition from polychaetes typically associated with sandier sediments (e.g. *Scolelepis* sp. and *Agalophamous macroura*) to species more tolerant of fines (e.g. *N. aestuariensis* and *Scolecolepides* sp.). There has also been a marked reduction in the abundance of the amphipod *P. excavatum* at all sites over time.

SUMMARY

54. Given evidence of accumulation of organic matter at site A it may be expected that the infaunal community there responds in a manner that is different and perverse compared to other sites. Certainly the infaunal community structure during the 2017 survey was spatially variable and significantly different among sites, with communities tending to reflect differences in sediment texture, and to some extent, level of organic matter. However, the temporal component of variability, or natural variability, was also significant and indeed had a stronger influence on community structure than that explained by site, or spatial, differences.

55. Notwithstanding this finding the highest degree of inter-survey variability across all summary indices and among sites was site A, while the magnitude of variation in community structure, both within and between years, was relatively greater at sites immediately surrounding the outfall (particularly site A) compared to the reference site C. This suggests that despite significant year to year variation there is a discernible site effect with those sites immediately surrounding the outfall not as resilient to perturbations in the environment as reference site C.

56. In terms of infaunal summary indices, apart from significantly higher abundance at site B compared to all other sites, few other differences were detected among sites for any of the other indices. This suggests that the despite the differences in community structure and increased levels of stress at sites around the outfall, the magnitude of effects from organic matter accumulation on infaunal community characteristics is slight-minor. Moreover the dominance of polychaete species among all sites and the generally low numbers of filter feeding bivalve species suggests the infaunal assemblages among all sites is subjected to one or more stressors that have a greater influencing effect on community characteristics than the outfall discharge.

57. A comparison of biological summary indices from the 2017 survey against other Hawke's Bay estuary sites (Table 1) does tend to support this view with scores for taxa richness and abundance in particular from the present survey in the lower half of the range, suggesting that the overall health of the Wairoa River estuary may be compromised. Further evidence of broader scale deterioration in the

estuary infaunal health was provided by the detection of significant negative trends in taxa richness and abundance at site C and site A and abundance at site B.

Table 1: Summary of average abundance, taxa richness, Pielou's evenness, Margalef's richness and Shannon-Weiner diversity index scores at estuarine monitoring sites in the Hawke's Bay region from recent benthic surveys, including the present survey.

Estuary (site)	Abundance (N) ±1SE	Taxa richness (S) ±1SE	Margalef's richness (d) ±1SE	Pielou's evenness (J') ±1SE	S-W diversity index (H'loge) ±1SE
Wairoa (site A)[1]	4.3 ± 1.2	3 ± 0.6	1.45 ± 0.12	0.92 ± 0.04	0.96 ± 0.16
Wairoa (site B)[1]	40.0 ± 3.5	5.2 ± 0.7	1.14 ± 0.18	0.55 ± 0.04	0.91 ± 0.13
Wairoa (site C)[1]	16.6 ± 2.1	3.2 ± 0.5	0.78 ± 0.14	0.69 ± 0.07	0.74 ± 0.07
Wairoa (site D)[1]	10.0 ± 2.8	3.2 ± 0.4	1.12 ± 0.24	0.81 ± 0.09	0.93 ± 0.17
Ahuriri (site A)[2]	44.4 ± 7.9	9.4 ± 0.8	2.30 ± 0.16	0.84 ± 0.02	1.85 ± 0.08
Porangahau (site A)[2]	6.6 ± 2.1	3.1 ± 0.3	1.31 ± 0.14	0.88 ± 0.04	0.94 ± 0.08
Waitangi (site A)[2]	89 ± 12.7	4.8 ± 0.5	0.83 ± 0.09	0.43 ± 0.04	0.68 ± 0.09
Tukituki (site A)[2]	72.8 ± 13.4	6.2 ± 0.6	1.25 ± 0.18	0.76 ± 0.06	1.36 ± 0.12

[1]Present survey (2017), [2]Hawke's Bay Regional Council Estuarine Monitoring Programme - 2016 results.

58. There are several factors influencing the biological characteristics of sites including both the discharge and other up catchment sources of contaminants, e.g. organic matter and fine sediments.

59. In summary, ecological condition among all sites is poor-moderate, though evidence indicates infaunal communities around the outfall are responding negatively to wastewater discharge. The magnitude of this effect on infauna however is slight-minor, though there is also some evidence of a deterioration of infaunal characteristics of the Wairoa River estuary as a whole.

60. In situations where the wastewater is able to exit the estuary in a timely manner the contribution of this effect to the suggested overall estuary deterioration is likely to be less than minor.

61. At times of rivermouth restriction, and wastewater lingers in the primary basin, it is suggested that the discharge constitutes a significant adverse effect.

POTENTIAL EFFECTS ON THE BENTHIC ENVIRONMENT – PROPOSED OUTFALL

62. Sediment characteristics at sites in close proximity of the proposed outfall site are likely to change as a result of the discharge. The extent

and shape of the affected zone and the magnitude of effects will depend on:

(a) Quantity and quality of the waste solids discharged

(b) Hydrodynamic characteristics in the area around the outfall that control deposition, re-suspension and transport

(c) Physical and biological characteristics of the benthic environment.

63. However, given that the effects of the discharge are no more than minor during times when the rivermouth is unrestricted around the existing outfall and that the composition of the treated effluent will remain the same, potential benthic effects around the proposed site will depend on the sites hydrodynamic, physical and biological characteristics only.

BASELINE SURVEY RESULTS

64. eCoast undertook some sampling in the vicinity of the proposed new outfall in September 2020. Visual assessment of sediment cores revealed extremely fine grained sediments and areas of darkened sediment (anoxia) within the length of cores at all sites.

65. In terms of infauna, of significance was the finding of adult pipi (*P. australis)* and cockles (*Austrovenus stutchburyii*). Several other species including polychaete worms were also found though these were the same species as those found at sites during the benthic survey.

66. At the numbers and size found, it is suggested that these pipi and cockle comprise an unknown portion of the reproductive population of these species.

67. In the past these species were a significant kaimoana resource for mana whenua, though presently are not harvested to any significant degree as their whereabouts became unknown, and concerns about poor water quality in the estuary and effects of consumption of filter feeding organisms on human health.

68. The unknown extent of the shellfish bed provides significant uncertainty as to the health of the bed and ability to recolonise following disturbance. Moreover, the current degraded state of the estuary could potentially preclude recolonization over a time period acceptable to the community.

69. Turning to the hydrodynamic characteristics of the proposed outfall area, it is likely that winnowing of fine sediments will occur in the near

vicinity of the outfall potentially altering the community composition of the resident fauna, including pipi and cockles.

70. On the contrary the increased shear forces at the benthic boundary layer will likely preclude the build-up of organic matter and associated negative effects, and increased mixing and dilution will minimise the discernible zone of influence.

OTHER MATTERS

71. It is suggested however that the dilution modelling associated with the application is overly optimistic, given the comparison with the estimated results from the 2007 dye dilution study (Barter 2007) (*see* Figure 2).

72. In response to Dr Mead's (EIC paragraph 67) statement that there are no records of the dates and durations of historical closures in regard to rivermouth closure and restriction, I submit that there are records held by the HBRC and that on average the Wairoa rivermouth closes on average twice a year for anywhere up to 7 days.

73. This suggests that treated wastewater could potentially circulate for up to 5 days in the estuary if additional storage of 10,000m3 were constructed.

SUMMARY

74. The proposed discharge regime takes into account flow in the river but not river discharge to Hawke Bay.

75. In general, effects of the current discharge on the ecology and sediments around the outfall are no more than minor when the rivermouth is open and unrestricted, however, when the mouth is closed or restricted significant adverse effects on ecology and human health are more than minor.

Signature

Shade Smith
23 November 2020

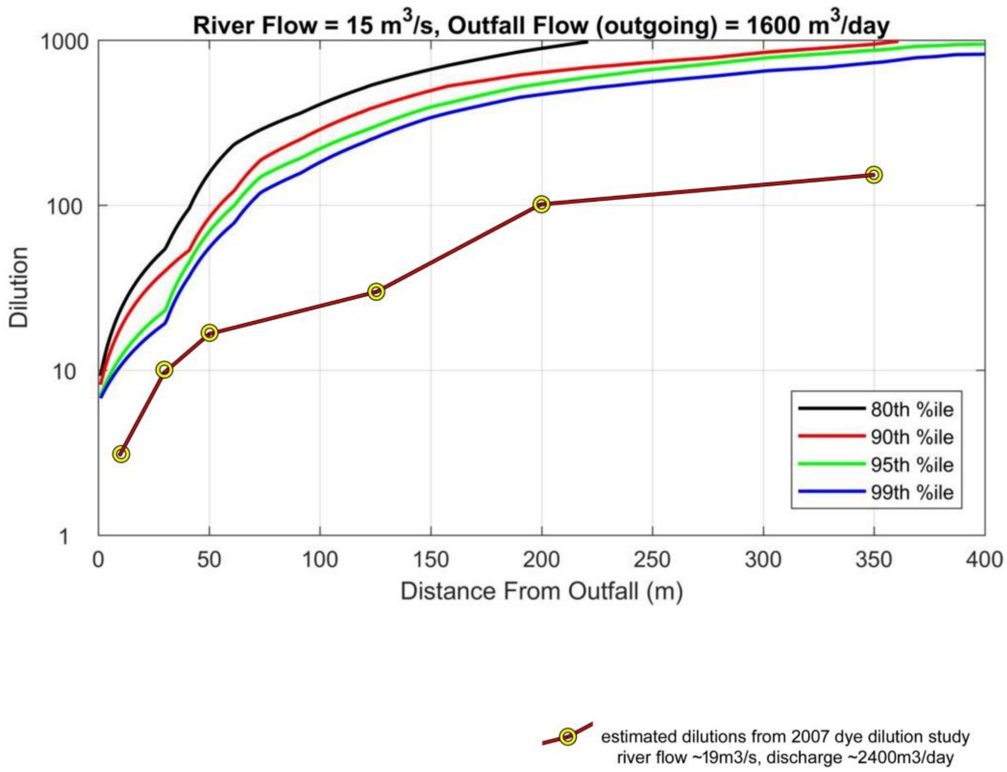

Figure 2: Comparison of modelled results and estimated dilutions from 2007 dye tracer study.